KATSINOV: A MEASURING TOOL FOR THE LEVEL OF INNOVATION READINESS

ISBN 978-606-95069-1-2

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Technium Press
2024

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ISBN 978-606-95069-1-2

TECHNIUM
BOOKS

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EDITORIAL OFFICE
TECHNIUM PRESS
E.U.

For citation purposes, cite as indicated below:

Susalit Setya Wibowo, et al, KATSINOV: A MEASURING TOOL FOR THE LEVEL OF INNOVATION READINESS; 978-606-95069-1-2, TECHNIUM PRESS, 2024..

FIRST EDITION 2024

ISBN 978-606-95069-1-2 (PDF)

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KATSINOV

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Susalit Setya Wibowo, *et.al.*

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Preface

Praise be to God Almighty for the completion of this work titled "**KATSINOV: A Measuring Tool for the Level of Innovation Readiness**". This book has been developed with the aim of providing a comprehensive understanding of the importance of innovation in this era of disruption and introducing KATSINOV as a framework to assess an organization's innovation readiness. KATSINOV emerges as a response to the challenges of an age that increasingly demands adaptability, creativity, and innovation to survive in a global competitive landscape. The book is divided into four main parts, systematically exploring the philosophy, framework, and practical application of KATSINOV.

In the first part, readers are invited to understand the challenges of the era of innovation and disruption, along with foundational explanations of innovation and the reasons why innovative products often fail in the market. This section sets the groundwork for seeing innovation as an opportunity, echoing the insightful words of Steve Jobs. The second part delves into the basic philosophy behind KATSINOV, focusing on innovation management, the innovation lifecycle, and methodologies such as design thinking and the business model canvas. This philosophy aims to help organizations establish an effective innovation framework. The third part introduces the KATSINOV framework in detail, covering its urgency, phases, aspects, levels, and indicators, which serve as the foundation for its measurements. This section demonstrates how KATSINOV is designed to be a flexible and relevant tool for a variety of organizations. The fourth and final part, as the core of this book, elaborates on the KATSINOV measurement model, reporting methods, and case studies that illustrate its application across diverse contexts. Through this part, readers are encouraged to implement KATSINOV effectively within their own organizations. We extend our gratitude to all parties who have contributed to the creation of this book. It is our hope that this book will serve not only as a theoretical guide but also as an inspiration to take concrete steps toward creating sustainable innovation. Happy reading, and may this book provide you with new insights and a foundation for your innovation journey.

The Authors

Editors

Innovation has become a central theme in today's rapidly evolving world, influencing every aspect of life, from business and technology to education and public services. The pressing need for adaptability and creative solutions in the face of global challenges underscores the importance of innovation readiness for individuals, organizations, and societies. In light of this, I am honored to present this book, "**KATSINOV: A Measuring Tool for the Level of Innovation Readiness**", which aims to serve as a comprehensive guide for assessing and enhancing innovation capacity.

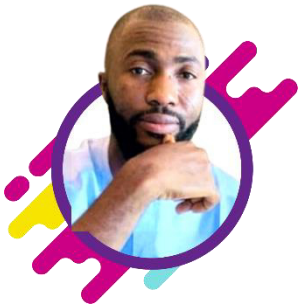
The journey of compiling this book has been both enlightening and fulfilling. The KATSINOV framework, as detailed in these pages, is not merely a theoretical construct; it is a practical tool designed to address the dynamic needs of organizations in navigating the complexities of innovation. By offering a structured methodology, KATSINOV empowers organizations to identify their strengths, address weaknesses, and develop actionable strategies to improve their innovation readiness. This book is divided into four main parts, each thoughtfully crafted to provide a seamless flow of ideas. The first part introduces the broader challenges and opportunities of the era of innovation disruption. It lays the groundwork by exploring why innovation is critical in the modern world and why some innovative products fail despite their potential. These discussions are essential for understanding the context in which KATSINOV operates. The second part delves into the philosophy that underpins KATSINOV. It emphasizes the importance of innovation management, the life cycle of innovation, and methodologies such as design thinking and business model canvassing. This section provides valuable insights into the mindset and processes necessary for fostering innovation. The third part focuses on the core framework of KATSINOV, providing a detailed explanation of its phases, aspects, levels, and indicators. This section showcases how the framework is tailored to help organizations assess and enhance their readiness for innovation. By breaking down the framework into manageable components, it ensures clarity and usability for a diverse range of users. Finally, the fourth part explores the practical application of KATSINOV. Through discussions on the measurement model, reporting techniques, and case studies, this section demonstrates how the framework can be implemented effectively in real-world scenarios. It bridges the gap between theory and practice, offering readers actionable insights and examples.

As the editor, I am deeply committed to ensuring that this book not only provides theoretical knowledge but also serves as a practical tool for innovation. The inclusion of case studies and real-world applications reflects this commitment, aiming to make KATSINOV accessible and relevant to practitioners across various fields. I believe that the combination of rigorous research, clear explanations, and practical examples makes this book a valuable resource for anyone seeking to enhance their innovation readiness. I would like to extend my gratitude to the authors/contributors

who have dedicated their time and expertise to this project. Their collaborative efforts have enriched the quality and depth of the content, ensuring that it meets the highest standards of accuracy and relevance. I am also grateful to the organizations and individuals who provided data, insights, and feedback, which have been instrumental in shaping the framework and its applications. To the readers of this book, I hope you find the KATSINOV framework as inspiring and useful as we intended it to be. Whether you are a business leader, educator, policymaker, or researcher, I trust that the concepts and tools presented here will empower you to drive innovation in your respective domains. Innovation is not just a goal; it is a continuous journey of learning, adaptation, and improvement. With this book, we aspire to be your companion on this journey. In closing, I invite you to explore the pages ahead with an open mind and a willingness to embrace change. The future belongs to those who innovate, and readiness is the first step towards achieving meaningful and sustainable innovation.

Editors

Prof. Dr. Bohari Mohd Yamin is a distinguished chemist born on 1950, in Port Dickson, Negeri Sembilan, Malaysia. With over four decades of experience, he has made significant contributions to the fields of inorganic chemistry, organometallic chemistry, and crystallography. He is currently an Emeritus Professor at the Faculty of Science and Technology, Universiti Sains Islam Malaysia (USIM). He earned his Ph.D. in Chemistry from King's College London, United Kingdom (1977), following a bachelor's degree from Universiti Malaya (1973). Prof. Bohari began his academic career as a tutor in 1974 at Universiti Kebangsaan Malaysia (UKM) and was promoted to full Professor in 1994. Throughout his career, he served as Head of the Department of Chemistry, Deputy Dean of the Faculty of Science, and Head of the School of Chemical Sciences and Food Technology at UKM. As a researcher, Prof. Bohari specializes in the synthesis of organometallic compounds, chemical kinetics studies, and applications of X-ray crystallography. He has published over 336 scientific papers in prestigious international journals, with an H-index of 18 and more than 1,900 citations. Additionally, he has served on the editorial boards of several notable journals, such as Acta Crystallographica Section E and the Oriental Journal of Chemistry. He was also appointed by the Royal Swedish Academy of Sciences to propose candidates for the Nobel Prize in Chemistry. Prof. Bohari has received numerous accolades, including the P.J.K., K.M.N., and D.N.S. honors, recognizing his contributions to science. As a keynote speaker and guest lecturer, he has shared his insights at international conferences across Asia, Europe, and the Pacific. His academic networks, such as the SAFEnetwork, foster cross-national collaborations involving Malaysia, Indonesia, the Philippines, and Thailand. Since retiring in 2017, Prof. Bohari has actively supported the development of young academics through charitable initiatives and professional training. He continues to contribute to building research and publication capacities at various regional and international universities. With his exceptional dedication and achievements, Prof. Dr. Bohari Mohd Yamin stands as a role model in academia, advancing chemical sciences and inspiring the next generation of scientists.



Amodu, Salisu Ameh PhD is a dedicated academic and researcher born on August 30, 1990, in Anyigba, Dekina Local Government Area of Kogi State, Nigeria. With a robust foundation in African philosophy and general African studies, he serves as a Lecturer in the Department of Philosophy and a teacher at the Centre for Diploma and Pre-degree Studies, Prince Abubakar Audu University (PAAU), Kogi State, Nigeria. Amodu earned his Ph.D. in African Philosophy from the University of Nigeria, Nsukka (2024), a Master's degree in African Philosophy from Prince Abubakar Audu University (2021), and a Bachelor's degree in Philosophy from Kogi State University (2016). His academic journey also includes professional development through courses from international institutions such as the Millar Open University, India, and the International Community for Education Technology, Amsterdam. His teaching career spans several institutions, including the Shehu Shagari College of Education, Sokoto, and various secondary schools, where he imparted knowledge in philosophy, social studies, and other humanities disciplines. He joined PAAU in 2021, where he actively contributes to both undergraduate and diploma programs. Amodu specializes in African metaphysics, epistemology, ethics, and gender studies. His research highlights include: Exploring themes such as African humanism and conflict resolution. Publishing works like Rational Proof of the Existence of God in Igala Ontology and co-editing volumes on African philosophy and traditional metaphysics. Authoring journal articles on communalism, spiritualism in African traditions, and the ontological structures of African religion. His contributions also extend to collaborative efforts on projects like Land in African Ontology and Democracy Experience in Africa. Amodu is the founder of initiatives such as "Educate 500 Students on Quality Research," which aims to empower students in collaboration with the NACA Center. He has also established platforms like the Igala World Magazine and Teens Education and Public Affairs, focusing on youth engagement and cultural awareness. His academic excellence has been recognized through awards, including the African Credibility Gold Award for contributions to education and human development and honors from organizations like the Igala Students Association and the Association for the Promotion of African Studies (APAS). Amodu remains committed to innovation in philosophy and African studies, fostering the development of new perspectives and methodologies. His passion for education and mentorship continues to inspire students and colleagues alike. With a deep commitment to the advancement of African studies and education, Dr. Amodu Salisu Ameh embodies the spirit of academic excellence and societal impact, making significant strides in his field and beyond.

Contributors

Susalit Setya Wibowo holds a bachelor's degree in chemistry from Gadjah Mada University (UGM) obtained in 1995 and a master's degree in chemical engineering from the University of Indonesia (UI) completed in 2011. He began his career at the Directorate of Industrial Process Technology, BPPT in 1997, progressing through various significant roles in technology research and development. His professional trajectory includes key positions such as Staff at the Polymer Technology Center, BPPT (1999-2003), Head of the Technology Audit Division (2012-2015), and Mid-Level Engineer at the Center for Technology Strategy and Technology Audit (2015-2018). From 2018 to 2022, he served as the Deputy Director for Telecommunication Empowerment at the Ministry of Communication and Information Technology and later as a mid-level engineer in the Center for the Study of Manufacturing, Telematics, and Electronics (PPIMTE) at BPPT. Since 2022, he has been serving as a Mid-Level Engineer at the Center for Research on Process and Manufacturing Technology within the National Research and Innovation Agency (BRIN), where he is also the Chair of the Technology Evaluation, Value Engineering & Value Analysis Research Group. In this role, he focuses on technology evaluation, value engineering, and value analysis, leading projects aimed at improving technology readiness and market competitiveness. In addition to his professional roles, Susalit Setya Wibowo has a rich background in training and education. He has conducted advanced training programs on Technology Readiness Levels (TRL), TRL & KATSINOV, Design Thinking, and IPTEK Utilization Organization. Notable training includes serving as an instructor at Science & Technology Park, UI in 2023, and various other institutions. His expertise extends to technology audits, having trained as an instructor at the Indonesian Technology Auditor Association (IATI) in 2021. Susalit Setya Wibowo 's work has included comprehensive evaluations and improvements in research readiness levels for major companies and organizations, such as PT Pupuk Indonesia (Persero), and involvement in strategic projects related to supply chain and industrial processes. His roles as a reviewer for national and international innovation competitions further underscore his commitment to advancing technology and innovation.

Dr. Ir. Jumain Appe, MSi, currently serving as a Senior Engineer at the National Research and Innovation Agency (BRIN), began their academic journey with a bachelor's degree in electrical engineering from Hasanuddin University in 1984. This was followed by a master's degree in data communication from Monash University, Australia, completed in 1992. Further education includes a master's degree in economics from Darul Ulum University in 2002 and a PhD in Business Management from Padjadjaran University in 2010. The professional career commenced as a Junior Researcher in Energy at BPPT from 1986 to 1989. After studying abroad, [Your Name] returned to BPPT, assuming the role of Head of Data Processing and Information Division in 1997. Subsequent roles included Structural Echelon II at the Ministry of Research and Technology, leading the Planning, Finance, and Supervision Bureau from 2003 to 2005. The position of Secretary General of BPPT was held from 2005 to 2014, coordinating numerous high-impact programs. From 2015 to 2019, served as Director General of Innovation Strengthening at the Ministry of Research, Technology, and Higher Education, and later as Acting Deputy for Innovation Strengthening at BRIN from 2019 to March 2021. Additional roles included Commissioner at PT. Boma Bisma Indara from 2018 to 2021 and Expert Staff to the Minister of Research and Technology from February to June 2021. Contributions to international activities include coordination of significant programs and involvement in international training and R&D system development in the United States and South Korea. Played a key role in planning and developing the BPPT laboratory in Puspiptek Serpong and leading national innovation projects. Training and development experience includes Leadership Training Level 3 in 1997, Leadership Level 2 in 2002, and Senior Expert Functional Training in 2020. International training includes extensive courses in Germany, the USA, Japan, South Korea, and Australia, focusing on energy strategy, nuclear safety, and R&D management. Key involvement in international meetings includes leading Indonesia's delegation at significant events in France, Beijing, and Nanning, and serving as the chairman for Hakteknas and other notable international forums. Additional contributions include participation in seminars and conferences such as the UMKM BRIlian-BRIncubator Go Global webinar in January 2021 and the national seminar at the University of Eastern Indonesia in December 2020, among others related to policy and innovation.

Ophirtus Sumule, built his career as an Aquaculture researcher then became a Bureaucrat with the main task oriented to policy formulation and innovation ecosystem development and implementation both at the national and local levels and finally as a permanent lecturer at the Fisheries Product Technology Study Program at Hasanuddin University of Makassar. Born on October 25, 1959 in Tana Toraja, Ophirtus Sumule continued his education in Bogor and earned a S1 degree in 1985 in Aquaculture, Faculty of Fisheries IPB, in 1988 he earned a DEA (S2) degree in Coastal Management at the Universite de Bretagne Occidentale Brest France and in 1998 he earned a PhD (S3) in Fish Physiology from Kagoshima University in Japan. Ophirtus Sumule as a Researcher at the Agency for the Assessment and Application of Technology (BPPT) then became a bureaucrat with the following positions: Head of Production Network System Development, Head of Central and Regional Science and Technology Network Development, and Assistant Deputy of Provider Network with Regulatory Institutions at the Ministry of Research and Technology. In 2016 he served as Director of Innovation Systems at the Ministry of Research, Technology and Higher Education and in 2019 became a permanent lecturer at the Faculty of Marine Sciences and Fisheries Unhas.

During his career, Ophirtus Sumule has handled research and assessment of crab cultivation, hatchery and rearing of lobsters, hatchery and rearing of grouper, freshwater lobster cultivation, formulation of cheap and environmentally friendly fish feed and various technical activities related to the Aquaculture sector. In the context of the science and technology policy, Ophirtus Sumule participated in formulating the Regional Innovation System (SIDa), the implementation of the Agrotechnopark program, the regional innovation cluster program - the concept of agricultural development based on regional leading commodities such as: coffee, honey bees, patchouli, coconut, pepper, chocolate with an integrated upstream-to-downstream approach. Ophirtus Sumule in addition to guiding students' final projects, especially S1 and S2, has also been a guest examiner for doctoral promotions such as at IPB and Unhas, delivering scientific orations at various universities. During his tenure as a lecturer, Ophirtus Sumule taught courses: Science and Technology Insights and Maritime Continents, Agrotechnology Innovation, Basic Basics of Agricultural Extension, Sustainable Agriculture, Integrated Agricultural Systems, Food Chemistry, Biochemistry of Fishery Products, Nutrition of Fishery Products, Management of the Fishery Products Industry, Transportation Technology of Fishery Products, Diversification and Development of Fishery Products. Ophirtus Sumule is also a speaker at various national-level scientific meetings as well as abroad such as in Japan, Tehran, Hong Kong, Taiwan, India and has produced dozens of publications and scientific books.

Yudi Widayanto, currently serving as a Mid-Level Policy Analyst at the Directorate of Research, Technology, and Innovation Measurement and Indicators within the National Research and Innovation Agency (BRIN), the user has an extensive academic and professional background. They obtained a bachelor's degree in Statistics from the Sepuluh Nopember Institute of Technology (ITS) in 1993, followed by a master's degree in public policy from the Faculty of Economics at the University of Indonesia in 2001, and later completed a Doctoral program in Agricultural Industrial Technology at the Bogor Agricultural University (IPB) in 2013. In their role, the user has been instrumental in the development and analysis of key national publications, such as the Indonesian Science, Technology, Research, and Innovation Indicators (IIRI) Book and the Regional Competitiveness Index (IDSD) Book. They specialize in public policy analysis, drafting a range of scholarly documents including Academic Manuscripts, Policy Papers, and Policy Briefs, all focused on advancing research and innovation in Indonesia. Expertise extends to their previous active involvement with the Agency for the Assessment and Application of Technology (BPPT) and the Ministry of Research and Technology, where they played a significant role in strengthening the Regional Innovation System (SIDa). They were also pivotal in developing and implementing measurement tools for the Innovation Readiness Level (Katsinov), contributing to the creation of numerous training modules and guidelines in this field. As an accomplished author, the user has penned several influential books, including Smart Regions, Creative Public Spaces, Technology Database for Smart Regions, and a variety of SIDa Strengthening Guides. Their work reflects a deep commitment to enhancing Indonesia's innovation landscape and fostering regional competitiveness through rigorous analysis and evidence-based policymaking.

Kusumawati Dewi Budiarti is a mid-level engineer at the Center for Research on Process and Manufacturing Technology within the National Research and Innovation Agency (BRIN). With a master's degree in management from STIE-IPWIJA Jakarta, they bring a strong background in budget management and electronic procurement (e-Procurement). Currently, [Name] is dedicated to research in the Technology Evaluation, Value Engineering & Value Analysis Research Group, where they apply their expertise to enhance the efficiency and effectiveness of technological processes. Their work is pivotal in driving innovation and ensuring that industrial practices align with the latest advancements in technology management.

Warseno, SH, with a strong background in Environmental Law and Science and Technology Management, serves as a mid-level researcher at the National Research and Innovation Agency (BRIN) and has made significant contributions in both academic and public policy spheres. He completed his undergraduate studies in Constitutional Law at the Faculty of Law, Jember University in 1989, followed by a Master's degree in Law from Pamulang University in 2024. His work encompasses public policy analysis, where he has authored academic manuscripts, policy papers, and brief reports in the fields of research and innovation. In addition to his contributions to publications, he has played a vital role in strengthening the Regional Innovation System (SIDa) and developing instruments for measuring the Innovation Readiness Level (Katsinov). He has written several training modules and guidelines, and his research has resulted in numerous internationally indexed publications. Notable works include studies on the formulation of technical references for the development of a "Technology Transfer Office," waste management, and the development of Invention Management in specific areas. His publications have been presented at conferences, including the Sustainable Strategy Management of Cable-Based Tsunami Detection Equipment Instrumentation, as part of the Social, Humanities, and Education Studies (SHEs) Conference Series 5 in 2022. His expertise and dedication have been recognized with various national awards, including the Satyalancana Dwidya Sistha, Satyalancana Karya Satya for 10 and 20 years of service, and the Satyalancana Wira Karya. His research and contributions to policy development continue to have a significant impact at both national and international levels, particularly in the fields of sustainable development and innovation management.

Suharto Ngudiwaluyo is a dedicated researcher at the National Research and Innovation Agency (BRIN), with a strong academic background in Chemical Engineering, having earned a bachelor's degree from Institut Teknologi Sepuluh Nopember Surabaya. Further advancing their expertise, they obtained a master's degree in Ecosystem Engineering from the University of Tokushima, Japan. Their research primarily focuses on Technology Policy, Technology Management, Technology Audit, and Value Engineering. At BRIN, they play a crucial role in shaping and assessing technological advancements, ensuring that innovation is aligned with strategic goals and sustainable practices. Their work contributes significantly to the development and implementation of technology-driven solutions that address national and global challenges.

Dr. Wihatmoko Waskitoaji, as a Senior Policy Analyst since December 15, 2020, at the Directorate of Research and Innovation Utilization for Ministries/Agencies, Society, and Micro, Small, and Medium Enterprises, bring a wealth of experience in policy analysis and management. Academic journey began at Keio University, both bachelor's degree on March 23, 1992, and master's degree on March 23, 1994. Later completed doctoral studies at Waseda University, receiving my PhD on March 25, 2010. Throughout career, have undertaken significant leadership roles, including serving as the Acting Director and later the Director of the Directorate of Regional Research and Innovation Dissemination and Utilization. These roles, held from December 2021, involved driving key initiatives in research dissemination and innovation application across regions. Also completed various structured training programs, including DIKLAT PIM levels IV and III in 2003 and 2013, respectively, which have further honed expertise in public administration and leadership.

Sania Diaurrahmi BS, S.PT., ME. is a Junior Policy Analyst specializing in data collection and processing for research indicators in technology and innovation at the National Research and Innovation Agency (BRIN). In their current role, [Your Name] contributes to various significant projects, including the Industrial Research and Business Innovation Surveys (2022), the Indonesian Demographic and Health Survey (SDKI) (2023-2024), and the Basic Data Survey on Religious Life (SDDKB) (2023-2024). They also work on the Regional Competitiveness Index (IDSD) Pillar 1 team (2023-2024), focusing on enhancing regional innovation capabilities. Previously, Sania Diaurrahmi BS, S.PT., ME served as the Head of Strategic Partnerships at the Directorate of Innovation Systems, Ministry of Research, Technology, and Higher Education (Kemenristekdikti) from 2015 to 2021. Their role involved facilitating the Regional Innovation System (SIDa) from 2015 to 2019, developing and drafting innovation readiness regulations (Katsinov) (2016-2019) and supporting innovation clusters and innovation villages (2017-2021). Additionally, [Your Name] was a Junior Policy Analyst in the Technology and Regional Innovation Network Analysis and Design at Kemenristek from 2010 to 2015, where they managed the Agro Techno Park and contributed to the joint regulation on strengthening regional innovation systems. Sania Diaurrahmi BS, S.PT., ME has undergone various training programs, including Policy Drafting Training at BRIN (2022), specialized Policy Analyst Training (2021), Legislative Drafting Training (2020), Leadership Level IV (2019), and Facilitator Competency Enhancement Training (2018), underscoring their commitment to advancing policy analysis and innovation management.

Herni Widya Retno, S.IP., M.S.P. is a Technology Utilization Analyst at the National Research and Innovation Agency (BRIN), specializing in regional research and innovation. Currently, they are engaged in technical guidance and supervision at the Directorate of Dissemination and Utilization of Regional Research and Innovation. With over nine years of experience, [Your Name] has been instrumental in advancing national innovation systems, including the development of innovation clusters, innovation villages, and tools for measuring innovation readiness. They hold a master's degree in development studies from Bandung Institute of Technology (2021-2023), with a thesis focused on developing innovation ecosystems in Cimahi City through the Cimahi Techno Park. [Your Name] also earned a bachelor's degree in international relations from Airlangga University (2004-2009). Their professional journey includes roles such as a Science and Technology Knowledge Analyst at BRIN, where they managed programs for innovative villages and centers of excellence and supported the Consortium Research and Innovation Program for Covid-19. Prior to this, [Your Name] worked as an Administrator for Innovation Systems, contributing to the management of innovation cluster programs and the development of regulatory drafts. They have also developed tools for measuring innovation readiness and served as a policy analyst, focusing on network provider regulations. Herni Widya Retno, S.IP., M.S.P possesses skills in legal and legislative drafting, public administration, and policy analysis, with proficiency in both Indonesian and English. Their publications include research on digital transportation service platforms, lake management strategies, and seaweed-based innovation models. They have also completed training in legislative drafting and technopreneurship, further enhancing their expertise in the field.

Nasrul Baddu, a seasoned professional at the National Research and Innovation Agency (BRIN), currently holding the position of a Mid-Level Engineer within the Research Group for Technology Evaluation, Value Engineering & Value Analysis. With an academic foundation in Architectural Engineering from Hasanuddin University in Makassar, have demonstrated a strong commitment to advancing technological and engineering projects. In addition to their current role, have also gained valuable experience as a coordinator in the Bureau of Legal Affairs and Cooperation, where contributed to the strategic alignment of legal frameworks and collaborative initiatives within the agency. Diverse background reflects a blend of technical expertise and organizational leadership, making them a vital asset in driving innovation and technology evaluation at BRIN.

Ir. Adhi Pramono, as a member of the Research Group for Technology Evaluation, Value Engineering & Value Analysis at the Center for Research on Industrial Process Technology and Manufacturing under the National Research and Innovation Agency (BRIN), bring extensive experience in both technical and managerial domains. Academic background includes a bachelor's degree in electrical engineering from Universitas Gadjah Mada, Yogyakarta, earned in 1989. Completed various specialized training programs, including courses on Xylan Switches, Oracle Database and Application System Administration, Project Management, and Government Procurement. These have been conducted in prestigious institutions across Southeast Asia, including Singapore and Jakarta. Contributed to several significant projects and initiatives, such as the Tri Nusa Bima Sakti Transportation Study, solar power generation programs, and the development of integrated technology management systems with have held various roles, from procurement committee member to technical team leader, showcasing my versatility in managing complex projects. Recent involvement in research groups focused on Supply Chain and Domestic Content Requirements (TKDN) and Technology Evaluation underscores my commitment to advancing industrial process technologies.

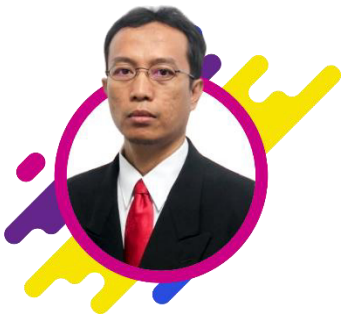
Ir. Makmuri Nuramin, MM is a seasoned professional in technology and management, currently serving as the Head of the Inspectorate at the BPPT. They bring a wealth of expertise from their diverse academic and professional background. Ir. Makmuri Nuramin, MM completed their bachelor's degree in mechanical engineering from Universitas Diponegoro, Semarang, in 1992. Their undergraduate thesis focused on designing a cold storage truck for transporting potatoes, with a capacity of 3 tons, from Wonosobo to Jakarta. This project aimed to address logistical challenges in the agricultural sector. In 2011, they obtained a master's degree in production management from Universitas Pembangunan Nasional Veteran. Their master's thesis examined strategies for selecting raw materials in the biodiesel industry. The study aimed to identify the most optimal and economically viable feedstocks for biodiesel production as a substitute for diesel fuel. Ir. Makmuri Nuramin, MM is also a doctoral candidate in Economics at Universitas Pancasila. Their research focuses on the factors influencing student loyalty towards low-cost carrier airlines, exploring the dynamics of consumer behavior in the aviation industry. With their extensive academic background and practical experience, Dr. [Name] is well-positioned as an authority in technology management and economic research, contributing valuable insights to their field.

Ari Gunawan, S.E., M.M., is a seasoned researcher and practitioner at the Center for Research on Process and Manufacturing Technology, under the National Research and Innovation Agency (BRIN). He is a dedicated member of the Technology Evaluation, Value Engineering, and Value Analysis Research Group. With a bachelor's degree earned in 1991 and a Master's degree from Diponegoro University in 2023, Ari has amassed significant experience in government asset management, procurement, and infrastructure development. Over a career spanning more than three decades, Ari has held various key positions, including roles in national asset management and the development of laboratory facilities. He served as a mid-level engineer, overseeing the management and enhancement of national infrastructure, demonstrating his expertise in both strategic and operational capacities. Notable projects include leading initiatives in national asset management, laboratory development, and energy and water efficiency programs. Ari's professional development includes certifications in Government Management (1995), Procurement Expertise (2012), and Internal Control Systems (2016). He has also undergone specialized training in ISO 50001 (2017). His recent research focuses on supply chain management, local content requirements (TKDN), and value engineering to enhance competitive advantage in various industries, including energy and manufacturing. His ongoing work involves evaluating and improving manufacturing processes, particularly in developing carbonization technology for plastic waste management. Ari's extensive experience and commitment to research and innovation make him a key contributor to BRIN's mission to advance national technological capabilities and sustainable development.

Asep Duduh Abdurahman is currently a staff member at the National Research and Innovation Agency (BRIN), holding a bachelor's degree in architectural engineering from Universitas Jakarta. In their role as a Functional Junior Expert Engineer, they specialize in Technology Audit, Value Engineering, and Value Analysis. With a strong foundation in architectural engineering, Asep Duduh Abdurahman applies their technical expertise to assess and enhance the efficiency and effectiveness of various technological processes and systems. Their work focuses on ensuring that technology audits are conducted with precision and that value engineering principles are applied to optimize both cost and functionality in projects. As a dedicated professional, Asep Duduh Abdurahman contributes to the advancement of technological innovations and the implementation of best practices within BRIN, playing a key role in the agency's mission to drive national research and innovation efforts.

Hartanto Kurniawan S.Kom., M.Sc serves as a Mid-Level Engineer at the National Research and Innovation Agency (BRIN), specifically within the Artificial Intelligence and Cybersecurity Research Group. With over 15 years of experience in the information technology industry, Hartanto Kurniawan S.Kom., M.Sc has established a distinguished career marked by leadership in designing and implementing innovative and efficient IT solutions. Hartanto Kurniawan S.Kom., M.Sc holds a master's degree in computer engineering from Keimyung University, South Korea. Their extensive expertise encompasses a broad range of technologies and methodologies, reflecting a deep commitment to advancing the field of IT. Throughout their career, Hartanto Kurniawan S.Kom., M.Sc has successfully led teams in developing cutting-edge solutions, demonstrating a strong ability to integrate technological advancements into practical applications. In their current role, Hartanto Kurniawan S.Kom., M.Sc continues to contribute to the development of sophisticated artificial intelligence and cybersecurity solutions, driving forward research and innovation within BRIN. Their work not only enhances the agency's technological capabilities but also contributes to the broader field of IT by fostering advancements that address complex challenges.

Cahyono Nugroho is a seasoned researcher and staff member at the National Research and Innovation Agency (BRIN), where they play a pivotal role in driving forward research and innovation in the realm of technology. Holding a master's degree in computer science from Budi Luhur University, they possess a robust academic background that complements their extensive practical experience. Their professional focus lies in several critical areas, including Information Technology, Technology Governance, Technology Audit, and Value Engineering. At BRIN, Cahyono Nugroho is deeply involved in exploring and developing advanced technological solutions that address contemporary challenges. Their work is characterized by a commitment to enhancing technology governance, ensuring that technological advancements are managed effectively and ethically. [Name] is also engaged in conducting thorough technology audits, assessing the efficiency and impact of technological implementations, and providing valuable insights for improvements. In addition to their role in technology audit and governance, Cahyono Nugroho applies their expertise in Value Engineering to optimize processes and systems, aiming to maximize value and performance. Their contributions are instrumental in shaping strategies and policies that drive innovation and technological excellence. With a blend of academic knowledge and practical experience, Cahyono Nugroho is dedicated to advancing the field of technology and contributing to the broader goals of research and innovation at BRIN. Their work not only supports the agency's mission but also enhances the overall technological landscape through strategic research and analysis.

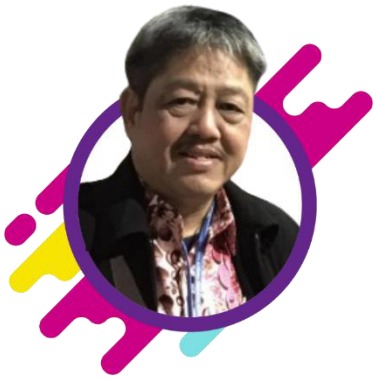


Satmintareja is a seasoned researcher at the National Research and Innovation Agency (BRIN), currently working at the Center for Process and Manufacturing Technology Research. They hold a bachelor's degree in informatics management from Sekolah Tinggi Manajemen Informatika dan Komputer Jakarta, completed in 1999, and a master's degree in information systems from Universitas Diponegoro, graduating in May 2024. Satmintareja has a robust background in technical training and development. They completed the "Training for Outbound Trainers" program at Learn Training and Consulting in May 2015 in Sukabumi, West Java. They further enhanced their skills with the "Human Resources Development Training Program for Supporting Innovation" organized by the Science and Technology Policy Institute in Korea from November to December 2016. Additionally, they undertook "Basic Network Administration" training at the Ministry of Communication and Information in Cikarang, West Java, in January 2017, and completed the "Training Officer Course (TOC)" provided by BPPT and LAN in Jakarta in March 2017. Their professional experience spans several roles within government research institutions. They began their career at BPPT as a Data Staff in the Center for Development, Education, and Infrastructure Maintenance from 1992 to 2017, where they were responsible for data processing and system management. They then served as Head of the Evaluation Sub-Division at Pusbindiklat from 2017 to 2019, overseeing evaluation reports and administration. In early 2021, [Your Name] was promoted to Sub-Coordinator of the Evaluation Section at Pusbindiklat, continuing to manage evaluations and administrative tasks. Since September 2021, they have been with BRIN, focusing on research within the Center for Process and Manufacturing Technology, contributing to advancements in industrial processes and manufacturing technologies.

Darmawan is currently a researcher in the Technology Evaluation, Value Engineering & Value Analysis Research Group at the Industrial Process and Manufacturing Technology Research Center, under the National Research and Innovation Agency (BRIN). Darmawan earned their S1 degree in Mechanical Engineering from Universitas Pamulang, Tangerang, in 2012. With an extensive career spanning from 1993 to 2020, they served as the Supervisor of Maintenance and Repair for the Baruna Jaya research vessels at the Marine Survey Technology Center, BPPT. Since 2021, [Name] has been contributing to BRIN as a Senior Engineer, focusing on advancing technological innovations and improving industrial processes through rigorous evaluation and analysis.

Sigit Santosa, S.T. is a Senior Nuclear Analyst at the National Nuclear Energy Agency (BATAN), specializing in nuclear technology research and development. They hold a bachelor's degree in Nuclear Engineering from Universitas Gadjah Mada, graduated in 1999. [Your Name] has advanced their expertise through various specialized trainings, including the Functional Training for Nuclear Technologists and training on Reporting for Nuclear Technology Assessment, Design, and Utilization in 2021 at BATAN's Center for Education and Training. They have completed several structural training programs: SEPALA/ADUM/DIKLAT PIM TK. IV in 2010 and SEPADYA/SPAMA/DIKLAT PIM TK. III in 2019. Sigit Santosa, S.T. currently serves as a Senior Nuclear Technologist at the Center for Radiation Detection Technology and Nuclear Analysis since 2020, and as a Junior Nuclear Technology Developer at the Center for Nuclear Analysis Technology since 2022. They will advance to Senior Nuclear Technology Developer in 2024 at the same center. Sigit Santosa, S.T. has made significant contributions to the field with numerous publications. Their research includes national and international work on nuclear technology and its applications, such as "Clearing House on Nuclear Technology Based on Standardization" (2017) and "Gamma Radiography Testing of Collimators for Boron Neutron Capture Therapy" (2019). They have also explored topics like environmental assessment for offshore nuclear power plants (2020), and concepts for enhancing nuclear energy security (2021). Their recent work includes international publications on radiation monitoring and quality assurance for high-temperature gas-cooled reactors (2022) and advancements in accident-tolerant fuels for light water reactors (2024).

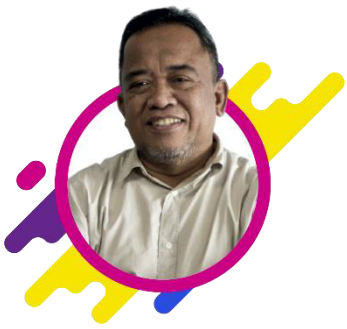
Suyatmin, currently serving as a staff member at the National Research and Innovation Agency (BRIN), [Name] hold a diverse educational background, starting with a D3 degree in Naval Architecture from Diponegoro University, Semarang, completed in 1995. This was followed by an S1 degree in Naval Architecture from Darma Persada University, Jakarta, obtained in 2002. In 2009, [Name] furthered their expertise with an S2 degree in Mechanical Engineering from the National Institute of Science and Technology, Jakarta. With a strong focus on Technology Audit, Value Engineering, and Value Analysis, [Name] play a key role in advancing research and development initiatives within these fields. Their extensive knowledge and experience make them an invaluable asset to BRIN's mission of innovation and technological progress.



Drs. Amos Lukas, MM, as a Principal Researcher at the Center for Agro-Industry Technology within the National Research and Innovation Agency (BRIN), [Your Name] has made significant contributions to the field of agro-industrial technology. With a focus on technological innovation and sustainability, they have authored five influential books, including Technological Innovation and Diversification of Competitive Palm Oil Products (2018) and Technological Innovation in Nutmeg Processing (2021). Their academic journey began with a bachelor's degree in chemistry from Universitas Riau, followed by a master's degree from Sekolah Tinggi Ekonomi IPWIJA, and culminated in a doctoral from Universitas Persada Indonesia YAI Jakarta. Drs. Amos Lukas, MA, MM is deeply committed to advancing research in agro-industrial technology, with a particular interest in eco-friendly practices and sustainable economic development. Their work on Startup Innovation: Eco-Friendly Catfish Farming to Boost Cooperative Economies exemplifies their dedication to integrating technological advancements with environmental stewardship. An active participant in the global scientific community, Drs. Amos Lukas, MA, MM regularly publishes in both national and international journals. Their research is widely recognized, with citations across various academic platforms, including Scopus (ID: 58650405400) and Sinta (ID: 6826756). Through their research, Amos Lukas continues to push the boundaries of innovation in agro-industry, contributing valuable insights and practical solutions to the challenges facing the industry today.

Ir. Eko Bhakti Susetyo, MT is a Mid-Level Engineer at the Center for Agroindustrial Technology, within the National Research and Innovation Agency (BRIN). With a robust academic background, Ir. Eko Bhakti Susetyo, MT holds a bachelor's degree in mechanical engineering from Universitas Diponegoro and a master's degree in industrial engineering from Universitas Indonesia. They have significantly contributed to the field through their publication, Synergies to Address Stunting In Papua: A Multisectoral Approach and Improving People's Quality of Life, which explores innovative strategies for enhancing public health and quality of life. In addition to their book, [Author Name] is the holder of two patents: 1) Instant Noodle Formula Based on Sago Starch (2022), and 2) Sago Instant Noodles Using Oven Method (2023). These patents reflect their dedication to advancing agroindustrial technology and improving food processing methods. An active contributor to the academic community, [Author Name] publishes regularly in scientific journals and maintains a professional presence with a Scopus ID of 55649045700 and an ORCID ID of 0009-0008-8235-8749. Their work not only furthers the scientific understanding in their field but also provides practical solutions to real-world problems.

Sunarto, ST, possesses extensive training and expertise across a broad spectrum of ISO standards and management systems, making them a well-rounded professional in quality assurance, environmental management, and occupational health and safety. Their qualifications include ISO 9002 for Technical Inspection, ISO 14001 for Environmental Management, ISO 45001 for Occupational Health and Safety Management, and numerous others, including advanced certifications like Lead Auditor for ISO 9001, 14001, and 45001 under IRCA accreditation. In their career, Sunarto, ST has held roles as a QA Engineer at the Project Management Organization (PMO) of BATAN and has provided quality control services at several prominent companies, such as PT El Nusa, PT Chemical Cilegon, and PDAM Way Rilau in Lampung. As an Inspector, they have worked with companies like PT Sanyo Electronics and PT Multi Fabrindo, among others. Their offshore experience includes significant projects in fields like Arjuna Field Java-sea and Unical Field East Kalimantan, and onshore roles in locations such as Gunanusa Field Cilegon and Selat Sunda, Merak, Banten. Additionally, [Name] has served as a consultant for various organizations, offering expertise in ISO 17020 and Ultrasonic Testing Level 3 for institutions like Lembaga Inspeksi Migas (LIM) Cepu and PT Semen Gresik. Their auditing experience is equally vast, having conducted audits for companies such as PT Hindoli in Palembang, BATAN for Integrated Management Systems, and LNG BP Tangguh in Papua.

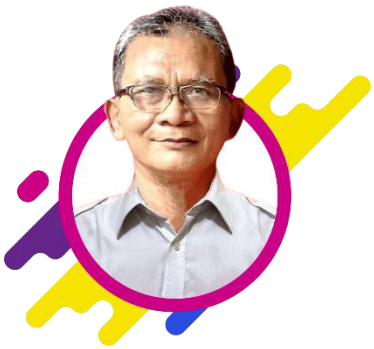


Ir. Irshan Zainuddin, M.Si., as a Mid-Level Engineer at the Center for Process and Manufacturing Technology Research within the National Research and Innovation Agency (BRIN), the user plays a critical role in advancing technological innovation and optimizing industrial processes. They hold a bachelor's degree in mechanical engineering from Hasanuddin University and a master's degree in Agricultural Engineering from Bogor Agricultural University. Their academic background equips them with a deep understanding of both mechanical systems and agricultural technologies, enabling them to tackle complex challenges in manufacturing and process technology. From 2013 to 2019, the user was deeply involved in evaluating research activities at BPPT, utilizing Technology Readiness Level (TRL) assessments. This period marked a significant phase in their career, where they applied TRL methodologies to rigorously evaluate the maturity and readiness of various research outcomes. This work was crucial in refining and enhancing research processes, ensuring that innovations were effectively developed and ready for practical application. The user's role in this evaluation process highlighted their expertise in both the technical and strategic aspects of technology development, reinforcing their commitment to advancing research and fostering innovation within their field.

Ir. Fauzie Dahmir, M.Eng. is a distinguished expert in telecommunications and technology management, with an extensive academic and professional background. They earned their bachelor's degree in electrical Telecommunications Engineering from Institut Teknologi Sepuluh Nopember Surabaya (ITS) in 1985, followed by a master's degree in electrical and Electronic Engineering from Ehime University, Japan, in 1995. Ir. Fauzie Dahmir, M.Eng has pursued several advanced training programs to enhance their expertise. They completed a specialized course in CDMA Technology at the Korea Telecom Human Resources Development Center in South Korea (2001). They also participated in Japanese language courses at Tokyo Nihonggo Gakkuin and Takushoku University, Tokyo, Japan. Their training includes a project management course at LAN, Jakarta (1989), and a study visit for Indonesian IT officials at the Korea Information Society Development Institute (2007). Professionally, Ir. Fauzie Dahmir, M.Eng has held prominent positions in both government and research institutions. They served as the Head of Planning and Cooperation at Puslitbang APTEL SKDI, under the Ministry of Communication and Information Technology, from September 2006 to November 2008. Following this, they became the Head of the Sub-Directorate for Rural Telematics Empowerment at the Directorate of Telematics Empowerment, Directorate General of Telematics Applications, from November 2008 to June 2009. They also served as the Head of the Sub-Directorate for E-Government Implementation at the Ministry of Communication and Information Technology from June 2009 to February 2011, and later as the Head of the Sub-Directorate for Community Informatics Empowerment from February 2011 to September 2012. In September 2021, Ir. Fauzie Dahmir, M.Eng transitioned to the National Research and Innovation Agency (BRIN) as a researcher at the Center for Research on Process and Manufacturing Technology. Here, they focus on advancing industrial process technologies and manufacturing innovation. Ir. Fauzie Dahmir, M.Eng's international experience includes participating in key conferences and training programs. They attended the APEC Japan 2010 TELMIN 8 in Okinawa, Japan (2010), the Telecom Network Optimization Asia (TNO Asia 2009) in Hong Kong, and a study visit for Indonesian IT officials in Korea. They also contributed to the Second Meeting of the Working Level Task Force between the Republic of Korea and the Republic of Indonesia. With their comprehensive experience and contributions to telecommunications and technology management, Ir. Fauzie Dahmir, M.Eng is a leading figure in their field, recognized for their expertise in both national and international contexts.

Andjar Prasetyo, SE, M. Si, a seasoned researcher specializing in regional economics, resides in Magelang City, Central Java, Indonesia. He is actively engaged in authoring internationally recognized scientific articles and books, collaborating with both domestic and international publishers. His works primarily focus on economic and regional issues, addressing a wide spectrum of challenges and opportunities.Beyond his prolific writing, Prasetyo is deeply involved in multidisciplinary research collaborations, bridging diverse fields to provide innovative solutions to complex regional and economic problems. His dedication to advancing knowledge and fostering interdisciplinary approaches has made him a respected figure in his field.

Djarwadi is a Principal Researcher at the Center for Agro-Industry Technology, part of the National Research and Innovation Agency (BRIN). With a career spanning several decades, Djarwadi has developed a robust expertise in industrial technology and management, particularly within the agro-industry sector. Their educational background includes a master's degree in industrial engineering and management from the Bandung Institute of Technology (ITB) in 1996 and a bachelor's degree in management economics from Diponegoro University in 1986. Throughout their career, Djarwadi has held numerous key positions, including Chair of the Labor System Study Group at BPPT in 1998 and Technology Auditor at the Center for Technology Assessment (PAT-BPPT) from 2007 to 2021. Currently, they are involved in Research and Development at BRIN, focusing on national projects aimed at advancing industrial technology and economic strategies. Their work has been recognized with several prestigious awards, including the Satya Lencana Karya Satya in three different classes (X, XX, and XXX years) for their dedication to public service. In recent years, Djarwadi has contributed to numerous projects, such as auditing the technological capacities of the defense and security industry, evaluating industrial salt production, and analyzing the techno-economic feasibility of palm oil processing plants. As an author and researcher, Djarwadi has published several significant works, including analyses on Indonesia's defense industry, palm oil industrial strategies, and the valuation of technology products. Their research is regularly featured in national and international conferences, such as the International Conference on Battery for Renewable Energy and Electric Vehicles (ICB-REV) in 2022. In addition to their research activities, Djarwadi is actively involved in professional organizations, including the Indonesian Association of Technology Auditors and the Indonesian Researcher Association, where they have contributed to advancing the field of technology and industrial research. Their ongoing commitment to innovation and development in the agro-industry sector continues to influence policy and practice both within Indonesia and internationally.



Drs. Sudono, as a Senior Engineer at the Center for Research on Industrial Process and Manufacturing Technology (PRTIPM) within the National Research and Innovation Agency (BRIN), the user has built a robust career characterized by a deep expertise in engineering and policy analysis. Appointed to this role on September 1, 2015, they have played a key role in driving forward BRIN's mission to advance Indonesia's technological and industrial capabilities. Their academic background in Public Administration from STIA-LAN RI has been instrumental in their ability to navigate and influence the complex intersections between science, technology, and government policy. Over the course of their career, the user has held several strategic positions within the Ministry of Research and Technology of the Republic of Indonesia. These roles have included serving as a Policy Analyst for Science and Technology Support, Head of the Macroeconomic Policy Analysis Subdivision, Head of the Science and Technology Human Resources Competency Mapping and Improvement Division, and Head of the Scientific Ethics and Professional Organizations Division. Their leadership in these areas has significantly contributed to the development of Indonesia's science and technology policies, ensuring that they align with the nation's broader economic and social goals. The user's commitment to advancing technological innovation is further demonstrated by their involvement in numerous strategic programs and initiatives. Notably, they have played a pivotal role in the development and implementation of policies for the diffusion of specific technologies tailored for regional development, as well as thematic policy studies aimed at bolstering regional innovation systems. Their work on these programs, particularly in the context of the Pelalawan Techno Park development, underscores their expertise in managing complex, multi-stakeholder projects that drive regional growth through technological innovation. In addition to their policy and project management roles, the user has also made significant contributions to the academic and research community through various publications. Their works have focused on topics such as e-business for creative industry players, knowledge management implementation in small and medium enterprises (SMEs), and the organizational readiness of Techno Parks in Indonesia. These publications reflect their deep understanding of the practical and theoretical aspects of technology management and their commitment to sharing knowledge with a broader audience. Currently, the user is actively involved in research activities within the Biorefinery Research Group at BRIN, where they contribute to cutting-edge research on sustainable industrial processes. Their ongoing work includes projects aimed at reducing the slagging and fouling tendencies in co-firing systems using palm oil solid waste, which is crucial for improving the efficiency and environmental performance of Indonesia's energy sector. The user's distinguished career is marked by a blend of technical expertise, strategic policy development, and a strong commitment to advancing Indonesia's technological capabilities. Their contributions continue to shape the future of the nation's industrial and technological landscape.

Acknowledgements

First and foremost, we would like to express our deepest gratitude to God Almighty, whose blessings and guidance have enabled us to complete this book, "**KATSINOV: A Measuring Tool for the Level of Innovation Readiness**". It is with great humility and appreciation that we acknowledge the efforts, support, and contributions of many individuals and organizations that have made this work possible. We would like to extend our heartfelt thanks to our mentors and advisors who provided invaluable insights and expertise throughout the creation of this book. Your guidance, encouragement, and constructive feedback have been instrumental in shaping the structure and content of this work.

Our sincere appreciation goes to our colleagues and research partners, whose collaboration and shared knowledge enriched this book's conceptual framework. The discussions, brainstorming sessions, and research contributions have truly made this project a shared accomplishment. We also wish to acknowledge the organizations and institutions that supported our research. Your resources, data, and case studies have been essential in validating the ideas and concepts presented in this book. Special thanks to the innovation leaders and practitioners who shared their experiences, allowing us to incorporate practical perspectives into the KATSINOV framework. To our family and loved ones, we are eternally grateful for your patience, understanding, and unwavering support throughout this journey. Your belief in our vision and your constant encouragement kept us motivated during the most challenging moments.

Lastly, to the readers of this book, we extend our gratitude for your interest in exploring the concepts and tools within. It is our hope that this book serves as a guide and source of inspiration for driving innovation readiness in your respective fields and organizations. This book is the result of collective efforts, and while we have strived for accuracy and thoroughness, we acknowledge that perfection is an ongoing process. Any shortcomings or errors are solely our responsibility, and we welcome constructive feedback for improvement in future editions.

Thank you all for being part of this journey.

The Authors

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Abbreviations

AHEAD	Approach to Human-centered, Evidence-driven Adaptive Design
AI	Artificial intelligence
AUTM	Association of University Technology Managers
BMC	Business Model Canvas
BPPT	Badan Pengkajian dan Penerapan Teknologi
CAC	Customer Acquisition Cost
CSR	Corporate Social Responsibility
CT	Computational thinking
DoD	Department of Defense
DT	Design Thinking
EF	Engineering Feasibility
ERP	Enterprise Resource Planning
EV	Electric vehicle
GDI	Great Dictionary of Indonesian
GDP	Gross domestic product
GFA	Gross Floor Area
GMP	Good Manufacturing Practice
HR	Human Resource
HR	Human Resources
HRL	Human Readiness Level
ICT	Information and communication technology
IMF	International Monetary Fund
InRL	Integration Readiness Level
IoT	Internet of Things
IP	Intellectual Property
IP	Intellectual Property
IPB	Institut Pertanian Bogor
IPO	Initial Public Offering
IPR	Intellectual Property Rights
IPR	Intellectual Property Rights
IPTN	Industri Pesawat Terbang Nusantara (PT Dirgantara Indonesia)
IRL	Innovation Readiness Level
IRL	Innovation Readiness Level
ITB	Institut Teknologi Bandung
ITRI	Industrial Technology Research Institute
IUR	Industry-University-Research
KMS	Knowledge management systems
MoU	Memoranda of understanding
MRL	Manufacturing Readiness Level

MSME	Micro, Small, and Medium Enterprises
MVP	Minimum Viable Product
NIS	National Innovation System
OIP	Open innovation platforms
PC	Personal Computer
PLC	Product Life Cycle
PLM	Product lifecycle management
PPP	Public-private partnerships
PT	Perseroan Terbatas
R&D	Research and Development
ROI	Return on investment
RRL	Regulatory Readiness Level
SaaS	Software as a Service
SCAMPER	Substitute, Combine, Adapt, Modify, Put to another use, Eliminate, Reverse
SF	Scientific Feasibility
SNI	Standar Nasional Indonesia
SPBE	Sistem Pemerintahan Berbasis Elektronik
SRL	System Readiness Level
STEM	Science, technology, engineering, and math
STEM	Science, Technology, Engineering, and Mathematics
TAM	Total Available Market
TKDN	Tingkat Komponen Dalam Negeri
TOT	Transfer of Technology
TRL	Technology Readiness Level
TTO	Technology Transfer Office
UAE	United Arab Emirates
UI	University of Indonesia
USP	Unique selling point
VC	Venture Capital

Part 1

CHALLENGES OF THE AGE AND THE ROLE OF INNOVATION

"Innovation is the ability to see change as an opportunity – not a threat."

- Steve Jobs

Chapter 1
THE ERA OF INNOVATION DISRUPTION

Susalit Setya Wibowo, Ophirtus Sumule

1.1. Technology Disruption

The era of disruption has brought profound transformations across various sectors, demanding rapid adaptation and continuous innovation to overcome challenges and capitalize on the opportunities that arise due to the development of digital technology. This era also emphasizes the importance of global collaboration and mature policy strategies to ensure that digital transformation delivers inclusive and sustainable benefits (Schneider & Kokshagina, 2021). The era of disruption, which is characterized by rapid digital transformation, has had a significant impact on various sectors, including the economy, politics, and education. Digital transformation has driven major changes in the way businesses operate, market structures, and social interaction patterns, simultaneously creating new opportunities and challenges. In the economic sector, digital transformation has overhauled traditional business models and accelerated innovation and productivity. For illustration, studies show that the adoption of digital technologies, such as big data, artificial intelligence (AI), and the Internet of Things (IoT), has improved economic performance in different countries, with results varying among sectors, especially in the manufacturing and health sectors (Kaggwa et al., 2023). In the political field, digital technology has changed the way of political participation, communication among the government and the public, and the dissemination of information. These changes include increased transparency and public participation through social media and other digital platforms. However, these changes also bring challenges, including the risk of spreading disinformation and threats to individual privacy (Rwigema Pierre-Celestin, 2020). In the education sector, digital transformation has changed the method of learning and education management. Educational institutions are increasingly relying on technology such as online learning, AI, and data analytics to improve the quality of education and meet the needs of the digital learner generation. The era of disruption demands innovation in teaching, including the use of virtual classrooms and more flexible and personalized learning methods (Gillpatrick, 2020). However, these changes also present challenges, such as the gap in access to technology and the need for digital upskilling for educators (Nabung et al., 2022).

The era of disruption is a time full of severe challenges for human life. The rapid changes in technology and way of life have threatened the stability and well-being of many people. Those who are unable to adapt to these changes will face great difficulties in living a daily life full of competition and uncertainty. The impact of this disruption is very wide, ranging from shifting corporate culture that must face a generational gap in the world of work, to challenges in improving human resource performance during the COVID-19 pandemic which exacerbates global challenges (Manaf, 2022; Marsudi & Sanica, 2021). In addition, the era of disruption also raises philosophical and ethical issues, where increasingly sophisticated technology becomes a double-edged sword that can have both positive and negative impacts. In this context, philosophy is faced with the challenge of providing a constructive direction for the development of technology that continues to develop (Abustan et al., 2022). This era also affects the Islamic economic sector, which must adapt to these major changes to remain relevant and able to contribute significantly to the economy (Hayati et al., 2023). The inability to adapt quickly can cause individuals and organizations to fall behind in an increasingly fierce global competition. Therefore, it is important for every individual and organization to develop flexibility, creativity, and the ability to continue learning to survive and thrive in this era of disruption (Wijaya, 2023). Overall, the era of disruption requires humans to have high adaptability and sensitivity to change to be able to survive in an increasingly competitive and fast-changing world. Fail to adapt can lead to downturn amid increasingly fierce global competition.

Technological disruption and innovation are an increasingly common phenomenon in various industrial sectors, driven by several interrelated factors. According to the latest literature, there are five main factors driving disruption, namely cost, quality, changing customer preferences, regulations, and the availability of resources.

1. Cost, cost is one of the main driving factors of disruption. When new technologies allow for a significant reduction in production costs, older technologies become no longer competitive. This makes old products or services unprofitable, forcing companies to adopt new technologies to remain relevant in the market (Assel & Fei, 2020).
2. Quality, improving quality through new technologies or processes can make old products or services obsolete. When new products offer higher quality at the same or lower cost, consumers are likely to switch to those new options, driving disruption in the market (Kharlov, 2021).
3. Changes in customer preferences, changes in customer preferences are often the main trigger for disruption. When customers want something

new and different, companies must be able to adapt quickly or risk losing the market. For illustration, the shift in preferences from offline shopping to online shopping has prompted massive disruption in the retail industry (Mitra et al., 2023).

4. Regulation, new, stricter regulations could force the industry to adapt to new ways of complying with those rules. For illustration, strict environmental regulations can force companies to adopt greener technologies, disrupting traditional ways of working (Zimmerling & Chen, 2021).
5. Resource availability, when resources that were previously available become scarce or no longer accessible, companies must look for new alternatives. This often drives innovation that disrupts old ways of working and products. For illustration, the scarcity of fossil fuels advises the development of renewable energy that disrupts the traditional energy industry (Tehrani, 2023).

Disruption is the result of the interaction of various factors, which leads to radical changes in the industry and the market. Companies that are unable to adapt to these factors risk falling behind or even disappearing from the market. Therefore, understanding and managing the drivers of disruption is essential for business continuity in this modern era. Disruption in the context of technology and innovation is a change that causes a previous product, service, or process to become ineffective. This phenomenon is driven by a variety of interrelated factors, each of which has an important role in facilitating disruption. Here are the five main factors driving disruption:

1. Technological Innovation: Technological innovation is often the main trigger for disruption. The emergence of new technologies that are radically more efficient or more affordable can replace old technologies or methods. An illustration is how digital cameras are replacing film cameras, or how electric vehicles are starting to replace fossil fuel vehicles (Roblek et al., 2021).
2. Changes in Market and Consumer Needs: Changes in consumer preferences and needs can also drive disruption. When consumers want more convenient, cheap, or innovative products or services, companies that can meet these needs in new ways will disrupt old players in the market (Kharlov, 2021).
3. Globalization and Connectivity: Globalization and increased connectivity through the internet and digital technologies have accelerated the spread of new innovations and business models around the world. This allows companies to operate in global markets, which increases the intensity of

competition and accelerates the disruption process (Cozmiuc & Petrisor, 2019)

4. External Pressures such as Crisis or Regulatory Change: Economic crises, pandemics, or regulatory changes can force companies to innovate or face disruption. For illustration, the COVID-19 pandemic has forced many companies to adopt digital technologies faster than they previously planned (Zimmerling & Chen, 2021).
5. Innovative Leadership and Organizational Culture: Internal factors such as innovative leadership and an organizational culture that advises innovation are also important in driving disruption. Organizations that have leaders who understand the importance of innovation and foster an adaptive culture will be better prepared to face disruption and even create it (Sunarmo et al., 2023).

Disruption is the result of a complex interaction among technological innovation, market changes, globalization, external pressures, and internal factors such as leadership and organizational culture. These factors work together to drive radical changes that are changing the industry landscape and require companies to constantly innovate to stay relevant. The era of disruption we are experiencing today is the result of a synergy of cutting-edge technologies that not only change the way we work and live, but also expand the boundaries of what is possible in a variety of sectors, from healthcare to industry and public services. These innovations, while bringing great benefits, also require rapid adaptation and a deep understanding of the social and economic implications of the application of such technologies. Technological disruption can be defined as a major change triggered by the emergence of new technologies capable of creating radical innovations, thus replacing or overhauling the old order. The era of disruption, especially in the context of technology and innovation, is triggered by the emergence of technologies such as the internet, AI, and the IoT that have revolutionized many aspects of human life, from industry to daily lifestyle. IoT technology, for illustration, has changed the way we interact with our surroundings. IoT enables automated connections among devices, which generates large amounts of data (big data) that can then be analyzed using AI to provide insights and more efficient solutions in various fields, such as healthcare, manufacturing, and transportation (Trivedi et al., 2023). Thus, IoT and AI are not just tools, but also the foundation for sustainable innovation in this era of disruption (Mashiko, 2020). On the other hand, this technological integration is also driven by the phenomenon of globalization and economic integration, where geographical boundaries are increasingly blurred due to information digitization. This digital

globalization is accelerating the adoption of new technologies in different parts of the world, forcing companies to adapt quickly to changes to stay competitive (Ray Walshe, 2020). The combination of AI, IoT, big data, and other technologies not only creates opportunities, but also new challenges in data security, privacy, and the need for international standardization that ensures the interoperability and reliability of such technologies (Zewdie & Girma, 2020).

The era of disruption requires companies to not only respond to change, but also lead those changes in innovative and strategic ways, leveraging the power of digital technology and social networks to create new value in their business ecosystem. The era of technological disruption has fundamentally changed business models in various industries, driven by the rapid development of technologies such as the internet, AI, IoT, and social media. New business models emerging in this context, such as joint ventures networks and social media platforms, are not only responding to social change, but also accelerating the pace of such change. Joint ventures networks, for illustration, allow companies to leverage the resources and expertise of various parties within their business ecosystem. Companies that can integrate disruptive technologies into their business models are not only able to survive but also develop a significant competitive advantage (Santoso, 2023). On the other hand, social media has become a very effective tool in changing the communication pattern among companies and customers. With the ability to connect individuals and communities at scale, social media allows companies to not only promote their products and services but also build and maintain closer relationships with their customers (Ding, 2023). In addition, social media platforms have also created revolutionary new business models, such as multi-sided platforms that allow interaction among different groups of users, including consumers, service providers, and advertisers (Gawanmeh & Al-Karaki, 2021).

Disruptive innovations such as Uber, Go-Jek, Grab, Tokopedia, and Bukalapak have provided great benefits to society by offering more efficient solutions and wider access to services and products. However, this disruption also requires rapid adaptation from existing industry players as well as supportive regulations to ensure that these innovations are sustainable and inclusive. In today's era of technological disruption, disruptive innovations such as the emergence of online transportation services (such as Uber, Go-Jek, and Grab) and ecommerce platforms (such as Tokopedia and Bukalapak) have had a significant social impact. These innovations not only transformed related industries, but also provided great benefits to many customers by providing more efficient, accessible, and often cheaper services. Online transportation

services such as Uber, Go-Jek, and Grab have disrupted conventional transportation services by introducing business models that utilize mobile application technology and the internet to connect passengers with drivers directly (figure 1.1). This not only provides convenience for customers, but also opens new economic opportunities for drivers who can work flexibly (Radhi & Pramuditya, 2021). Similarly, Tokopedia and Bukalapak have changed the retail landscape in Indonesia by disrupting physical stores and changing the way people shop. By providing a platform that allows anyone to open an online store, these two platforms not only facilitate trade, but also empower small and medium-sized enterprises (SMEs) to reach a wider market without having to open a physical store (Tusyanah et al., 2021). In addition, these two platforms also support the growth of the digital economy in Indonesia, especially in increasing financial inclusion and market access for groups that were previously difficult to reach by traditional business models. Tokopedia and Bukalapak have succeeded in creating an ecosystem that allows for more dynamic interactions among sellers and buyers, ultimately improving the quality of service and the overall shopping experience (Husnah et al., 2021).

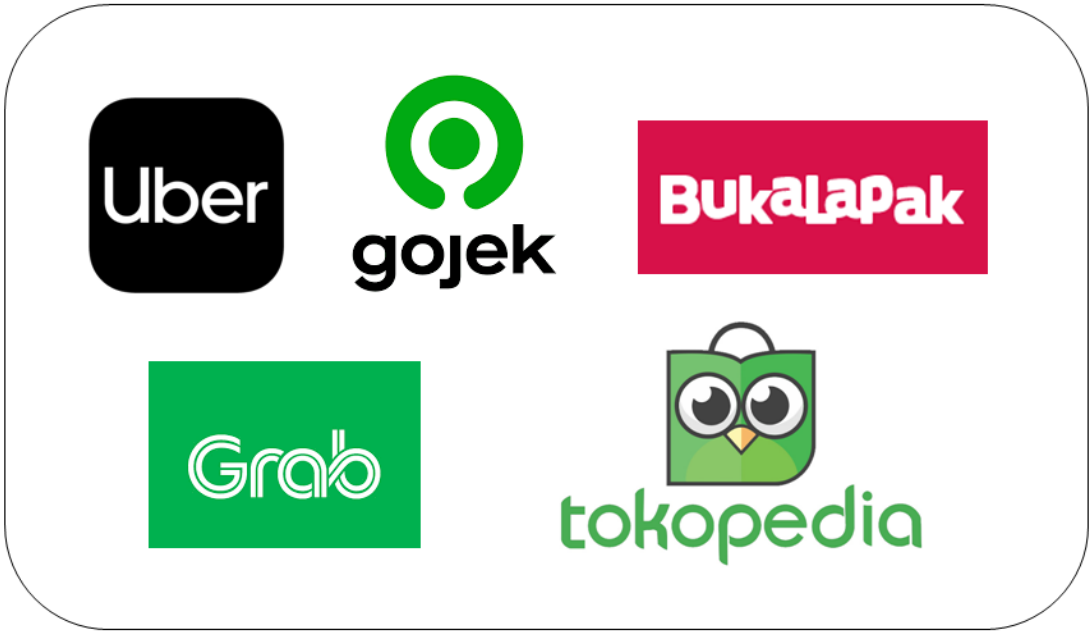


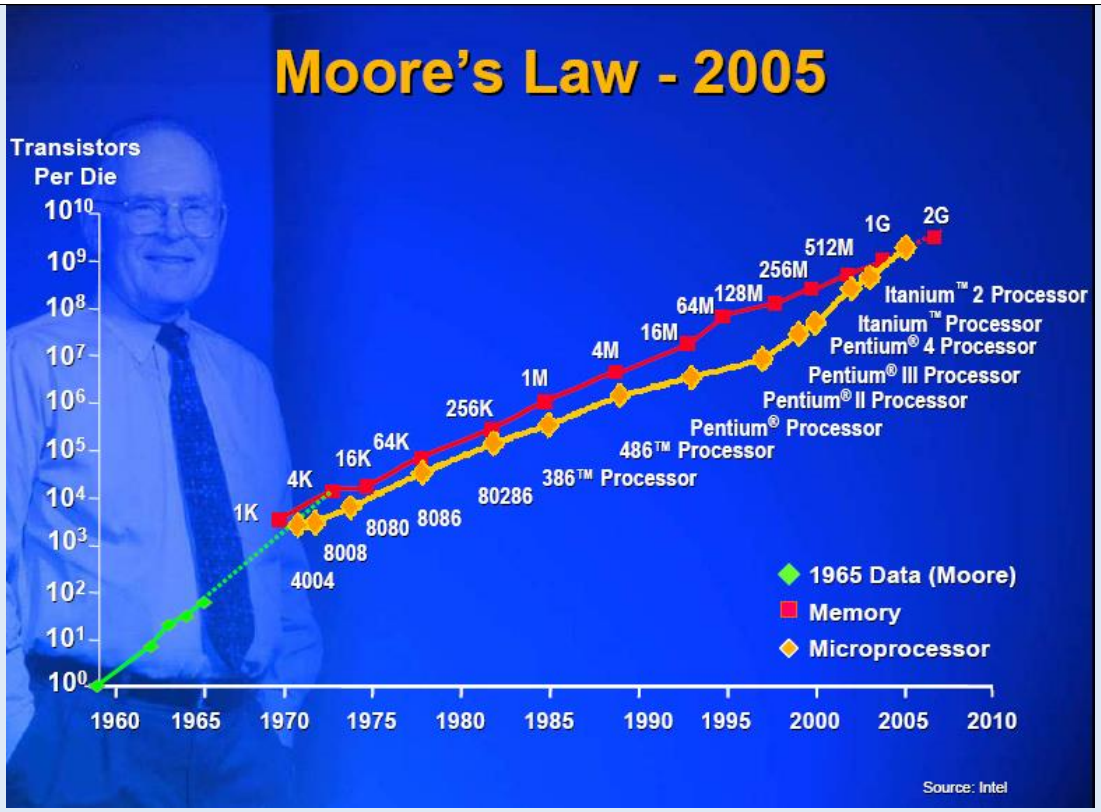
Figure 1.1. Startup

The era of technological disruption not only advises the acceleration of new product cycles but also demands new approaches to understanding and managing technological innovations, in line with the exponential developments predicted by Moore's Law. The era of technological disruption

has given birth to a phenomenon known as "big-bang disruption," which is a major change that urges a new product cycle and demands a fundamental transformation in business models and market strategies. This phenomenon involves technological innovation so rapid and large, that the traditional model used to manage innovation, such as Geoffrey Moore's theory in "Crossing the Chasm" (1991), must be revised. This theory, which essentially focuses on how companies navigate the gap among early adopters and the early majority in technology adoption, has been influenced by Moore's Law, which states that the computing speed of microprocessors is growing exponentially, thus changing the technological landscape very quickly. Moore's Law, originally proposed by Gordon Moore, states that the number of transistors in microprocessors will double every two years, leading to an exponential increase in computing power and a decrease in production costs (Shalf, 2020). However, this law now faces major challenges as the physical boundaries of miniature transistors approach, which require new innovations beyond traditional silicon scales, such as quantum computing and biocomputing (Zhu et al., 2023). Big-bang disruption illustrates how technological innovations can quickly disrupt the market in ways previously unthinkable. Innovations such as cloud computing, AI, and the IoT are not only shifting existing products and services, but also creating new markets that force companies to adapt or fall behind (Coccia, 2020). Moore's Law is instrumental in accelerating this pace of disruption by strengthening the technological foundations that enable innovation to happen faster and cheaper. However, with the terminate of Moore's Law approaching due to the physical limitations of miniature transistors, companies and industries must look for new solutions to maintain the pace of innovation. This includes the exploration of new technologies such as customized hardware architectures and the development of more efficient algorithms to improve computing performance (Leiserson et al., 2020).

Moore's Law

Moore's Law is one of the well-known laws in the microprocessor industry that describes the growth rate of microprocessor speed. Introduced by Gordon E. Moore co-founder of Intel. He said that the growth in microprocessor computation speed followed an exponential formula.

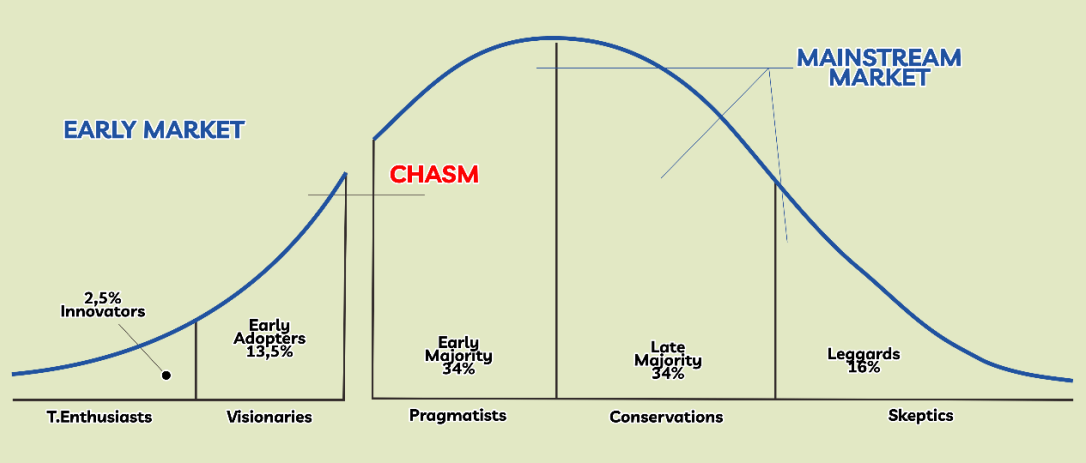


But Moore's Law may not continue indefinitely. The high-tech industry may enjoy his talk about exponential growth and diversity in digitally driven "scarcity," but there are physical limits to the ability to continually reduce the size of components on a chip.

Geoffrey Moore

Geoffrey Moore is an author, speaker, and adviser who shifts consulting time among startups in the Mohr Davidow portfolio and Wildcat Venture Partners and founding high-tech companies, most recently including Salesforce, Microsoft, Autodesk, F5Networks, Gainsight, Google, and Splunk.

Moore's work focuses on market dynamics around disruption innovation. His first book, Crossing the Chasm, focuses on the challenges startup companies face in the transition from early adoption to mainstream customers. It has sold more than one million copies, and its third edition has been so revised that most of its illustrations and case studies have become references to the corporation's past decades. Moore's most recent work, Zone to Win, explores the challenges great companies face when embracing disruption innovation, even when it is in their best interest to do so.



Simply put, Moore wants to say that chasm is a phase where there is a difference in the way of adoption among consumers in the initial market who are visionary and consumers in the real market who are pragmatic. The character traits of visionary consumers prefer product innovation revolution, they are curious, dare to try to be the first. Meanwhile, the character traits of pragmatic consumers prefer the evolution of product innovation, tend to be waiting, prudent and they feel they do not have enough references to make a purchase. In this chasm area, No one to sell to! so it is no wonder that companies focus their endeavors so that their products can safely cross this chasm in the shortest time possible. Of course, fail to pass through this chasm will result in the corporation losing its embedded investment.

The increasingly sophisticated digitalization trend in the future will encourage business entities and government agencies to increase investment in technology development, including in digital infrastructure. In the face of disruption, an important step is to accept and control it through the development of the right strategy. Various studies show that digitalization has a significant impact on business continuity and strategic management of companies. For illustration, a study on digital disruption in the education sector in the UAE highlights the need for a resilience framework to protect stakeholder interests in the face of disruptions such as COVID-19 and technological disruptions (Iyer et al., 2023). Meanwhile, digital transformation in retail shows that the integration of digital technology is a priority to increase value for customers and employees, as well as manage the customer journey more effectively (Evanschitzky et al., 2020). Furthermore, another study underscores the importance of innovation in the supply chain through Digital Twin technology that can improve the visibility and resilience of future supply chain systems (Kajba et al., 2023). In addition, a study on infrastructure investment suggests that the trend of disruption requires asset managers to adopt new, more flexible approaches in dealing with this transformation trend (Gatti & Chiarella, 2020). From these studies, it can be concluded that digitalization advises strategic and operational changes in various sectors.

Investments in digital technology and infrastructure are key to ensuring business resilience amid evolving disruptions. As such, organizations need to adopt a proactive and planned approach to managing risk and capitalizing on the opportunities presented by digital disruption.

The era of disruption that we are facing today, triggered by the rapid development of technology, has fundamentally changed various aspects of life. The innovation needed is not just a change in the shape, size, or design of the product, but a comprehensive change that includes work methods, operational methods, and the product itself to remain relevant in this millennial era. Innovation must be carried out holistically and thoroughly, covering every aspect from the production process to the business model, to remain competitive and relevant in the face of evolving challenges. Research shows that technological disruption affects not only large industries but also SMEs. A study by (Roblek et al., 2021) found that digital transformation as a disruptive innovation has a significant impact on product and process development methods in SMEs and requires changes in organizational culture and the development of new production concepts. In addition, (Khan, 2020) in his research on restaurant services shows how technological innovations, especially in food delivery services, have changed the classification of restaurant services and presented new challenges in service quality. Furthermore, disruptive innovation not only affects operational aspects but also has an impact on business models. (Cozmiuc & Petrisor, 2019) emphasized that innovative business models are key in the face of digital disruption, where companies must be able to adapt quickly and creatively to survive the increasingly fierce competition. Another study by (Sundarrajan & Krishnan, 2023) highlights how disruptive technologies in the automotive industry have transformed work practices, increased contractor engagement, and encouraged innovation and creativity in the production process. This shows that technological disruption affects not only the final product but also the internal processes of the organization.

Disruption does present great challenges for companies, but it also presents a great opportunity to create greater value for consumers. By understanding and leveraging the power of this disruption, companies can continue to grow and maintain their relevance in the market. Disruption can be seen as something positive because it is a dynamic innovation that gives more power to consumers. In recent years, disruption has changed the way industries and businesses operate, creating products and services that better suit the needs of today's consumers. Research shows that disruptive innovations not only shake up the market but also provide new value for consumers. For illustration, research by (Nwoye Obi, 2023) highlights that

innovation disruption creates a new phenomenon that ultimately provides added value for both consumers and society. Meanwhile, (Cruz-Sanchez et al., 2020) argue that innovation disruption requires the dynamic ability of companies to identify and capitalize on emerging opportunities from new markets and new technologies, all of which focus on increasing competitive advantage in a highly dynamic environment. Furthermore, disruptive innovations have also shifted the consumer value system. According to (Schmidt & Scaringella, 2020) research, innovation in the value proposition is often a full mediator among dynamic capabilities and disruptive innovation, demonstrating the importance of business model innovation in responding to disruption dynamics. In addition, (Wyk et al., 2022) emphasized that more informed and empowered consumers are now encouraging companies to continue to innovate to survive the increasingly fierce competition.

The power is held by consumers through digital communication channels, product personalization, and digital ancillary services, forcing companies to continue to innovate and adapt to stay competitive and relevant in the global market. As power passes into the hands of consumers, a few new challenges arise. One of them is the ability of consumers to communicate and interact through various channels, including personalization of products and services through the implementation of feedback from consumers into the design of products and services. In addition, global cost comparisons and digital ancillary services also play an important role in influencing market opinion globally. Studies show that online consumer feedback can influence pricing decisions and product design in a decentralized supply chain. For illustration, research by (Li et al., 2021) identified that intra-brand competition triggered by consumer feedback can lead to conflicts among sellers and platform manufacturers, especially when consumers' assessment of new products is not high enough. In addition, (Wang et al., 2024) showed that the effect of consumer reference prices has varying impacts on prices, channel demand, and revenues for both producers and retailers in dual supply chains. On the other hand, the ability for consumers to compare prices globally through digital channels has prompted companies to be more cautious in their pricing strategies. A study by (Ronayne & Taylor, 2022) found that increasing the size of cost comparison channels can increase competition within those channels, but it can also weaken competition among channels, ultimately harming consumers by raising prices. Furthermore, digitalization and the addition of digital services have significantly affected consumer behavior. A study by (Kaur & Tailor, 2023) shows that digital marketing through social media, SEO, and SEM has the most significant influence on consumer behavior, especially in the evaluation stage of purchasing decisions.

To succeed in an era of disruption, a paradigm shift involving rapid adoption of new innovations is needed, as well as close collaboration among innovators, entrepreneurs, and regulators to ensure that emerging challenges can be effectively addressed, and existing opportunities can be optimally utilized. In the current era of technological disruption, a paradigm shift is needed regarding the innovation platform that will be used. The old mindset that hinders innovation stakeholders will only result in defeat in the face of disruption. The main challenge of disruption is the large number of individuals, including innovators, entrepreneurs, and regulators, who do not fully understand what is happening today. Research shows that technological disruption forces companies to adapt quickly or face the risk of falling behind. For illustration, research by (Wijaya, 2023) highlights that the entrepreneurial paradigm that emerges in the era of disruption emphasizes the importance of flexibility and deep innovation, where entrepreneurs must be prepared to face unexpected market changes and increasing competition. Additionally, a study by (Odey & Eno Willie, 2023) underscores how disruptive innovation in emerging markets can drive more radical entrepreneurial innovation than incremental ones, which is critical to navigating new business opportunities in emerging markets. Furthermore, regulators also face major challenges in responding to technological disruptions. (Al Kautsar, 2021) emphasizes that innovation disruption is changing the way producers and consumers interact in the market, which requires changes in regulatory policies to balance the interests among innovation and consumer protection. (Hinmikaiye et al., 2021) also identified that the regulatory response to disruptive technologies in Nigeria needs to be improved to balance the benefits brought by new technologies with the interests of the wider community.

The disruption presented by this online-based application corporation does disrupt conventional business, but on the other hand, it also opens new opportunities for innovation and growth in the digital economy in Indonesia. The answer to these disruptions must include rapid adaptation from all stakeholders to ensure that these changes bring benefits to the economy. The emergence of online-based application companies such as Go-Jek, Bukalapak, Tokopedia, and Traveloka has brought major disruption to conventional businesses that have existed before in Indonesia. Many parties, especially those from traditional industries, feel disturbed and reject the presence of these companies, because they are damaging to established business models. Studies show that these companies have successfully changed the way businesses are conducted by leveraging digital technology to create new markets and break down existing boundaries. (Rofii, 2020) discusses how companies such as Go-Jek and Tokopedia have grown into large companies

with high valuations, attracted foreign investment, and transformed the digital business ecosystem in Indonesia. However, new challenges have emerged, especially related to cyber threats that can disrupt this rapidly growing digital industry. In addition, (Gunawan, 2022) in his research shows that ecommerce startups such as Bukalapak and Gojek have become saviors for MSMEs during the COVID-19 pandemic, where many MSMEs that previously relied on offline sales switched to online platforms to maintain their businesses. However, with the increasingly fierce competition and reduced promotional funds, major challenges arise for these startups to remain viable and profitable. Another study by (Almunawar et al., 2020) highlights that the digital market in Indonesia, supported by high internet penetration, has created a fertile platform for the development of new startups. However, digitalization also poses its own challenges, especially in the adaptation of small business actors to this new technology.

To answer the challenges in this era, universities in Indonesia must adopt a paradigm shift that emphasizes knowledge development, collaboration, and innovation oriented toward solving real problems in society. In the era of technological disruption, a paradigm shift in the innovation process is urgently needed, especially in universities in Indonesia. Some important aspects that should be the focus in universities today are: 1) a culture of building knowledge; 2) collaborative work; and 3) the provision of solutions to community problems. Research shows that a change in the scientific paradigm in higher education, such as the one that occurred in several State Islamic Universities in Indonesia, requires a broader integration of science and different models of institutional transformation, which can significantly improve the multidisciplinary scientific structure and expand the authority of the faculty to develop new study programs (Muthohar et al., 2023). Furthermore, the introduction of a collaborative culture in higher education institutions is key in facing sustainability challenges and achieving the sustainable development goals (SDGs). (Wright et al., 2022) show that by building collaborative infrastructure designed to achieve the SDGs, universities can better face unique social, economic, and cultural challenges. In addition, a study by (Mariam et al., 2020) on the application of the concept of collaborative knowledge creation in Polytechnics shows that this collaboration can produce more creative and innovative learning, which is very important to increase organizational competitiveness and prepare graduates who are ready to face the needs of the industry. To provide solutions to societal problems, social innovation in higher education needs to be strengthened through active methodologies that allow students to play a more dynamic role in the learning

process and in creating real solutions to social challenges (Dieguez et al., 2022).

1.2. Disruptive Innovation

The term disruptive innovation was first introduced by Clayton M. Christensen and Joseph Bower in an article "Disruptive Technologies: Catching the Wave" published in the Harvard Business Review journal in 1995. This article is intended for executives who determine funding and purchases in the corporation regarding the corporation's future earnings. In the book "The Innovator's Dilemma," Christensen introduces the disruptive innovation Model, in which the customer's ability to take advantage of something new is divided into categories. The lowest category consists of customers who are satisfied quickly, while the highest category describes more demanding customers. The distribution of customers in this median can be taken as a dotted line to implement new technologies. More recent research on disruptive innovation shows how the concept continues to evolve and is gaining widespread attention in business theory and industry practice. (Steven et al., 2020) investigated the evolution of disruptive innovation theory and how it has been applied in various industry contexts over more than two decades. In addition, research by (Viltard, 2021) shows that a deep understanding of disruptive innovation theory and Job-To-Be-Done Theory can help companies reach more customers with more customized products and develop markets and organizations more broadly. The research also shows the challenges faced by companies in adopting disruptive innovation. (Lee & Csaszar, 2019) examines how cognitive and structural factors affect a corporation's adaptation to disruptive innovation, especially in the video game industry. Furthermore, research on the impact of disruptive innovation in emerging economies shows how new technologies are changing the way entrepreneurs innovate. (Odey & Eno Willie, 2023) states that new market disruption has a significant impact on entrepreneurial innovation in Nigeria, where these innovations must be radically designed to capture new business opportunities. The disruptive innovation theory developed by Christensen not only remains relevant but also continues to evolve to face new challenges in various industry sectors. These disruptive innovations require a deep understanding of customer behavior and new technology deployment strategies to successfully shift incumbent players in the market.

Wikipedia is a clear illustration of a disruptive innovation that has disrupted the traditional (print) encyclopedia market. Nowadays, it is difficult to fine print encyclopedias sold in bookstores, as most people have turned to Wikipedia. Traditional encyclopedias that used to cost millions of rupiah are

now eliminated by Wikipedia which offers information for free. Therefore, Wikipedia is called "disrupting" pre-existing print encyclopedias. Research reveals that Wikipedia meets the key criteria of disruptive innovation by being simple, convenient, free, and easy to use. (Flavin, 2020) in his research stated that Wikipedia has changed academic practice, becoming the main source of information for both students and lecturers, although there are still institutional alternatives that are often expensive. This shows how Wikipedia has managed to integrate itself as a support tool in academic work despite being considered less academically superior. (Kharlov, 2021) also acknowledges that disruptive innovations such as Wikipedia often succeed not only because of factors directly related to the theory of disruption, but also because of the random factors that support the success of this disruption, regardless of the strategic choices of the incumbents. In this context, Wikipedia has succeeded in replacing traditional encyclopedias by offering products that are more suitable for the needs of modern users. Furthermore, (Flavin, 2021) in another study discusses how technologies that improve learning, including Wikipedia, can be seen as disruptive innovations that have the potential to transform higher education even though there has not been a full major disruption in this sector. Wikipedia as a disruptive innovation has transformed the global information landscape, offering easier, faster, and free access to information that was previously available in expensive print formats. These changes reflect how disruptive innovations can overhaul traditional markets and create new models that are more relevant in the digital age.

Disruptive innovations have played a crucial role in transforming markets and technologies across various sectors. Here are some illustrations of disruptive innovations that have overhauled traditional markets:

- Print Encyclopedias which were replaced by Wikipedia innovations. Wikipedia, with its internet-based collaborative model, offers easily accessible and free information, replacing print encyclopedias that are expensive and limited in their distribution (Flavin, 2020).
- The Telegraphy was replaced by the Telephone. Telephone innovations introduced a more efficient way of communicating, replacing telegraph technology that was slower and limited in its capacity.
- Mainframe computers (Mainframes) were replaced by Minicomputers, which were then also replaced by Personal Computers (PCs). These technological developments allow for wider and more flexible access to computing, which was previously limited to large companies (Kharlov, 2021).
- Floppy Disks have been replaced by CD and USB innovations that offer greater storage capacity and better durability, shifting the use of diskettes that have limitations in capacity and data transfer speed.

- Cathode ray tubes (CRTs) are being replaced by LCDs. LCD screens provide better image quality with lower energy consumption, as well as a slimmer design compared to CRTs (Hung & Lai, 2024).
- Metals & Wood are being replaced by lighter, more flexible, and cheaper Plastics, replacing traditional materials in many industrial applications.
- Radiography (X-Ray Imaging) is replaced by Ultrasound (Ultrasound). Ultrasound offers a non-invasive, safe, and faster diagnostic method compared to X-ray, especially for soft tissue examination (Khatab & Yousef, 2021).
- CDs and DVDs are being replaced by Digital Media such as iTunes and Amazon which allow the distribution of music and video content online, eliminating the need for physical media.
- Film Cameras have been replaced by Digital Cameras that offer ease in taking, storing, and distributing photos without the need for a film process.
- Offset Printing has been replaced by Computer Printers that allow fast and efficient printing on the spot without the need for large printing services.
- Traditional Publishing has been replaced by Desktop Publishing which allows individuals to design and print their own documents using PCs (Ho, 2022).
- Horse and Rail trains are being replaced by Cars that offer more flexible and efficient individual mobility, changing the way transportation is done around the world.

These disruptive innovations show how new technologies can replace traditional methods and products, create new markets and transform people's way of living and working.

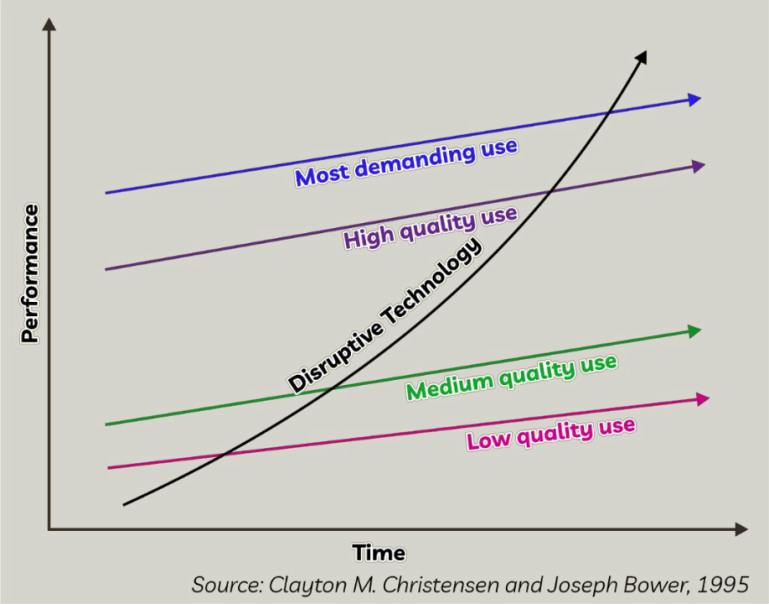


Figure 1.2. Disruptive technology

Disruptive technologies continue to transform a wide range of industries, from energy to education and finance. This development underscores the importance of adaptation and innovation in the face of rapid technological change. The concept of disruptive technology was first popularized by Clayton M. Christensen (figure 1.2).

1. Disruptive Technology: Disruptive technology is an innovation that changes or replaces existing technology, often in a simpler, more affordable, and more efficient way. This technology may not initially meet the needs of the main market, but over time, it has improved and displaced existing technologies.
2. Low Quality Use: Disruptive technologies first emerged to serve markets with lower performance requirements (low quality use). At this stage, the technology is not yet sophisticated enough to meet the higher demands of the market.
3. Medium Quality Use: As disruptive technologies develop, they commence to meet the needs of the market with intermediate quality. This is the stage where the technology is starting to gain traction in the wider market.
4. High Quality Use: Disruptive technologies are finally reaching a level where they can compete with existing technologies in performance for high quality applications. At this point, the technology is starting to take over market share from established technologies.
5. Most Demanding Use: Ultimately, disruptive technologies become so good that they can serve the most demanding applications, completely replacing existing technologies.

Disruptive Technologies in the energy industry, technologies such as renewable energy (*e.g.,* solar and wind) have become disruptive in the energy sector, replacing fossil fuels in many applications. Studies show that the adoption of this technology is increasing exponentially along with decreasing costs and increasing efficiency (Zhou et al., 2021). In the health industry, technological disruption in the health sector is mainly seen in the advancement of telemedicine and AI-based medical technology. This technology is changing the way healthcare is delivered, making it more affordable and accessible to a wider population (Haleem et al., 2022). Education, online education and adaptive learning technologies are other illustrations of disruptive technologies. Studies indicate that online learning can effectively replace or complement traditional education, especially in situations such as the COVID-19 pandemic (Jena, 2020). Transportation, electric vehicles (EV) are disruptive technologies that change the automotive industry significantly. Improvements in battery efficiency and charging infrastructure are making electric vehicles increasingly attractive to consumers, shifting fossil fuel vehicles (Li et al., 2021). Financial Technology

(Fintech), blockchain and cryptocurrency are disruptive technologies that challenge the traditional financial system. Studies show that this technology, while still evolving, has the potential to disrupt global banking and financial services (Risius & Spohrer, 2020).

The innovations made by Apple in the 1980s (figure 1.3.) played a significant role in changing the face of the computer industry. By creating smaller, more affordable PCs, Apple not only made the technology more accessible to ordinary consumers, but also drove the rapid advancements in the tech industry that we still feel today. Innovations made by Apple in the 1980s, especially in the development of PCs, brought a significant impact on the technology industry. Apple managed to change the paradigm in the industry by introducing smaller, more affordable, and more accessible computer devices to the public, compared to previous computers that cost hundreds of thousands of dollars.

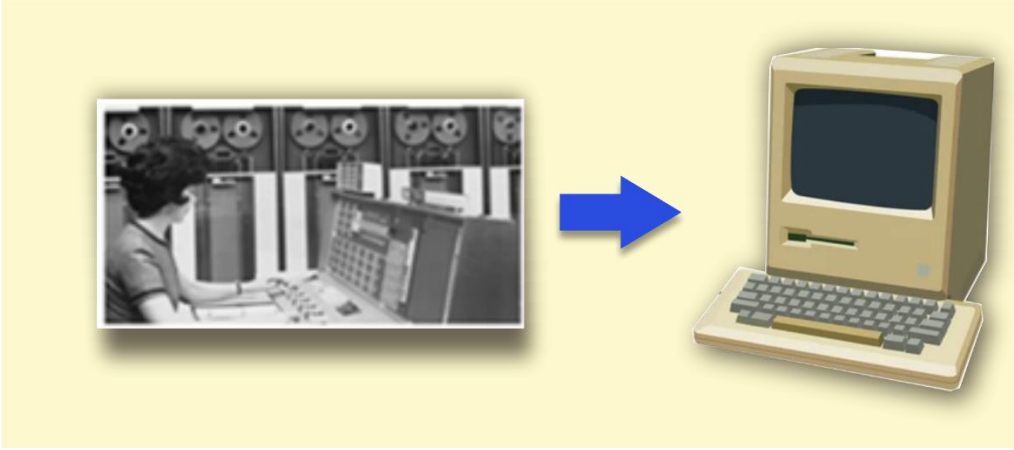


Figure 1.3. Disruption of computer technology by Apple.

Innovation disruption by Apple in the 1980s, Apple played an important role in initiating innovation disruption in the computer industry in the 1980s. At that time, computers were generally used by limited groups such as governments and large corporations, with very high prices and large sizes. However, Apple changed this by introducing PCs designed for general consumers, making them more affordable and practical to use at home as well as in the office (Sathiyaa et al., 2022). Creating a More Accessible PC, through products such as the Apple II and Macintosh, Apple presents smaller and simpler PCs, but still powerful. This innovation not only makes computer technology more affordable for ordinary consumers, but also drives the growth of the large personal computer market and paves the way for the development of wider software and applications (Gratton, 2021). Apple's positive influence on the computer industry, Apple's influence in the computer

industry continues to this day. Apple's contribution to making technology more accessible to the wider public has inspired many other tech companies to develop more innovative and user-friendly products. In the long term, this step helps drive faster innovation in the technology industry, including in software development, user interface design, and overall user experience (Yousaf et al., 2021).

Blockbuster and Netflix are often used as case studies to understand how disruptive innovation a determining factor in a corporation's success or failure can be. In 2000, Blockbuster was a giant in the movie rental industry with thousands of brick-and-mortar stores around the world, while Netflix was just starting out as a small corporation offering DVD rental services by mail. However, in just ten years, Blockbuster filed for bankruptcy in 2010, while Netflix grew into a multibillion-dollar corporation. Research shows that one of the main reasons for Blockbuster's failure is the corporation's inability to adapt to technological changes and consumer preferences that are increasingly geared toward digitalization. Blockbuster is sticking to the old business model of relying on physical stores, although there have been clear signals that market demand is starting to shift to online streaming services. In this case, Blockbuster has failed to innovate business models that are crucial to survive in the digital era (Adam, 2021). Instead, Netflix quickly realized the potential of digital technology and switched from a DVD rental service to a subscription-based streaming platform. Netflix's business model innovations, including the use of algorithms to personalize content, have succeeded in attracting consumers from all walks of life and increasing customer loyalty. This transformation of the business model has not only allowed Netflix to survive but also become a market leader in the digital entertainment industry (Smith & Taylor, 2022). Other research shows that Blockbuster's decide to reject a partnership with Netflix in 2000 was one of the biggest strategic blunders. This decision is based on Blockbuster's belief that their traditional business model is still relevant, without considering the potential for rapid changes in technology and consumer behavior (Jones, 2023). In this comparison, the ability to innovate and adapt to change is key to surviving in an ever-evolving industry. Netflix managed to identify and capitalize on the opportunities generated by disruptive innovation, while Blockbuster failed to respond to those changes and was eventually eroded by more adaptive competition.

Companies like BlackBerry, Borders, and Kodak have suffered major failures because they have not been able to recognize changes in the wants and needs of customers who are better served by other companies that choose to change their business models. These three companies are classic illustrations of how technological disruption can destroy businesses that fail

to adapt to rapid change. Disruption is not a one-time act, but rather an ongoing evolution that requires the ability to constantly adjust business models to stay relevant. BlackBerry, for illustration, once dominated the smartphone market with its encrypted email feature, but failed to adapt as touchscreen smartphones with a rich ecosystem of apps became popular. BlackBerry focused too much on its strength in the corporate sector and ignored broader trends in the consumer market, which ultimately led to a drastic decline in their market share (Metzler, 2021). Borders, once one of the largest book retailers, fails to see the importance of the shift toward online shopping. They ignored the potential of ecommerce and even handed over their online operations to Amazon in 2001. When Borders tried to catch up by launching their own online platform, it was too late; consumers have switched to more convenient and cheaper online shopping (Verses, 2020). Kodak is another illustration where a corporation that dominated the photographic film market failed to adapt to the shift toward digital photography. Although Kodak is one of the pioneers in digital photography technology, they fear that digital products will cannibalize their profitable film business. This failure led to the bankruptcy of Kodak, while other, more agile companies such as Canon and Nikon managed to dominate the digital camera market (Schmidt & Scaringella, 2020). From these cases, disruption is not something that can be avoided with a one-time innovation. Instead, companies need to adopt a more dynamic and adaptive approach to market and technological changes. Business models must evolve continuously, considering the changing needs and preferences of customers, as well as by taking advantage of new emerging technologies. Disruption requires companies to continue to innovate and anticipate future trends to remain competitive and relevant in an increasingly dynamic global market.

The emergence of online-based application companies such as Go-Jek, Bukalapak, Tokopedia, Traveloka, and others has disrupted conventional businesses that existed before. The presence of these companies brings about a major change in the way transactions and services are conducted, focusing on efficiency, convenience, and accessibility through digital technology. However, this disruption also presents significant challenges for traditional businesses, which are often unprepared for these rapid changes. As a result, many parties feel disturbed and reject the presence of this application corporation. One illustration of the positive impact of this disruption is on the Micro, Small, and Medium Enterprises (MSMEs) sector in Indonesia. Platforms such as Tokopedia and Bukalapak have given MSMEs access to a wider market without having to rely on physical stores, especially during the COVID-19 pandemic, where many MSMEs have been able to survive through online sales

(Gunawan, 2022). However, on the other hand, the presence of online transportation such as Go-Jek has also triggered conflicts with conventional transportation, such as base motorcycle taxis and city transportation (angkot), which feel threatened by cheaper fares and more accessible services offered by online applications. This conflict shows significant resistance to innovation that comes from new technology-based businesses (Kania et al., 2020). Furthermore, the issue of personal data security has become a major concern with the emergence of startup companies such as Tokopedia, Bukalapak, and Traveloka. With the increasing use of online applications, the problem of personal data leaks is becoming more and more frequent, which raises concerns among users and drives the need for stricter regulations in personal data protection (Ameliani, 2021). Although online-based application companies have brought significant innovation and economic benefits to many parties, especially consumers and MSMEs, they also face resistance from conventional businesses and challenges in regulation and data security. Adaptation and collaboration among traditional businesses and digital innovators is essential to ensure that the benefits of this disruption can be widely enjoyed, while minimizing its negative impact on society.

In the current era of technological disruption, innovation has undergone significant changes characterized by acceleration, openness, and its increasingly disruptive nature. This change creates an environment where disruption no longer comes from traditional competitors, but rather from "garage" projects or startups created by passionate entrepreneurs. These innovators often start with inexpensive components to solve their problems quickly, without the ultimate goal of making money. The most well-known illustrations are companies such as Google, Facebook, Airbnb, Go-Jek, Bukalapak, Tokopedia, and Traveloka. These disruptive innovations have radically transformed various industrial sectors. For illustration, Go-Jek has changed the transportation landscape in Indonesia by offering fast and efficient services through mobile apps, which not only makes it easier for consumers but also increases economic opportunities for traditional motorcycle taxi drivers (Radhi & Pramuditya, 2021). Similarly, Bukalapak and Tokopedia have changed the way people shop by allowing anyone to open an online store and reach a wider market, which is especially beneficial for SMEs in Indonesia (Gunawan, 2022). The speed of innovation is also driven by the ability to access information in real-time through digital technology, which allows for the development of new products and services more quickly. The innovations that emerge from these startups are often more responsive to changing consumer needs, and they tend to be bolder in taking risks than traditional companies (Febriany et al., 2022). However, the disruption brought

by these companies also poses new challenges, such as the need for stricter regulations related to personal data protection and cybersecurity. As these technology companies grow, the problem of personal data leaks and cyber threats is becoming more and more frequent, which requires a more sophisticated regulatory approach to protect consumers (Ameliani, 2021). The nature of innovation in this era of technological disruption has changed to be faster, more open, and disruptive, creating new challenges and opportunities for industry and society. The innovations that emerge from these startups not only change the way we live and work, but also demand rapid adaptation and better regulation to ensure that the benefits can be enjoyed by all.

Blockbuster Bankruptcy

Blockbuster is an American provider of home video game and movie rental services through video rental stores, DVD-by-mail, streaming, video on demand, and cinemas.

Blockbusters expanded internationally throughout the 1990s. At its peak in 2004, Blockbuster employed 84,300 people worldwide, including about 58,500 in the United States and about 25,800 in other countries, and had a total of 9,094 stores, with more than 4,500 in the US.

Competition from messaging service Netflix, automated kiosk Redbox, and video on demand services was a major factor in Blockbuster's demise. Blockbuster began to lose significant revenue during the 2000s, and in 2010, the corporation filed for bankruptcy protection. The following year, the remaining 1,700 stores were purchased by satellite television provider Dish Network. In November 2013, the last 300 corporation-owned stores closed.

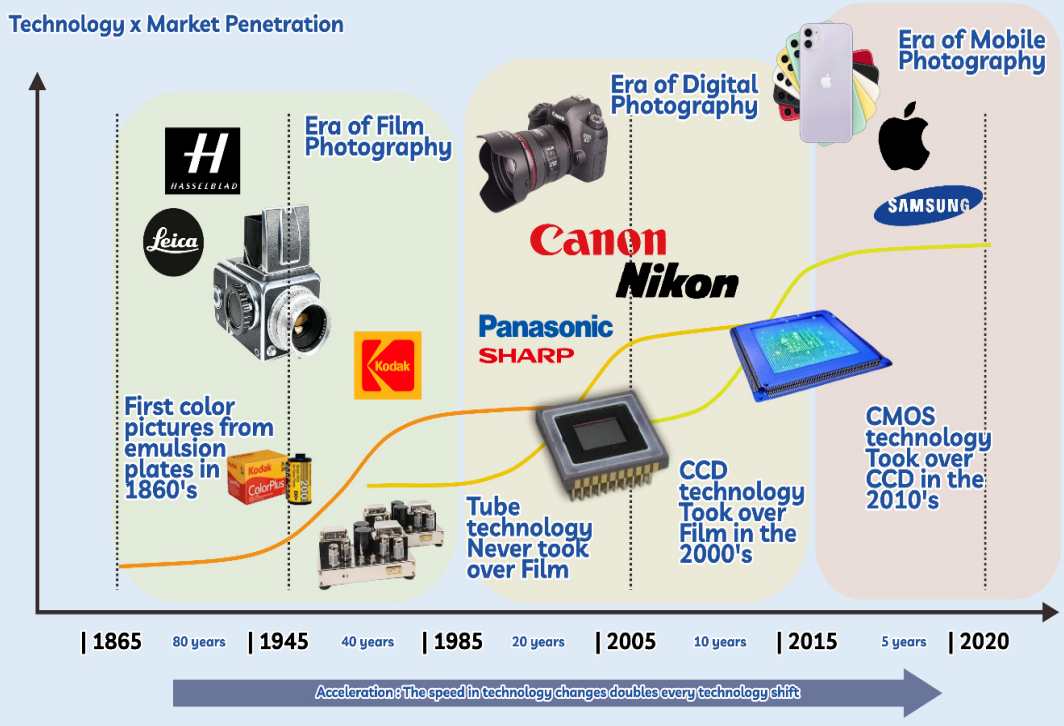
While the Blockbuster brand has largely retired, Dish maintains a few Blockbuster franchise agreements, allowing some stores to remain open. Ultimately only two stores remained open in early 2019, one in Bend, Oregon, and another in Morley, Western Australia, which will close at the terminate of March 2019.

Kodak Bankruptcy

If we were born in the 1990s, we might still remember this brand. We can still find remnants of Kodak's glory in old school photo studios or kiosks that offer photo printing services. Usually, the Kodak brand is displayed in their stores. Kodak is an illustration of a corporation that failed because it did not dare to initiate change.

The corporation, which was founded in 1888 by George Eastman, was very popular in the 1980s. Even in Indonesia, Kodak remained popular until the mid-1990s. However, signs of Kodak's downfall were visible when Kodak announced a 73% decline in profits in the first quarter of 1983.

In fact, Kodak already had the technology to make digital cameras in 1975. However, for afraid of killing its photo film roll business, the digital product was deliberately not launched. In 2009, Kodak announced it was discontinuing production of its roll photo film after being on the market for 74 years.



The Demise of Conventional Taxis

The meter system is considered an outdated system. People turn to Go-Jek and Grab because of the fixed cost system based on the distance shown on the map. Without having to arrive at the destination, we already know the costs that must be paid. People certainly tend to choose practical and economic.

Unlike the Blue Bird taxi, which still uses the meter system. If the driver deliberately takes a longer route, the fare will be more expensive. Especially if we do not know the way or tourists who ride the Blue Bird. So, the system offered by Blue Bird will gradually be abandoned. Unless Blue Bird changes the meter system to a fixed cost system. Source: Pefindo, 2016.

1.3. New Product Life Cycle

Technology disruption not only accelerates the lifecycle of new products, but it also changes the way companies respond to markets and manage innovation. Success in the modern market is no longer determined by success in introducing new products, but by the ability to continuously adapt and optimize products based on feedback and rapid technological developments. In the era of technological disruption, the life cycle of new products has undergone significant changes, which can now be simplified into three basic stages, development, deployment, and replacement. This change is in line with Gordon Moore's prediction in 1965 that the computing speed of microprocessors will double every two years. This has an impact on accelerating the cycle rate of new products, where innovators can now increase their strength exponentially, which also accelerates the rate of disruption in the market. The accelerating product life cycle is also influenced by the development of digital technology and Product Lifecycle Management (PLM) management methodologies. Studies show that the integration of product lifecycle management with data-driven approaches, such as those implemented by companies such as Amazon and Uber, allows organizations to accelerate the process of developing and deploying new products more efficiently (Subramoniam et al., 2021). Moore's Law, which was originally associated with the development of microprocessors, is now an indicator of the broader pace of product innovation. This is reflected in the adoption of disruptive technologies that are no longer defined by success in "bridging the gap" of marketing as proposed by Geoffrey Moore in "Crossing the Chasm". Instead, disruption is now more determined by the corporation's ability to respond quickly to previous product failures and use the learnings from those

failures to introduce better and faster solutions to the market (Udokporo, 2021). In addition, the rapid innovation process also reduces the time among the development and deployment stages, which means that new products must be prepared for replacement or upgrade immediately after launch. This requires companies to constantly innovate and adapt to real-time market feedback, optimizing product design and implementation processes to maintain their competitiveness (Chen & Wang, 2021).

The launch of innovative products that initially seemed impressive, but did not succeed in achieving success, such as the Magnavox Odyssey (home gaming), Apple Newton (tablet computing), Napster (digital music), Betamax (home video recording), and the first generation of electric cars, are illustrations of important momentum in the history of innovation. These products presented technology that was ahead of its time, but failed to gain wide market acceptance at the time of its launch. However, as time goes by and technology costs decrease, these products become more commercially viable, ultimately catering to more sophisticated consumer tastes. One of the main reasons for the fail of these products is that they were launched before the technology that supports them reached a point of maturity that allowed for competitive production costs and wider consumer acceptance. In these cases, companies that choose to wait for the market to develop before entering the market as fast followers often find that this strategy is no longer relevant. As the technology matures and production costs decrease, new players or the first innovators who are able to adapt quickly gain significant advantages that late entrants to the market cannot achieve (Reshetilova & Kuvaieva, 2021). For illustration, Apple Newton was a pioneer in tablet computing, but it failed because the technology and the market were not ready for mass adoption at the time. In contrast, when the iPad was launched a few years later, touchscreen and processor technology had advanced quite a bit, allowing the iPad to become a very successful product. This case shows that while early innovative products may fail, they can pave the way for future success when technology and markets have evolved (Kim et al., 2022). In addition, the initial launch of these products also often faces challenges related to lack of market understanding and consumer behavior. Fail to anticipate market needs can lead to innovations that are technically overwhelming but commercially unsuccessful. Studies show that a deep understanding of consumer preferences is key to successful product innovation in the market (Talwar et al., 2020). Innovative product launches that seem to fail at first are often an important step in the process of technological evolution. As technology costs fall and the market becomes more prepared,

those products can achieve success, while companies that wait too long to enter the market may find themselves lagging behind the first innovators.

Innovation diffusion theory remains relevant in understanding the technology adoption process, but the phenomenon of big-bang disruption shows that big innovation can significantly accelerate the adoption cycle, forcing companies to innovate faster and be more responsive to market changes.

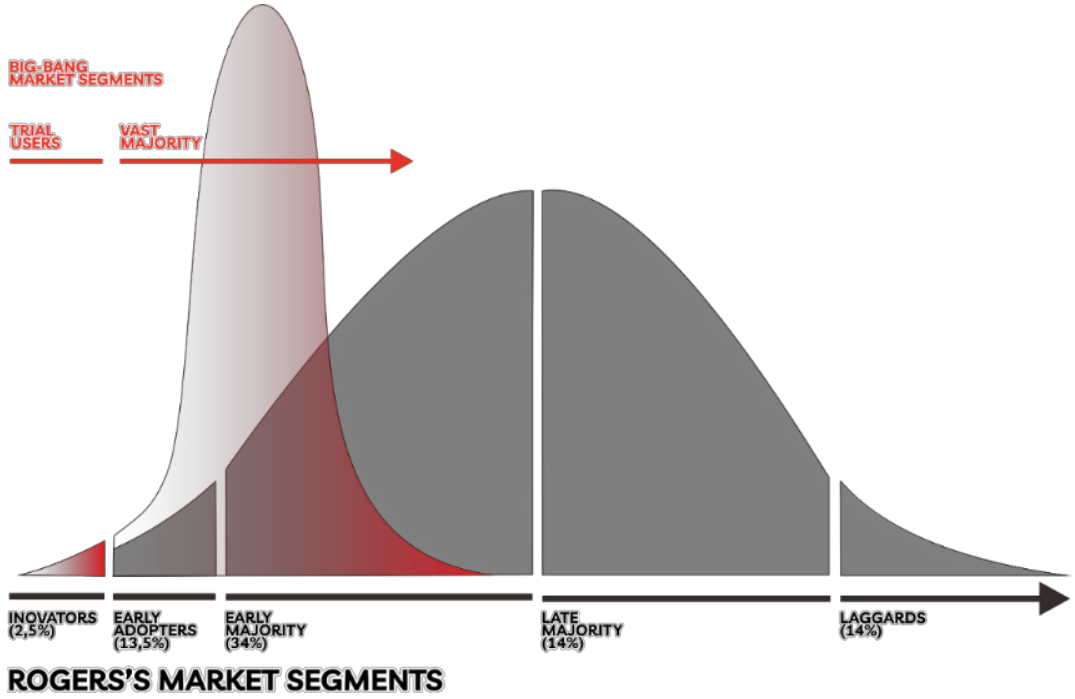


Figure 1.4. Big-bang market segments (Larry Downes & Paul Nunes, 2013).

In the world of innovation, the innovation diffusion theory put forward by Everett Rogers is the dominant model that explains how the adoption of new technologies spreads in the population. According to this theory, the adoption of innovation follows a normal curve known as the "*bell curve*" (figure 1.4). This curve depicts five different groups of adoption innovators, early adopters, early majority, late majority, and laggards. Innovators were the first group to adopt innovation, representing about 2.5% of the population. They are usually individuals who are very interested in new technologies and have a high tolerance for risk. This group is followed by early adopters (13.5%), who are often the opinion leaders and help accelerate the adoption of new technologies by the next group. The early majority (34%) and late majority (34%) are the more conservative groups, which require proof of success before they adopt innovation. Finally, laggards (16%) are the slowest group to adopt innovations, often only after the technology has become an industry or social standard (Dale et al., 2021). Larry Downes and Paul Nunes (2013) proposed

the concept of "big-bang disruption" which describes how the market can be divided into these segments, but at a much faster pace of adoption than before. Major innovations can cause entire market segments, from innovators to laggards, to be adopted almost simultaneously, known as the big-bang adoption phenomenon. This is very different from the traditional innovation diffusion pattern that follows a normal curve. In this context, disruptive technologies often accelerate the pace of adoption across all market segments at once, mainly due to the decline in the cost of technology and the increased availability of information that accelerates decision-making by consumers. The strategy of waiting for the market to develop and hoping to become a fast follower has become irrelevant in this era, as big innovations can quickly dominate the market before traditional competitors have a chance to adapt (Iqbal & Zahidie, 2021).

Big-bang disruption is a phenomenon that is different from the traditional innovation adoption pattern described by Everett Rogers. According to Rogers, innovation adoption typically follows a normal curve with five different market segments innovators, early adopters, early majority, late majority, and laggards. In this model, the adoption of new technologies takes place gradually, starting from the innovator segment until finally reaching laggards, which are the last group to adopt innovation. However, big-bang disruption does not follow this pattern. Innovation in big-bang disruption is often developed and adopted very quickly by most markets, without going through a gradual adoption phase. In the big-bang disruption model, new products are often tested with a few early adopters, but once they are polished and refined, they are quickly accepted by the wider market. This makes the adoption curve on big-bang disruptions higher and denser, suggesting that product adoption occurs almost simultaneously across all market segments (Allaway et al., 2022). In comparison, on the traditional model described by Rogers, companies can rely on a gradual approach to introduce innovation and develop different marketing strategies for each market segment. However, in a big-bang disruption, companies must be ready to launch products that can be immediately accepted by the entire market. Traditional strategies, such as waiting until technology matures and becoming a fast follower, become less relevant in this context because change happens so quickly that companies that do not react quickly can fall behind and lose significant market share (Frasquet et al., 2020). Big-bang disruption requires companies to be more flexible and quicker in adopting and marketing innovations. With a faster and denser adoption curve, companies must be prepared to face major disruptions that could change the industrial landscape

in a short period of time. Traditional models that rely on gradual adoption may no longer be enough to survive in this era of technology-driven disruption.

Figure 1.5. People cue to buy the new iPhone XS Max in Singapore (source: © Apple 2018)

In the world of innovation, the adoption model described by Geoffrey Moore in "Crossing the Chasm" (1991) has long been used to understand how new technologies are adopted by the market. According to Moore, the main challenge in marketing new products is bridging the gap among "early adopters" and "early majority." Marketing strategies must be carefully tailored to each of these market segments to ensure that new products are not only adopted by early innovators, but also by the majority of the broader market. However, the phenomenon of big-bang disruption has changed this paradigm significantly. Powerful disruptive innovations, such as iPad, do not require a phased approach to achieve broad market adoption. Instead, a product like this can be launched with near-instant success across all market segments, from innovators to laggards, without going through a sequential process as Moore explains. This phenomenon shows that disruptive products are not only attractive to one specific group of consumers but can immediately attract the interest of the entire market, including groups that are usually slower in adopting new technologies (Ho, 2021). A clear illustration is the launch of the iPad by Apple (figure 1.5). This product is not only aimed at those looking for a cheap alternative to laptops, but it also attracts the interest of millions of consumers, including those who can allow premium products. This marketing strategy that embraces the entire market segment reflects a shift from the

traditional model to the big-bang model, where technology adoption can occur massively and rapidly across market demographics (Sun & Lin, 2021). Thus, in the era of digital disruption, the strategy of waiting for the market to mature and then trying to become a quick follower is becoming increasingly irrelevant. Disruptive innovation requires the readiness to aggressively enter the market and create a significant impact from the start, without having to rely on the phased strategy described by Moore (Ritala et al., 2021). Big-bang disruption demands a new approach in marketing strategies and technology adoption, where innovative products must be ready to be adopted by the market simultaneously and widely, without going through the traditional adoption phase that requires a bridge among the initial user group and the early majority.

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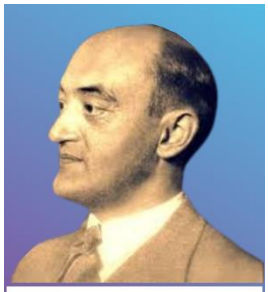
Chapter 2
BASIC UNDERSTANDING OF INNOVATION

Jumain Appe, Wihatmoko Waskitoaji

2.1. Innovation Concept

Innovation according to the Great Dictionary of Indonesian (GDI) is an invention that is different from what already exists or is known previously, either in the form of ideas, methods, or tools. This definition emphasizes that innovation is not just the development or improvement of something that already exists, but must have a significant element of novelty and be different from what has been known or applied before. Innovation can encompass various fields, such as technology, business, education, and others, and is often a major driver of change and development in various sectors.

1. Definition According to Joseph Schumpeter (1942)



Joseph Schumpeter (1942)

Joseph Schumpeter (1942) defined innovation as introducing new products, and new production methods, opening new markets, conquering new sources of supply, and applying new organizations in an industry. Schumpeter sees innovation as an important dimension of economic change, with technology often creating temporary monopolies that then face competition from imitators. This opinion is relevant today, with various studies reviewing and comparing its views with modern economic dynamics. Several recent studies further examine Schumpeter's thinking about innovation and monopoly. For illustration, (Karbowski, 2020) Reviewed Schumpeter's hypothesis regarding the relationship between market structure and corporate Research and Development (R&D) investment, and identified various controversies in the economic literature that emerged from Schumpeter's work. Moreover (Y. Zhang, 2023) Applying Schumpeter's economic model to the digital economy era, shows how digital technology contributes to the optimization of industrial structure and company management innovation. These studies confirm the relevance of Schumpeter's thinking in understanding the dynamics of innovation and monopoly in the modern economy.

2. Definition According to Paul Stoneman (1995)

Paul Stoneman (1995)

The definition of innovation as a process that involves developing new ideas into valuable products and processes, as explained in The Handbook of Economics of Innovation and Technological Change (1995), underlines the importance of innovation in creating added value in the economy. This definition is relevant in the context of the modern economy where innovation is considered a key driver of economic growth and competitiveness.

Recent studies support this view with a variety of approaches. For illustration, (Novaković et al., 2020) Highlight that innovation is the foundation of economic development, with technology and knowledge being the main drivers. Innovation is considered essential in meeting the needs of an ever-evolving market and in creating more efficient products and processes. In addition, (Malerba & McKelvey, 2020) Emphasize the importance of knowledge-based entrepreneurship in innovation, which includes the creation, diffusion, and use of knowledge to drive economic change. (Makoveieva, 2021) Also proposes a comprehensive approach to innovative development in modern companies, emphasizing the importance of integrating management systems that support innovation throughout business processes. Another study by (Perry, 2021) Offers a critique of conventional approaches in the innovation economy, emphasizing the importance of political and social factors in supporting effective innovation in developing countries. Innovation is seen as a key factor in the ever-changing dynamics of the global economy, where the diffusion of innovation plays a crucial role in spreading new technologies and driving economic growth.

3. Definition According to Crysthoper Freeman (2004)

Crysthoper Freeman (2004)

Innovation, as defined by Freeman (2004), is a corporation's effort to modify or find new ideas to continuously improve and develop products that meet customer needs through the use of technology and information. This view is particularly relevant in today's business competitive context, where the ability to innovate is a key factor in a corporation's success. Recent studies support and expand the understanding of these innovations. (Riesener et al., 2019) developed a framework for the implementation of continuous innovation in technical products, highlighting the importance of manufacturing companies to

continuously improve or update products during their use phases to remain competitive. Meanwhile, (Jin et al., 2022) emphasized that customer involvement in the new product development process can improve the performance of new products, especially when combined with the corporation's marketing and technology capabilities. In addition, a study by (Modolo et al., 2021) found that a corporation's market orientation and dynamic capabilities greatly affect the performance of new products, suggesting that companies need to adapt their processes, resources, and capabilities to market demand to achieve better results. This is in line with the findings of (Derkach & Tsygankova, 2021) which show that product innovation plays an important role in improving the competitiveness of companies, especially in the information technology industry. Overall, the literature shows that innovation, especially those focused on continuous improvement and adaptation to customer needs, is a key element in maintaining and improving a corporation's competitiveness in the global market. Technology- and information-driven innovation not only allows companies to better meet customer needs but also to create significant added value in their products and services.

4. Definition According to Pervaiz K. Ahmed & Charles D. Shepherd (2010)

Crysthoper Freeman (2004)

Innovation is defined as the process of realizing a new idea that is different from the previous one, either through production or by making it a reality, where innovation includes the generation of evaluation, new concepts, and implementation. This definition emphasizes that innovation is not only limited to the object or goods produced, but also includes attitudes, behaviors, or movements toward a process of change in all forms of social life. Innovation, in general, includes new ideas, products, information technologies, institutions, behaviors, values, and practices that are not yet widely known, accepted, and used by the majority of people in a given region, that can be used to drive change in all aspects of people's lives to improve the quality of individuals and all members of the community concerned. Some studies support the view that innovation involves a complex and thorough process, which depends not only on the development of new technologies but also on social and behavioral change. (Valtonen et al., 2023) Revealed the importance of individual factors in the implementation of innovative ideas, which involve expertise, motivation, cognitive factors, and social skills to support the successful implementation of innovations. (Boak, 2022) also states that action learning can stimulate the creative aspects of innovation and

provide support for challenges in implementing new ideas. In addition, (Rincón et al., 2022) in their study on the implementation of telemedicine in the health sector emphasized that the innovation implementation process often involves significant changes in existing institutional practices, where interactions among organizational actors play a crucial role in the success of innovation. (Kohlgrüber et al., 2021) Add that in the process of social innovation, technology must be seen as enablers that derive its relevance from new social practices, where the involvement of end-users and stakeholders is essential for the success of innovation. Thus, innovation is not just the creation of new products but also involves changes in social and institutional practices, which aim to improve the quality of life of society as a whole. Effective innovation implementation requires a comprehensive approach that involves the interaction among technology, individuals, and social change to achieve optimal outcomes.

2.2. Innovation Characteristics

An idea, notion, or theory can only be classified as an innovation if it has the following characteristics:

1. Typical distinctiveness or uniqueness is one of the main characteristics of innovation. An idea or theory can be categorized as an innovation if it has unique characteristics or is different from pre-existing ideas. (Syeed et al., 2022) Mentioned that innovations in health technology, for illustration, must have distinctive attributes such as substantial benefits and improvements over pre-existing technologies. This concept of uniqueness is also emphasized in product innovation, where innovative products must be significantly different from products already on the market. (Galkina & Yang, 2020).

   Innovation involves the development of new technologies and must have distinctive characteristics that distinguish it from pre-existing ideas or products. (Syeed et al., 2022) emphasized that innovations in health technology must offer unique benefits over pre-existing technologies. Similarly, (Han & Zhang, 2022) point out that business model innovations in the manufacturing industry oriented towards green development should reflect the uniqueness in the application of digital technology to achieve environmental goals. In addition, (Krishnan et al., 2020) highlight that innovative start-ups often have distinctive characteristics that distinguish them from traditional companies, allowing them to better deal with the risk of failure. (Sebök et al., 2022) also emphasized that innovations in the short food supply chain must offer significant added value through the application of distinctive technological and non-technological solutions.

Research by (Lopez-Vega & Moodysson, 2023) illustrates how digital technologies, such as autonomous vehicles, are transforming the automotive industry by creating a distinctive new interdependence between companies and industry boundaries. The study shows that truly distinctive innovations not only result in new products but also change the overall landscape of the industry, reinforcing the importance of uniqueness in the definition of innovation.

2. Every innovation must be a new idea or idea that has never been expressed or published before. Novelty is a key element of innovation, which distinguishes an idea or technology from pre-existing ones. In (Veretennikova, 2020), it is explained that novelty is the main factor that every innovation must have to be considered different and significant compared to previous technologies. (Lugovoi et al., 2022) Also assert that unrelated production experiences can lead to newer innovations, which can overcome the limitations of traditional production approaches. A study by (Silva et al., 2023) Shows that new digital technologies, such as artificial intelligence, can accelerate development and patents in various sectors, which confirms the importance of novelty in driving technological innovation. In addition, (Thomson, 2022) Research illustrates how new technology-based companies use digitalization to create innovative and efficient business models, which differ from traditional approaches. As such, the literature highlights that novelty is an absolute requirement in innovation, both in terms of technology and business models, to create unique and effective solutions across industries.
3. Planned innovation is usually made deliberately and planned to achieve a specific goal. In the research of (Andriani & Kaminska, 2021), it is explained that innovation can come from a planned process, such as a technology project, although sometimes it also happens by chance through exaptation or the use of objects for new functions. This shows the importance of planning in directing innovation to achieve the goals that have been set.
   Innovations are often made intentionally and planned to achieve a specific goal. In the research (Andriani & Kaminska, 2021), it is explained that innovation can come from a planned process, such as a technology project, although it can also arise by chance through exaptation, i.e. the utilization of objects for new functions. This is corroborated by (W. Liu et al., 2022), who underscore the importance of planning in innovation, especially in the context of rapid cross-industry collaboration during the COVID-19 pandemic, such as the Ventilator Challenge UK project. (Sedita et al., 2022) Also found that emerging innovations in environments with time and resource constraints, such as the use of snorkeling masks as medical tools

during the COVID-19 crisis, are examples of how planning and adaptation can lead to rapid innovative solutions. The research of (Huseynli et al., 2022) further shows that the use of science design methodologies can help in systematically creating innovative information system artifacts, reinforcing the importance of planning in the digital innovation process. Careful planning in technology projects and cross-industry innovation plays a key role in ensuring that innovation achieves the desired goals, although innovation can also occur unexpectedly through the process of adaptation.

4. Have a goal every innovation is designed to achieve a specific goal, such as increasing the value or quality of a product/service, creating a new market, or expanding a network. (Rincón et al., 2022) Mentioned that innovations in healthcare, such as telemedicine, are often designed to respond to specific needs in the sector, improve existing practices, and improve efficiency.
   Each innovation is designed with a specific goal, such as improving service quality or creating operational efficiency. In the context of telemedicine, (Rincón et al., 2022) Highlight that these innovations aim to increase efficiency and improve practices in the health sector through the utilization of technology for remote services. In addition, research by (Pundziene et al., 2023) Shows that digital health platforms in Europe are designed to generate significant social value, going beyond mere economic gains, with the primary goal of empowering communities and improving collective well-being. (S. M. Lee & Lee, 2021) Emphasized the importance of contactless healthcare services during the COVID-19 pandemic, demonstrating the potential for innovation to reduce direct interactions while still maintaining efficiency and patient satisfaction. Meanwhile, research in Indonesia by (Rerey et al., 2023) Underscores that the integration of telemedicine into the national health system is designed to improve accessibility in remote areas and support overall health service efficiency. Innovations that have a clear purpose, whether to improve services, empower users, or create efficiencies, contribute significantly to the successful application of technology in various sectors, especially in healthcare.
5. Having excellence, the innovation created must have advantages and uniqueness compared to its competitors. (Tian et al., 2021) Emphasized that the innovative capabilities of a corporation, especially in SMEs, can affect the superiority of new products introduced in the market. This advantage is important to ensure that the innovations created have a clear added value and are different from other products on the market.

Innovation excellence is an important aspect to ensure that the products or services created have added value and uniqueness compared to their competitors. (Tian et al., 2021) Emphasized that the innovative capabilities of companies, especially in SMEs, can directly contribute to the creation of competitive advantages through new, more creative, and value-added products. This is supported by (Wongsansukcharoen & Thaweepaiboonwong, 2023), which shows that innovation in human resource practices and innovation capabilities affects the competitive advantage and performance of SMEs in Thailand. (Normal et al., 2023) Found that supply chain collaboration and value innovation can strengthen the competitive advantage of ceramic SMEs in Bali, although its implementation still requires better organization for maximum results. In addition, (Suryantini et al., 2023) Show that intellectual capital, technology adoption, and strategic flexibility play an important role in creating a sustainable competitive advantage for export SMEs in Bali. Excellence in innovation arises not only from the products or services offered, but also from the company's ability to leverage its human resources, technology, and innovative strategies to achieve a strong competitive position in the market.

These characteristics show that innovation is not only about new ideas, but also how they are planned, and directed to achieve specific goals. They have clear advantages to provide added value for their users.

2.3. Type of Innovation

(Johne, 1999) and (Ojasalo, 2008) Distinguish three types of innovation: product, process, and market. The explanation of the three types of innovation is as follows:

1. Product innovation refers to developing or improving products that aim to increase a corporation's revenue. In the latest literature, product innovation is often identified as the key to improving a corporation's financial performance, especially in high-tech-focused sectors. A study by (Karadimce et al., 2021) Shows that product innovation has a positive impact on a corporation's financial performance, with a direct influence on revenue and profitability. In addition, (Nathan & Cecilia Rosso, 2019) Highlight the relationship between new product launches and increased productivity and corporation growth, especially among SMEs.
2. Process innovation, focuses on introducing new methods or improving existing processes to improve quality and efficiency and reduce costs. (Domnich, 2022) noted that process innovation has a significant impact on

increasing productivity, especially in industrial sectors. While the impact of process innovation on productivity can vary, it is generally considered essential to maintaining a corporation's competitiveness in the long term. In addition, (Iqbal et al., 2023) emphasize that innovative capabilities in processes can directly affect corporation performance, by optimizing internal operations and reducing operational costs.

3. Market innovation, involves strategies to identify and exploit new markets or improve the way companies serve existing markets. (Edeh et al., 2020) Showed that marketing innovations can significantly improve export performance, especially in developing countries, by helping companies reach new markets and improve their international competitiveness. (Vivchar & Ziailyk, 2021) Added marketing innovation plays an important role in improving the efficiency of marketing activities and expanding market share, which can ultimately increase the profitability of companies.

Overall, these three types of innovation – product, process, and market – have a crucial role to play in helping companies achieve competitive advantage and sustainable growth. Effective implementation of these innovations can increase the corporation's revenue, operational efficiency, and market share, thereby strengthening its position in the global market.

Meanwhile, (Meeus, M., & Edquist, 2006) Divide the types of innovation into two, namely technological process innovation and organizational innovation. Technological process innovation changes the way products are produced by introducing technological changes (physical equipment, techniques, systems). Organizational innovation is innovation in organizational structure, strategy, and administrative processes.

1. Technological process innovation, technological process innovation refers to changes in the way products are produced through the introduction of technological changes, such as new physical equipment, techniques, and systems. Recent studies show that technological process innovation has a significant impact on corporation performance, especially in improving operational efficiency and productivity. For illustration, research by (Plinta & Radwan, 2023) Highlights the importance of technological innovation in the manufacturing industry, where the effective application of technological innovation can improve a corporation's ability to compete in the global market.
2. Organizational innovation involves changes in organizational structures, strategies, and administrative processes to improve efficiency and effectiveness. These innovations are often necessary to meet the challenges that arise from a dynamic and high-tech business environment.

(Kaschuck, 2023) States that innovations in organizational management, such as the implementation of management 4.0 strategies, are essential to ensure that companies remain competitive and stable in a fast-changing market. Furthermore, (Moşteanu, 2020) Emphasizes that digital transformation has significantly changed organizational structures, with the adoption of new technologies leading to a massive restructuring in organizational processes and structures.

The comparison of these two types of innovation, both technological process innovation and organizational innovation, is interrelated in the context of modernization and improving corporation performance. Technological process innovation often requires changes in organizational structure to be implemented effectively. In contrast, organizational innovation can facilitate the adoption of new technologies by creating an environment that is more adaptive and responsive to technological changes. (S. M. Lee & Lee, 2021) Emphasized that technological innovation requires support from a strong organizational culture and leadership to be successful, showing that technological innovation cannot stand alone without changes in the organization. Overall, both technological process innovation and organizational innovation are critical components that must be strategically combined to achieve competitive advantage and sustainability in modern business. Based on the type, innovation can be classified into three, namely:

1. Product innovation, product innovation involves the development of new products, the improvement of the performance of existing products, or the development of new features in existing products. This innovation is very important in increasing the corporation's competitiveness by providing added value that suits customer needs. (Primadhani & Dwi Susilawati, 2023) Highlight that product innovation plays an important role in creating new market opportunities and increasing customer satisfaction, which in turn improves business sustainability. In addition, the digital product development model proposed by (Nikolić et al., 2022) Emphasizes the importance of adaptive product management in the face of competitive pressures, particularly in the news media industry (Nikolić et al., 2022). Illustrations of product innovation include:
    - Mighty mug (see Figure 2.1.a). Mighty Mug is an innovative glass product that provides a sturdy grip on the table when knocked over. Like an ordinary glass, this Mighty Mug functions to store water. What differentiates it from other glasses is that this glass uses Smart Grip Technology which makes the glass stick and be resistant to bumps on

flat surfaces. Even though it is firmly attached to the table, this glass can be easily moved without requiring any effort.

- Philips Hue (see Figure 2.1.b). This innovative product makes it easy and allows users to control lighting at home just via smartphone. We can enjoy this innovation carried out by Philips every day. The advantage of Philips Hue is that the lights can be controlled via WiFi and can also be changed to 16 million colors. Apart from that, you can also adjust the color of the lights when you are active, such as when you are sleeping the lights will be yellow when you are working the lights will be white, and others. Another unique thing about the Philips Hue feature is that the color of the lights can follow the rhythm or beat of the song you are listening to. Apart from that, there is also the Philips Hue Go which is smaller and can be turned on by plugging it into electricity or using a battery.

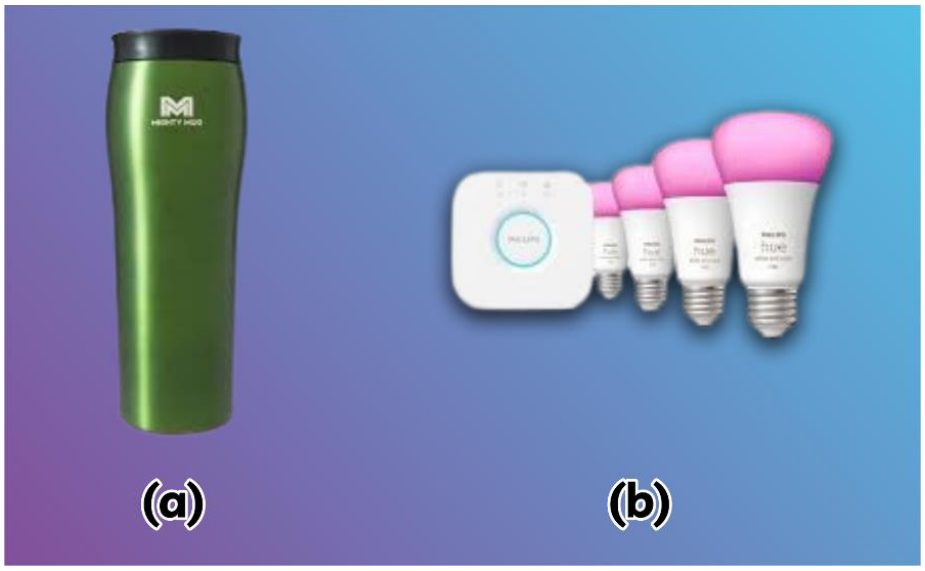


Figure 2.1. Illustration of product innovation: (a) Mighty mug; (b) Philips Hue.

2. Process innovation, process innovation includes changes in equipment and technology used in manufacturing, including software used in product design and development. These innovations also involve improvements in the tools, techniques, and software solutions used to support supply chains and delivery systems, as well as changes in methods of selling and maintaining goods. (Corallo et al., 2022) Examined a model-based approach in product lifecycle management that supports industry needs in product development and process technology, aiming to improve the efficiency and sustainability of business operations. Another study by (Efrata et al., 2020) shows that the innovation process in the development

of new products in the creative industry in Indonesia plays a very important role in long-term business success. Illustrations of process innovation include:

- ME 168 + DR 138 engine (Figure 2.2). The ME 168 + DR 138 machine was developed and produced by Pro Food Machinery, a corporation originating from Legok, Tangerang Regency, Banten Province, which is a high-tech star-making machine. This machine was officially released in 2012 and is capable of producing up to 4,200 pineapple cakes in one hour.

Figure 2.2. Illustration of process innovation: ME 168 + DR 138 engine.

Figure 2.3. Illustration of process innovation: Industrial Salt Production Process.

- Industrial Salt Production Process (Figure 2.3.). PT Garam is working with the Agency for the Assessment and Application of Technology to build a pilot project for industrial salt in Manyar, Gresik. The pilot project integrates a system of industrial salt production equipment equipped with technology capable of improving the quality of local salt products from NaCl with a content level of 88 percent to industrial salt with NaCl with a content level of 98 percent.

3. Business model innovation, business model innovation does not necessarily imply changes to products or production processes, but rather the way or model of bringing products and/or services to market. These innovations can help companies to stay competitive in a dynamic and uncertain business environment. (Keiningham et al., 2020) Developed a customer experience-driven business model innovation framework, which aligns customer values with the corporation's strategic needs. In addition, (Bresciani et al., 2021) Highlight the importance of digital transformation as a foundation for product, process, and business model innovation in achieving sustainable growth. Illustrations of business model innovation include:
   - Go Jek's #GakPakeLama campaign (Figure 2.4.), Gojek launches the #GakPakeLama campaign. Through this campaign, Gojek introduced three innovations for GoRide and GoCar services. The three latest innovations include the Nearest Pick Up Point Guide, Pick Up Points with Photos, as well as the GoRide and GoCar Instant features. The #GakPakeLama campaign provides the most comfortable, easy, and fast service for customers.

Figure 2.4. An illustration of an innovative business model: #GakPakeLama campaign from Go Jek.

- aStore (Figure 2.5.). Amazon's partnership innovation is also considered successful. Around 40% of sales on Amazon come from third-party sellers or what are usually called Amazon Associates. Services for Amazon Associates continue to be developed through aStore. aStore is a service in the member program that helps Amazon partners to access online easily. Now the number of Amazon Associates has reached more than 1 million members. This member program is one of the largest in the world.

Figure 2.5. An illustration of a business model innovation: Amazon

2.4. Innovation Level

In principle, innovation must contain two important elements, namely novelty and added value. Novelty in innovation refers to elements that are completely new or different from those that existed before. Novelty is a key element that distinguishes innovation from simple improvements or modifications. A study (Veretennikova, 2020) explains that novelty is not only related to the creation of new attributes but also to deep transformations or new combinations that have never existed before. In addition, research by (Foster et al., 2021) revealed that novelty can be measured based on the extent to which a new idea or technology violates existing expectations, which means that novelty is judged based on its uniqueness and unexpected occurrence. Added value in innovation refers to the ability of innovation to provide significant benefits to users or markets. This could be an increase in efficiency, a reduction in costs, or an improvement in the quality of a product or service. For illustration, a study by (Gusakov & Loiko, 2023) highlights how innovation management in Suppry Etiquetas companies generates added value through cost reduction and increased revenue after a new strategy is

implemented. (Ghosh & Wu, 2023) also found that in the context of organizations, priority is often given to innovations that increase value even though they may come at the expenditure of a certain level of novelty, suggesting that added value is often the primary focus in innovation. Novelty and added value are two aspects that complement each other in innovation. Novelty ensures that the innovation offers something that has not existed before, while added value ensures that the innovation is relevant and beneficial to the user or market. Research that combines these two elements shows that successful innovations are those that are not only new but also capable of providing real and significant benefits. Therefore, effective innovation must integrate these two elements in a balanced manner to achieve success in the market.

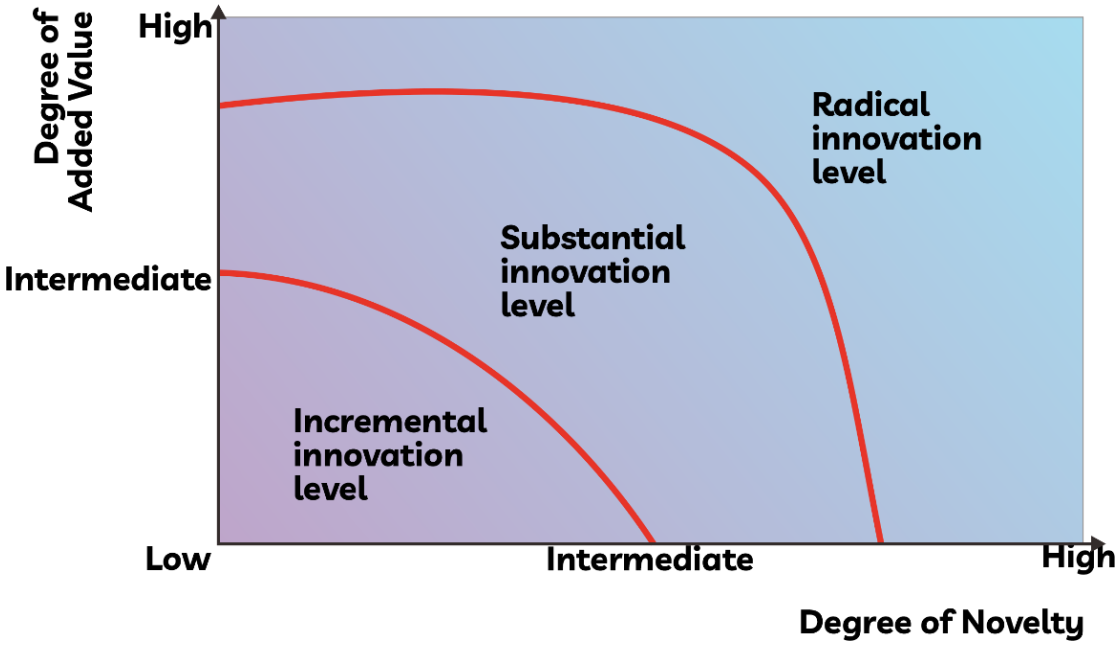


Figure 2.6. The level of innovation is based on the level of novelty and value-added.

Figure 2.6. illustrates the relationship among two important dimensions in innovation, the degree of novelty (the degree of innovation) and the degree of added value. In this context, innovation can be categorized into three main levels based on a combination of these two dimensions:

1. Incremental Innovation Level

   Innovation at this level has a low degree of novelty and relatively low added value. Incremental innovation is usually a small improvement or adjustment to an existing product or process. Illustrations of these innovations include improving operational efficiency or adding minor features to existing products. In recent literature reviews, incremental innovation is often considered a safer strategy for companies looking to

improve performance without taking major risks. According to research (Callander & Matouschek, 2022), incremental innovation is more suitable for stable industries where major changes are undesirable or unnecessary.

- An innovation that makes only minor improvements (eg making it cheaper, faster, lighter, more efficient, improving quality, etc.) to products, services, and other ways of doing business.
- Incremental innovation is unlikely to provide dramatic changes in business performance. However, this innovation is needed to encourage increased sustainability in this business. This innovation is also needed to prevent the corporation from falling behind its competitors and ensure its prospects for long-term survival.
- For illustration: Through serious innovation, AirAsia has become a low-cost airline. AirAsia received the World's Best Low-Cost Airline and Asia's Best Low-Cost Airline awards from SkyTrax for the first time in 2009. Since then, until now no other airline has been able to beat AirAsia (figure 2.7.).

Figure 2.7. Incremental innovation.

2. Substantial/Distinctive Innovation Levels

At this level, innovation has a moderate to high degree of novelty and added value. Substantial innovation often involves significant changes to existing products or processes but does not completely replace those products or processes. These innovations may include the development of new features that significantly increase the value of a product or service. A study by (Yanli et al., 2020) Shows that substantial innovation can provide a more durable competitive advantage over incremental innovation, as it creates a clearer differentiation in the market. In addition, innovation at this level is often associated with a more significant increase in competitive advantage.

- Substant innovation provides greater opportunities for added value because it creates business opportunities that tend to lead the industry and provide competitive advantages to the companies that develop them (figure 2.8).
- this level of innovation requires considerable investment in effective processes and strategies to manage innovation from ideation and development to successful commercialization.
- for illustration, the innovation carried out by the Sosrodjojo Family in 1969 to sell tea drinks en masse-produced bottles under the brand "The Botol Sosro". "Sosro Bottling Tea" is the first ready-to-drink bottled tea product in Indonesia, even in the world.

Figure 2.8. Substantial innovation.

3. Radical Innovation Level

Radical innovation has a high degree of novelty and added value. These innovations usually completely change the way an industry operates or create new markets. Illustrations of radical innovations include the invention of new technologies that completely change consumer behavior or the structure of an industry. According to research (Smith & Fressoli, 2021), radical innovation has the greatest potential to disrupt the industry and create great new opportunities, but it also carries a higher risk because it requires major changes in operations and often faces market resistance. However, companies that successfully launch radical innovations often become new market leaders.

While incremental innovations are safer and easier to implement, radical innovations can provide a significant competitive advantage,

although with higher risks. Choosing the right level of innovation depends on the corporation's strategic goals and its readiness to take risks.

- Radical innovation can revitalize an industry, creating new performance bases, new competitors, and new business models. Radical innovation often comes from outside the industry and is often technology-based or the result of lengthy Research and Development (R&D) activities (figure 2.9.).
- For illustration: Apple carried out radical innovation by creating a Personal Computer (PC) that allowed people to use it.

Figure 2.9. A radical computer innovation by Apple.

2.5. Evolution of Innovation

The fundamental changes that occurred in the way companies generated new ideas created value and brought them to market throughout the 20th century were heavily influenced by the innovation models used. In this century, the 'closed innovation' model has been quite successful in improving corporation performance. This model is based on the assumption that the innovation process takes place entirely within the confines of the corporation, where the knowledge generated is not shared with external entities. This creates an enclosed environment, with a focus on internal development and protection of innovation results through intellectual property rights (Chesbrough, 2003). However, as information technology develops and access to global knowledge increases, the 'closed innovation' model has begun to come under criticism. Limited access to external ideas and cross-border collaboration is considered to hinder the pace of innovation. In response, the concept of 'open innovation' emerged, which was introduced by

Henry Chesbrough in the early 21st century. This 'open innovation' model advises companies to leverage external resources, such as ideas, technologies, and knowledge from outside the corporation, as well as collaborate with external parties to develop innovative products and services (Chesbrough et al., 2006).

1. Openness in Innovation, Recent studies show that the application of 'open innovation' can increase efficiency and effectiveness in the innovation process. According to (M. L. A. M. Bogers et al., 2022), companies that apply this model tend to be more adaptive to market changes and have a better ability to identify innovation opportunities. In addition, this model also advises cross-industry and interdisciplinary collaboration, which can ultimately accelerate the innovation process and produce products that are more relevant to market needs.
2. Impact on corporation performance, research by (Randhawa et al., 2021) Shows that companies that switch from a 'closed innovation' model to an 'open innovation' model tend to experience an increase in product diversification and the speed of marketing new products. Companies that successfully leverage collaborations with external entities also show improvements in financial performance and competitiveness in the global market.
3. Implications for academics, this change also has a significant impact on the academic world. The 'open innovation' model has opened up space for a multidisciplinary approach in innovation R&D. According to West & Bogers (2021), this concept advises collaboration among researchers from different disciplines, creating space for more intensive interaction among academics and industry practitioners (T. Bogers et al., 2022).
4. Criticism of the open innovation model, although it has many advantages, the 'open innovation' model is also not spared from criticism. Some studies indicate that not all companies are ready to fully adopt this model. For illustration, (H. W. Lee, 2019) noted that companies with a culture that is overly protective of intellectual property rights may have difficulties in sharing information and technology with external parties. In addition, there is also the risk of strategic information leakage and difficulties in managing complex collaborations.

The shift from a 'closed innovation' model to an 'open innovation' model reflects a response to changes in the technological environment and market needs. The 'open innovation' model offers a great opportunity to improve corporation performance through external collaboration and a multidisciplinary approach. However, its application must be tailored to the

specific context of the corporation and the potential challenges it may face. As such, this model must be carefully considered in the corporation's innovation strategy.

The development of innovation has undergone a significant evolution from the early era of the Industrial Revolution to the present day. (Rothwell, 1994) explained that the evolution of innovation is divided into five generations, each with different characteristics and approaches to product and technology development. Knowledge of this evolution is essential for understanding the current position and approach of innovation research.

1. First Generation of Innovation (1G) – Technology Push

   The first generation of innovation focuses on the push of technology where innovation is considered as the result of the development of new technologies that drive product development and production. This model emphasizes the role of technology as a key driver of innovation, without paying much attention to market or consumer needs. Research by (Knight, 2023) shows that this approach tends to be successful in the early era of industrialization, where the development of new technologies is essential to building the foundations of modern industry. This approach is considered less responsive to the needs of the market that evolves.

2. Second Generation of Innovation (2G) – Need Pull

   In the second generation, the focus of innovation shifts toward demand pulling, where innovation is driven by market demand and consumer needs. In this model, consumers have a central role in determining the direction of innovation, with marketing playing a crucial role in formulating new ideas. Recent research by (Probst et al., 2021) shows that the 'need pull' approach is more responsive to changes in market demand and can increase consumer satisfaction. However, this model can hinder radical innovation because it tends to focus on short-term needs and solutions that only meet current demand.

3. Third Generation Innovation (3G) – Coupling Model

   The third generation of innovation combines the push of technology and the pull of needs into a merger model. In this model, innovation develops through the interaction between R&D and marketing. R&D develops new technologies that are then adapted to feedback from the market, creating a strong link between technology development and consumer needs. A study (Androschuk, 2021) shows that this model results in more comprehensive innovative solutions because it involves various parties in the innovation process. However, the challenge that arises is the complexity of coordination among various functions in the organization.

4. Fourth Generation of Innovation (4G) – Integrated Model

In the fourth generation, innovation models are becoming increasingly integrated, where R&D and marketing activities as well as suppliers become part of a more collaborative innovation process. This model emphasizes cross-functional collaboration and the elimination of barriers among departments, to respond to consumer needs more quickly and effectively. Research by (D. Zhang et al., 2020) shows that this integrated approach can accelerate time to market and improve the quality of innovation. However, the main challenge is how to maintain effective coordination among the various parties involved.

5. Fifth Generation of Innovation (5G) – System Integration and Networking Model

   The fifth generation of innovation is the most advanced stage, where system and network integration is the key to the innovation process. This model involves a broader collaboration strategy with suppliers and consumers, supported by a robust system and an integrated network. The main focus is on flexibility and speed of development, with an emphasis on quality and other factors such as sustainability. A study by (Abjani et al., 2020) highlights that this model allows companies to be more responsive to global market dynamics and leverage external collaboration for more effective innovation. The implementation of this model requires significant investments in complex technology infrastructure and network management.

The evolution of innovation from the first to the fifth generation shows a significant change in the approach to product and technology development. The move from a purely technology-driven model to a model that integrates various elements in a complex network reflects a response to changing market needs and technological advancements. Although each generation of innovation has its advantages and disadvantages, current trends show that systems and network integration (5G) models are becoming increasingly relevant in a dynamic and competitive business environment.

2.6. Strategy of Innovation

Generic innovation strategies can be divided into three main categories: Pioneer, Fast Follower, and Opportunistic. These three strategies have different characteristics, advantages, and challenges, and the right choice of strategy is greatly influenced by the industry context, available resources, and corporation goals (figure 2.10).

1. Pioneer

The Pioneer strategy focuses on developing new technologies and becoming leaders in the industry or market. Companies that adopt this strategy typically make large R&D investments to encourage radical innovations that can transform the industry or create new markets. According to research conducted by (Hermans & Van Peteghem, 2006), companies with a Pioneer strategy have the advantage of being a "first mover" that allows them to build a strong barrier to entry for new competitors, as well as gain significant market share before competitors catch up. However, the major risk faced by Pioneer companies is the high uncertainty associated with the success of new technologies, which often require significant time and cost.

2. Fast Follower

   The Fast Follower strategy involves improving existing technology through incremental innovation in products and technological processes. Companies with this strategy focus more on improving efficiency and reducing costs than creating new technologies from scratch. In a study by (Banerjee et al., 2023), it was stated that the Fast Follower strategy can be effective in fast-growing industries, where technology changes rapidly and companies cannot bear the huge risks associated with radical innovation. The advantage of this approach is that companies can take advantage of Pioneer innovations with lower risk, but with the potential to lose out if they cannot compete with the pace of innovation from Pioneers.

3. Opportunistic

   Opportunistic strategies involve investing in substantial innovations, but also leveraging innovation sources from third parties and adapting those innovations to market opportunities that have been identified. According to (Bernal-Ponce et al., 2020), this strategy is often used by companies that have limited resources for R&D but have the acumen to identify market opportunities that can be capitalized quickly. The main advantages of an opportunistic strategy are its flexibility in responding to changing market dynamics and its ability to reduce the cost of innovation by leveraging external innovation. However, the challenge is the reliance on third-party innovations that may not fully match the needs of the targeted market.

These three innovation strategies show variations in the approach to innovation and investment. The Pioneer strategy demands a large investment and a readiness to face high risks for long-term profits and a market leader position. In contrast, Fast Follower strategies tend to be safer and more cost-efficient, focusing on improvement and adaptation rather than creation. On

the other hand, Opportunistic strategies offer the greatest flexibility by leveraging existing innovations to meet existing market needs, but with challenges related to dependence on third parties and the possibility of suboptimal adaptation.

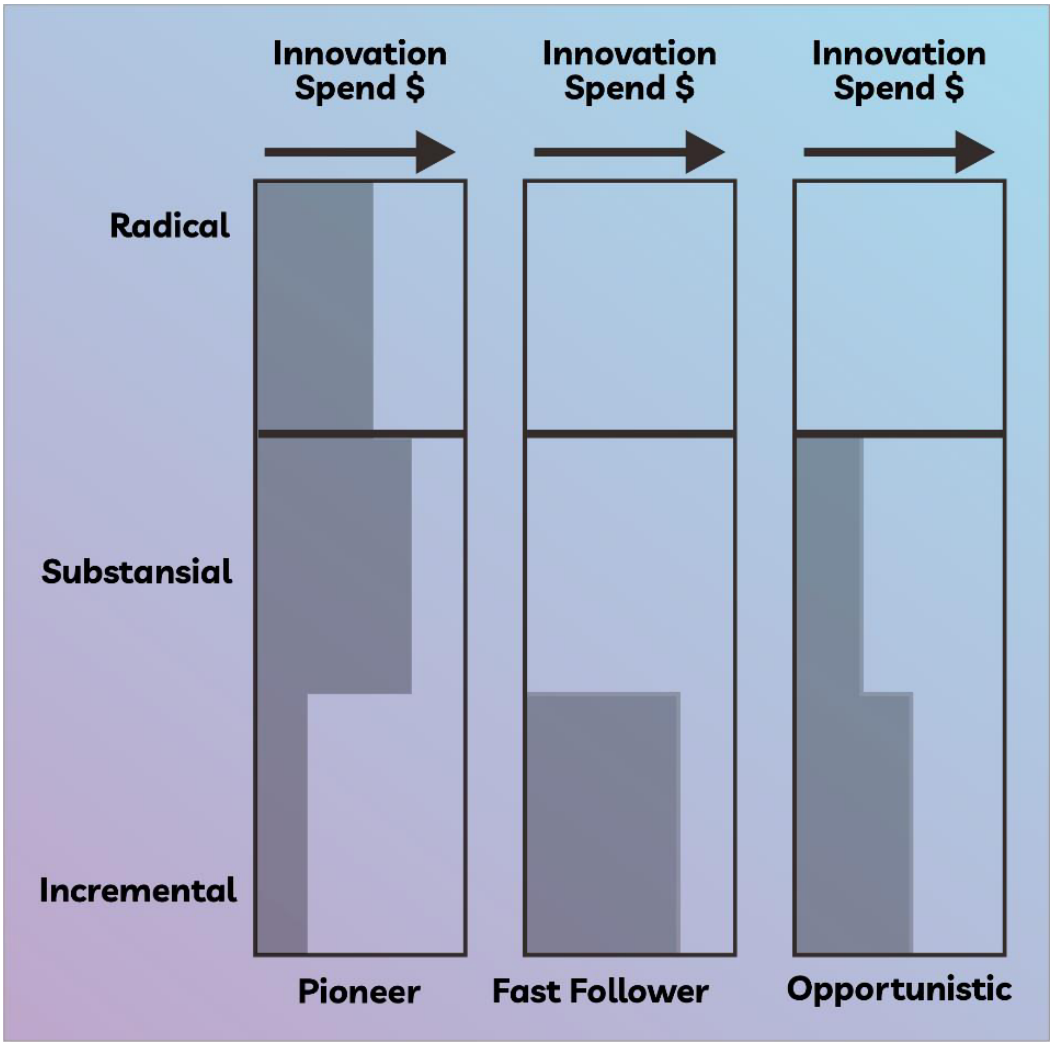


Figure 2.10. Three generic innovation strategies

In the context of a rapidly changing and diverse industry, there is no single strategy that excels in all conditions. The choice of innovation strategy should be based on an in-depth analysis of the market, competition, resources, and long-term goals of the corporation.

2.7. Innovation Criteria

The Indonesian Innovation Criteria are parameters used as a basis for assessing R&D products in Indonesia to be recognized as innovative products that meet certain requirements. This criterion is designed to be an ideal parameter that still considers the interests of innovators, the user community,

and the national interest. The established criteria for Indonesian Innovation are:

1. Novelty is a key element in innovation that functions to strengthen the unique selling point (USP) of an innovative product. Novelty is the result of a new invention or idea that has never existed before, and thus, provides an added value that sets the product apart from its competitors. The concept of novelty is very important in the development of innovative products because it determines the uniqueness and competitive advantage that is the main attraction for consumers and investors.

   Novelty as an element of innovation is often associated with a product's ability to offer something completely new in the market. According to a study by (Bernd W. Wirtz, 2016), novelty in innovation is not only limited to new technologies but can also include new business approaches, operating models, or applications of existing technologies. For illustration, a product with a high degree of novelty may be the first on the market or use a new technology that has never been applied before. In the context of USP, novelty strengthens the appeal of a product by offering value that other products do not. This may be in the form of higher quality, lower cost, or unique features not found in competing products. A study by (Rust et al., 2001) shows that products with strong novelties tend to be more successful in the market because they offer new solutions that are relevant to evolving consumer needs. Furthermore, novelty is also related to deep differentiation. A product with a strong novelty is not only different from other products but also provides much higher value to consumers. This allows the product to occupy a unique position in the market and is often the market leader in its category. For illustration, innovations in battery technology by Tesla that use novelty in energy storage allow the corporation to become a leader in the Electric Vehicle (EV) industry (SuII & Reavis, 2019). However, novelty also brings challenges, especially when it comes to market acceptance and technology risks. A study by (Anderson, 2019) states that while novelty can be an advantage, innovative products that are too new or too different may face obstacles in market acceptance because consumers may feel uncomfortable with changes that are too radical. Novelty is an important element in innovation that strengthens the USP of a product by offering something completely new and different from the products already on the market. Successful novelty not only increases the value of the product in the eyes of consumers but also provides deep differentiation, which is key to long-term success. However, novelty must also be carefully managed to address potential challenges in market acceptance and technology risks.

2. Has Been Implemented is an important stage in the life cycle of an innovative product. At this stage, innovative products have been introduced to the market by starting to market to the intended target market. Although sales in the early stages may not be high, the success of a product is measured by how well it is received by early adopters. After this initial acceptance, the next step is to expand the customer base through aggressive promotions and focus on brand building.

   The implementation stage in the development of innovative products is a critical phase that determines the success of the product in the market. According to a study by (Rahman & Shah, 2023), this process involves careful planning and effective execution, from marketing strategies to product distribution. Successful implementation requires the product to commence to be recognized by the market through various forms of promotion and market testing to understand customer needs and preferences. As part of a marketing strategy, acceptance by early adopters is very important. According to (Rogers, 2019), early adopters play a key role in the adoption of new technologies or innovative products because they are usually more open to change and have influence in their communities. They can help build the initial reputation of the product through positive feedback and recommendations. However, the main challenge at the implementation stage is ensuring that the product can reach a wider market. A study by (Kotler dan Keller, 2016) highlights the importance of aggressive promotion and focusing on brand building to expand market reach. Effective promotion not only increases product awareness but also builds brand trust and loyalty among new customers. Further, it is also important to consider pricing and distribution strategies during the implementation phase. Precise pricing and efficient distribution strategies can influence how quickly innovative products can be accepted in a wider market. The implementation stage is an important step in ensuring the success of an innovative product in the market. Success at this stage is measured by how well the product is received by early adopters and how effective the promotion and brand-building strategies are to expand the market reach. Although the challenges in this stage are significant, with the right marketing strategy and careful execution, innovative products can achieve long-term success.
3. Sustainability from a business perspective is an important aspect that assesses the extent to which innovation can sustain a corporation's long-term performance. In this context, the sustainability of business performance is greatly influenced by the level of innovation achieved by the corporation. Innovations that have a very strong degree of added value

and novelty—such as substantial and radical innovation—can create great business opportunities, making the corporation a market leader that has a competitive advantage over its competitors.

The sustainability of business performance is often directly correlated with a corporation's ability to create significant innovation. Substantial innovation, which involves major improvements in existing products or processes, and radical innovation, which introduces new technologies or products that change the market, play a key role in maintaining and improving a corporation's competitiveness. According to a study by (Schilling-Vacaflor & Gustafsson, 2022), companies that succeed in implementing radical innovations are often able to capture a large market share because they can offer something completely new and unprecedented. Meanwhile, substantial innovation is also very important, especially in the context of maintaining an existing market position. This type of innovation allows companies to stay relevant and competitive by introducing significant improvements to existing products or services. According to research by (Christensen & Raynor, 2003), companies that consistently innovate substantially tend to have more stable and sustainable business performance because they can continue to meet and exceed market expectations. However, innovation does not always have to be radical or substantial to create sustainable value. Incremental innovation, which involves small but continuous changes, is also important in maintaining a corporation's competitiveness. A study by (Pisano, 2019) highlights that while radical innovations can bring great benefits, incremental innovations are also important for sustainability because they help companies adapt to market changes without having to take huge risks. Sustainability from a business perspective is also influenced by the corporation's ability to manage innovation effectively. According to a study by (O'Reilly, 2021), companies that have a flexible management structure and can integrate innovation into their business strategy tend to be more successful in the long run. This shows that business sustainability depends not only on the innovation itself but also on how it is implemented and managed within the organization. The sustainability of business performance is greatly influenced by the level of innovation achieved by the corporation. Substantial and radical innovations have great potential to create a competitive advantage and transform a corporation into a market leader. However, incremental innovation also plays an important role in maintaining a corporation's sustainability and competitiveness in an ever-changing market. Therefore, effective innovation management is the key to achieving sustainability in business performance.

4. Providing solutions to community problems is one of the key indicators of the strength of innovation. Strong innovation can offer new ideas or ideas that are relevant and applicable in solving problems faced by society. The process of creating new ideas, often referred to as ideation, plays a crucial role in producing effective solutions. In this context, ideas are the main foundation in developing solution-oriented innovations, so that they can have a positive impact on society.

   A successful ideation process is not only about creating new ideas but also ensuring that the ideas are relevant and can be applied to solve real problems in society. According to a study (Taylor & Bessant, 2021), solution-oriented ideas are one of the most effective approaches to innovation, as they directly link the needs of society to the results of the resulting innovations. Furthermore, innovations that focus on community solutions typically involve a collaborative process among various stakeholders, including governments, the private sector, and communities. According to research (Chesbrough, 2012), cross-sector collaboration in the innovation process can improve the quality of ideas, because each party can provide a different perspective on the problems faced by society. This is also supported by the von Hippel study which emphasizes the importance of community involvement in the innovation process to ensure that the resulting solutions meet their real needs (von Hippel et al., 2023). However, not all innovations produced through the solution-oriented ideation process can be implemented effectively immediately. In many cases, innovation requires a process of iteration and testing before it can solve the problem at hand. According to a study (Chang & Ries, 2018), a lean startup approach that prioritizes rapid iteration and market testing is an effective strategy to ensure that the resulting solutions truly answer the needs of the community. This approach allows innovators to quickly refine and refine ideas based on direct feedback from users. In addition, innovations that provide solutions to the community must also take into account the long-term impact of their implementation. According to a study by (Vig, 2023), the concept of a triple bottom line that includes economic, social, and environmental impacts must be the main consideration in designing sustainable innovation. Innovations that focus only on short-term solutions without considering long-term impacts tend to fail in creating lasting change in society. The strength of an innovation is largely determined by its ability to provide effective solutions to problems faced by society. A good ideation process, cross-sector collaboration, and an iterative approach to product development are key factors in creating innovations that truly benefit society. In addition, considering the long-term impact of

innovation is also important to ensure the sustainability and relevance of the solutions offered.

5. Professionally managed product innovation has an important role in providing economic and social benefits. This is in line with the view of (Dalla Fontana et al., 2020) who states that innovation is social and economic success through the introduction or discovery of new ways or new combinations of old ways of converting inputs into outputs, thus succeeding in creating significant changes in the relationship between the use value or benefits perceived by consumers and monetary value or cost. Several recent studies support this view. For illustration, research by (Warnock-Smith & Christidis, 2021) shows that effective product innovation can improve a corporation's competitiveness in the global market, which in turn increases national economic growth. Furthermore, research by (Cordova-Buiza et al., 2022) reveals that collaboration among the public and private sectors in the development of product innovations can accelerate economic growth and expand access to social services. These studies show that although the focus and approach used are different, they all agree that well-managed product innovation has a significant impact on economic and social aspects. The difference lies in supporting factors such as collaboration among sectors, focus on sustainability, and implemented management strategies. However, the main similarity found is the importance of integration among innovation and professional management to achieve maximum benefits for the economy and society. Product innovation that is managed professionally is the key to driving economic growth and improving social welfare. A holistic approach involving various stakeholders and an effective management strategy are needed to ensure that the innovation can have a sustainable positive impact.
6. Product innovation must be aligned with existing systems, as misalignment can lead to innovation failure. In addition, innovation must also be by applicable laws or policies, as well as the values that are developing in society, previously known ideas, and the needs of those who want to adopt such innovations. Many studies have shown the importance of this compatibility for the success of innovation.

   For illustration, research by (Daniels & Gebhardt, 2021) highlights the importance of higher education systems, science, and research in supporting innovations that are compatible with existing social and economic systems in Africa. (Baranova et al., 2021) also emphasizes that social innovation must be aligned with the needs of society and existing policies to achieve success in research and education. In addition, (Sattiraju

& Janodia, 2023) discuss innovation policy in India, showing that compatibility among innovation policy and national challenges and existing systems is essential to achieve effective outcomes. (Cristiano & Proietti, 2022) also revealed that a multi-actor approach involving various perspectives and knowledge is essential to achieve sustainable innovation and by the needs of existing systems. These studies show that innovations that are incompatible with existing systems, both in laws, policies, and social values, tend to fail. Therefore, to achieve the success of innovation, it is important to ensure that the innovation goes hand in hand with applicable laws, evolving social values, and existing ideas and needs. Innovation compatibility with existing systems is a critical factor to ensure the success and adoption of innovation by society.

7. Innovative products that play a role in increasing the Domestic Component Level (TKDN) must focus on replacing imports and optimizing the use of local raw materials. Increasing TKDN is not only important to support domestic industry, but also to reduce dependence on imports and encourage national economic growth.

   Research by (Febijanto et al., 2023) highlights the importance of TKDN evaluation in the salt industry in Indonesia, where TKDN can be increased from 27.4% to 70.9% by increasing the use of domestic main components. The results show that the optimal use of local raw materials can significantly increase TKDN at the commercial stage. (Fikri et al., 2023) emphasized that product certification with high TKDN is very important for strategic projects funded by the state. However, challenges still exist in matching the needs of TKDN-certified products with government demands, demonstrating the importance of proper data optimization and analysis to meet policy targets (Fikri et al., 2023). A study by (Buleev I. & Ziuz D., 2021) emphasizes that import substitution policies are essential in revitalizing economic and industrial independence. This policy not only protects domestic producers but also advises the use of local raw materials in production, which can improve TKDN and national competitiveness. Furthermore, (Sopoeva, 2021) highlighted the importance of import substitution policies in high-tech industries. The development of industrial policies that support technological innovation and production can create better conditions for import substitution and increase TKDN in advanced technology products. Increasing TKDN through import substitution and optimizing the use of local raw materials is essential to strengthen domestic industries, reduce dependence on imports, and support sustainable economic growth. Proper policy implementation, careful

evaluation, and support for local innovations are key to achieving higher TKDN.

2.8. Innovation Platform

Technological developments in the era of disruptive innovation are characterized by increased connectivity, interaction, and boundaries among humans, machines, and other resources that are increasingly convergent through information and communication technology (ICT). When this situation is optimally utilized and integrated by various interested elements, it can produce significant economic and social impacts. In a study by (Yasin et al., 2021), the rapid development of digital technology, especially in the fields of artificial intelligence (AI) and robotics, has created great opportunities for organizations to improve efficiency and productivity through human-machine interaction. These innovative technologies not only transform organizational processes but also emphasize the importance of the role of humans in the increasingly complex ecosystem of new technologies. (Gurure & Takavarasha, 2020) highlights that ICT in developing countries has the potential to overcome existing social and economic gaps through strengthening network collaboration. However, the lack of equal access to these technologies can exacerbate inequality, especially in regions with isolated enclave economies. Furthermore, (Choi et al., 2021) discuss how disruptive technologies such as AI, blockchain, and 5G can bring about radical changes in operations management in the industry 4.0 and 5.0 eras. They emphasized the importance of sustainable social welfare and the role of policymakers in creating policies that support harmonization among humans and machines in new industrial ecosystems. Research by (Karaman Aksentijević et al., 2021) also shows that the use of ICT has a significant impact on human development, especially in low- and lower-middle-income countries. They suggest that investment in ICT infrastructure is essential for accelerating economic growth and improving the quality of life. From these various studies, the development of disruptive technologies that are well integrated into social and economic systems can produce great benefits, both in the form of increased productivity and social welfare. However, emerging challenges, such as inequality in access to technology and the need for supportive regulations, also need to be addressed to maximize the positive impact of these technologies.

Open innovation business models are becoming increasingly important in today's era of technological disruption, where companies need to open boundaries to leverage valuable knowledge flows from outside to create collaboration opportunities in the innovation process. In this context, collaboration with various partners such as consumers, suppliers, and even

competitors is key to driving innovation stimulation and improving corporation performance. Research by (Fisun et al., 2022) highlights that the open innovation model allows companies to conduct joint research and create innovations with external partners, as well as strategically use intellectual property rights to increase returns from internal R&D. However, the challenge that arises is the risk of information leakage, which requires companies to have strong control over their intellectual property. Furthermore, (Pigola et al., 2022) discuss innovative collaborations facilitated by technological advancements. They explained that technology collaboration includes interactions among organizations that involve the exchange of knowledge and resources for technology development. This collaboration not only advises innovation but also presents challenges such as the need for reliable technology alliances and good governance strategies. (Piddubna & Gorobynskaya, 2023) also emphasized the importance of an open innovation model in utilizing external resources for innovation. They point out that companies need to work closely with external partners such as research centers and academic institutions to accelerate the innovation process. The implementation of this model requires a combination of external and internal knowledge that allows companies to create more complex and innovative business systems. Another study by (Morasco & Costa, 2023) highlights that active methodologies can be an important tool in driving the adoption of open innovation. By involving internal and external teams in the innovation process, companies can reduce the time, cost, and risks associated with innovation, as well as improve interpersonal relationships in innovative collaborations. (Phonthanukitithaworn et al., 2023; Srisathan et al., 2023) revealed that open innovation strategies can vary among different generations in small and medium enterprises (SMEs). They found that younger generations tend to be more open to external collaboration in implementing innovations, while older generations pay more attention to human capital and strategic agility before implementing open innovation. Overall, the open innovation model provides many advantages in enhancing the corporation's innovative capabilities through collaboration with various external partners. However, this model also presents challenges that require good governance strategies, intellectual property risk management, and adaptation to various organizational dynamics. Effective implementation of this model can encourage companies to achieve faster, more efficient, and high-impact innovations.

Open innovation platforms rely on a variety of innovation sources, structured ones such as research partners, vendors/suppliers, customers, and employees, as well as unstructured sources such as scientific publications, corporate publications, social networks, and blogs/forums. These unstructured

sources contain large amounts of data that are often difficult to manage. However, with the use of advanced analytics, this unstructured data can be processed into valuable information to support the innovation process. Research by (Leible & Ludzay, 2022) highlights that the process of idea mining from unstructured data such as user comments on social media can generate valuable innovative ideas for organizations. Text mining techniques are used to collect and analyze data from social media such as Twitter and Facebook, which can then be used to support data-driven innovation within organizations. In addition, (Rodrigues et al., 2020) in their research on big data mining from social media show that sentiment analysis is one of the main applications of big data analytics. This analysis helps to understand public sentiment from text data generated on social media, which can be used for a variety of purposes, including customer satisfaction measurement and observation of market trends. (DeIanoy & KaszteInik, 2020) discuss how big data analytics from social media can support innovative management decisions, particularly in customer relationships. They found that the integration of feedback from crowdsourcing and social data analytics can strengthen an organization's position in the face of evolving market dynamics. Meanwhile, (Xiang, 2022) proposed a dynamic simulation model for the visualization of unstructured data from social networks. By leveraging the Hadoop platform and data visualization technology, this model is designed to improve stability and efficiency in the visualization of unstructured data on social networks. Unstructured data from sources such as social networks and online publications has great potential to be processed into valuable information through advanced analytics. The use of these analytics techniques not only supports the innovation process but also helps organizations to stay competitive in the market by understanding the needs and trends among consumers. Effective processing of unstructured data requires a proper analytical approach and a supporting technological infrastructure.

In the era of technological disruption, the emergence of startups as newcomers in the business world has brought major changes, both in the market map and customer habits. Startups usually bring disruptive innovations that impact the market significantly, and over time, existing customers from existing players or incumbents also have the potential to switch. This condition requires a response through a change in mindset from management, staff, and innovators in the corporation so that they can change their innovation strategy to be more disruptive. Research by (Högberg & Willermark, 2023) shows that established companies often have to adapt to disruptive digital innovations that shake up their traditional business models. In this study, they highlight that international hotel companies facing digital

disruption need to respond by changing their digital business strategies, adjusting internal practices, and renegotiating the value they offer to customers. discuss the importance of startups and SMEs in creating disruptive innovations, especially in finding profitable niche market segments. They found that startups often manage to enter the market through disruptive innovation by starting from underserved market segments before eventually disrupting the main market. Another study by emphasizes the importance of an existential mindset in the survival and growth of companies in the digital era. He argues that established companies must embrace innovation and move away from bureaucracy to responsiveness and adaptability to overcome the disruption brought by new innovators. In addition, (Hortovanyi et al., 2021) shows how incumbent companies can overcome disruptive innovations by developing hybrid products that combine old and new technologies. The study highlights the role of hybrid products in helping Oracle transition from traditional business applications to cloud computing, a disruptive innovation to which they adapted well. (Obi-Anike et al., 2022) in his study on entrepreneurial strategies to manage disruptive innovation stated that disruption creates a new phenomenon that provides added value for consumers and society. He recommends that organizations are not afraid of disruptive innovations, but rather embrace them and develop strategies to manage these disruptions to improve their business performance. Overall, these studies show that while disruptive innovations brought by startups can shake up markets and incumbent players, established companies can respond by changing their strategies and adopting a more adaptive mindset. Companies need to integrate innovations with their existing business strategies to stay relevant and competitive in an ever-changing market.

In observing the development of innovation, (Kim et al., 2022) stated that there are four important characteristics, increased collaboration among different stakeholders, strengthening the corporation's external relationships, expanding R&D roles, and the use of computational modeling and simulation as a growing solution for rapid learning related to the innovation cycle. This observation concludes that the current active approach to catalyzing innovation requires the expansion of corporate boundaries and the involvement of external parties. (X. Wang et al., 2023) found that intensive R&D endeavors have a positive influence on business model innovation through increased external collaboration. The study emphasizes that both the depth and breadth of external collaboration play an important role in improving corporate innovation. Furthermore, (Urbinati et al., 2020) show that project management in open innovation requires a different approach compared to traditional R&D projects. They found that relationships with external partners

in open innovation projects are more often governed by informal frameworks, which helps reduce tensions in multi-stakeholder collaboration. (Yao & Huang, 2022) investigated the impact of R&D subsidies on the performance of sustainable innovation in China. They found that external collaborative networks built through R&D subsidies can improve a corporation's innovation performance, but this effect can be negatively moderated by the subsidies themselves. In the context of the use of computational modeling, (Chiang et al., 2022; Shang et al., 2023) developed a collaborative strategy based on Computational Thinking (CT) to solve complex STEM problems. This study shows that collaborative strategies combined with system modeling and simulation can significantly improve learning and innovation outcomes. Overall, these studies reinforce the view that external collaboration, the expansion of R&D's role, and the use of advanced technologies such as computational modeling are essential to drive more effective and efficient innovation. Companies that can take advantage of collaborative forums with various external elements will be better able to maintain the flow of knowledge and information necessary to support a sustainable innovation cycle.

(du Plessis, 2007) stated that knowledge management helps innovation in creating tools, platforms, and processes for sharing knowledge. This statement is supported by some recent studies that show the importance of knowledge management in supporting innovation in various organizations. (Lima et al., 2020) emphasized that knowledge management plays an important role in public project innovation. They found that knowledge management aids in creating an organizational environment conducive to the emergence of innovative thinking through the sharing of knowledge and experience, which ultimately improves project performance. (Fait et al., 2023) examined the relationship between the application of knowledge management practices and the improvement of social innovation capabilities. This study found that social motivation, both intrinsic and extrinsic, plays a role in encouraging knowledge-sharing behavior, which in turn strengthens the social innovation capabilities of nonprofit organizations. In addition, (Di Vaio et al., 2021) in their systematic review show that digital innovation in Knowledge Management Systems (KMS) plays an important role in promoting new business models through the optimization of new knowledge. This digital innovation has also been found to contribute to creating a more effective knowledge-sharing process, supporting inclusive and sustainable growth. Research by (Crupi et al., 2020) also shows how an open innovation environment can help organizations implement knowledge-sharing practices by reducing barriers often faced in collaboration among organizations. This

study underscores the importance of an open innovation environment in supporting the knowledge-sharing process more effectively. Overall, these studies emphasize that knowledge management not only supports innovation through tools and platforms that facilitate knowledge sharing but also through the creation of an environment that advises organizational collaboration and learning. Thus, knowledge management plays a key role in strengthening the innovation capacity of organizations in this digital era.

The establishment of an innovation platform is expected to more effectively address challenges and opportunities at various levels of user elements. This is because, in this platform, all elements can interact directly at different levels, thus facilitating better collaboration and knowledge exchange. Research by (Rho et al., 2020) highlights the role of open innovation platforms in facilitating user-driven innovation within the innovation ecosystem. In this study, open innovation platforms (OIPs) are used as co-creation spaces that allow different actors in the innovation ecosystem to interact and collaborate effectively. This study shows that OIP not only plays a role in facilitating collaboration but also supports social sustainability by expanding access to innovation for different user groups. In addition, (Olvera-Fernández et al., 2023) in their study on open innovation platform design, mentioned that effective platform design must consider the context of complex ecosystems. The study offers a design framework for an open innovation platform that involves ecosystem management, innovation management, and co-creation support to ensure productive interactions among all actors involved. Another study by (Lievens & Blažević, 2021) emphasizes the importance of a service design approach in B2B innovation to manage stakeholder engagement during the innovation process. They developed a research agenda that focuses on how these approaches can support and facilitate multi-level stakeholder engagement in innovation, addressing complex challenges through systemic and dynamic approaches. In the context of health, (Seidel et al., 2022) developed and tested an interoperability platform that enables the integration of various technological solutions to support healthy aging. The platform creates an ecosystem that allows users and other stakeholders to collaborate at scale, demonstrating the importance of a multidisciplinary approach in developing an effective innovation platform. Overall, these studies show that the establishment of an innovation platform that allows direct interaction at different levels of users is essential to overcome challenges and capitalize on opportunities in various sectors. By facilitating collaboration, knowledge exchange, and multi-level engagement, the platform can help create a more inclusive and sustainable innovation ecosystem.

Innovation platforms are important instruments in the innovation ecosystem, involving various elements such as individuals, groups, and organizations. The platform is often used in R&D activities by universities and related institutions. Innovation platforms are often used to facilitate collaboration among various stakeholders, such as universities, research institutions, governments, and industry. These platforms allow for a more efficient flow of knowledge and technology among different entities, which in turn accelerates the process of innovation and technological development. For illustration, in the agricultural sector, innovation platforms are used to bring together key actors such as research institutions, governments, and farmer groups to achieve common goals through better connectivity (Hardiyati et al., 2021). Inter-institutional collaboration, an innovation platform enables deeper collaboration among universities, industry, and research institutions. In China, for illustration, the Industry-University-Research (IUR) collaboration platform has evolved into a deep integration model, driven by innovation mechanisms involving the government and the market (Na Liu, 2022). In contrast, in Taiwan, University-Industry Collaboration (UIC) funding plays a direct role in improving the performance of university technological innovation (Tseng et al., 2020). The use of digital technology and the development of digital platforms a crucial elements in the management of innovation and the educational process. Studies in Russia show that the development of cross-sectoral digital platforms can increase cooperation among universities and the business community, leading to the creation of breakthrough technologies (Sergeevna et al., 2022). Open Innovation, in Germany, the concept of open innovation began to be adopted using an internet platform that involves external problem solvers in the corporation's innovation process. This allows for more effective technology transfer and access to previously hard-to-reach third-party knowledge (Piller et al., 2021). Economic Impact, several studies show that innovation platforms play an important role in supporting local and regional economic development. In Ukraine, fintech platforms play a role in overcoming the challenges faced by small innovative businesses through fundraising through crowdfunding methods and other financial tools (ZAHAROV, 2021). Innovation platforms serve as key linkages in the innovation ecosystem, facilitating collaboration among institutions, leveraging digital technology, and contributing to economic growth through innovative funding and collaboration mechanisms. The further implementation and development of this platform can accelerate technological innovation and economic development in various sectors.

Innovation platforms are gaining popularity as an approach to enhance multi-stakeholder collaboration in the innovation process. The platform

facilitates interaction and collaboration among a network of innovation actors and users, to introduce and utilize new knowledge (both technological and non-technological) in economic and social processes. Facilitation of Technology and Social Collaboration Innovation platforms not only rely on technological collaboration but also integrate social aspects into the innovation process. In this case, collaborative innovation supported by technology platforms brings together various actors such as companies, universities, research institutions, and governments to create new knowledge and technologies (Pigola et al., 2022). Integration of Science and End-Users Another study highlights the importance of the integration of end-users and various stakeholders in the process of social co-creation. This is important to ensure that new technology solutions are truly relevant and acceptable to users, leading to wider adoption (Kohlgrüber et al., 2021).

Innovation Platforms:

Definition according to OECD (1999):

- The Innovation Platform is an approach to enhance multi-stakeholder collaboration in innovation.
- The Innovation Platform facilitates interaction and collaboration within and among networks of innovation actors and users.
- Innovation platforms have the goal of introducing and utilizing any new knowledge (technological or otherwise) in economic or social processes.

Understanding according to Homann-Kee Tui et al. (2015):

"The Innovation Platform is a space to learn, act and change. This is a group of individuals (often representing organizations) with different backgrounds, skills, and interests, for illustration farmers, traders, food processors, researchers, government officials, and so on. Members come together to diagnose problems, identify opportunities, and find ways to achieve their goals. They can design and implement activities as a platform or coordinate activities by individual members".

"The Innovation Platform advises creativity and learning, and provides a safe environment for multiple actors to experiment and explore solutions to their common problems."

-- Homann-Kee Tui et al. (2015)

Systemic approaches and multi-actor networks systemic approaches involving a wide range of actors, including end-users, are also critical in innovations that require the transformation of socio-technical systems. For illustration, in agricultural knowledge and innovation systems in Europe, the participation of users such as farmers in multi-actor cooperation has proven to be effective in creating sustainable innovations (Cristiano & Proietti, 2022).

Openness and Knowledge Transfer OIPs, which allow the participation of various external actors, facilitate the transfer of technology and knowledge more openly and collaboratively. This study emphasizes the role of platforms as intermediaries among organizations and innovators, accelerating the flow of knowledge in the innovation process (Eito-Brun, 2022). Innovation platforms play an important role in facilitating multi-stakeholder collaboration, enabling the integration of new knowledge and technologies into social and economic processes. They not only accelerate technical innovation but also increase social adoption, ensuring wider relevance and acceptance of new technologies. The use of these platforms has proven to be effective in a variety of contexts, from technological innovations to social transformation in the agricultural and industrial sectors.

Innovation platforms are spaces for individuals with diverse backgrounds, skills, and interests to learn, act, and transform existing processes. Through this platform, members who may come from various organizations such as farmers, traders, food processors, researchers, and government officials come together to diagnose problems, identify opportunities, and find ways to achieve common goals. Use and Implementation of Innovation Platforms, innovation platforms allow various stakeholders to collaborate effectively, especially in solving complex problems. For illustration, this platform has been used in an educational context, where collaboration among academics and external stakeholders has successfully improved the learning process and the application of concepts in real contexts (Čolić et al., 2023). In addition, in the urban planning sector, these platforms have helped in addressing urban challenges by involving multiple actors through complex collaborations (Borghys et al., 2020). Collaboration for Social and Technological Innovation, the innovation platform also serves as a means for collaboration among different sectors, including the social and technological sectors. Studies show that this platform can be a link between communities and the industry sector in creating sustainable social and economic value (Cleaver et al., 2023). In this context, the involvement of various actors is essential to ensure that the innovation process can run effectively and relevant to local needs. Challenges and Opportunities in Platform Management, the management of innovation platforms requires special attention to various challenges, such as actor motivation, intellectual property rights management, and quality assurance. A study by (Osorno & Medrano, 2022) shows that effective platform design must consider the context of the ecosystem, innovation management, and co-creation support to maintain the sustainability of the platform as well as the interests of stakeholders (Osorno & Medrano, 2022). Collaboration and Learning on

Innovation Platforms, studies also show that innovation platforms can serve as effective learning spaces, where platform members can learn simultaneously and adapt quickly. For illustration, a platform developed to improve the quality of healthcare in Aboriginal communities in Australia shows that continuous evaluation and learning can help platform adaptation to achieve better outcomes (Bailie et al., 2020). The innovation platform provides a space for various stakeholders to collaborate, learn, and implement innovative solutions that suit local needs and global challenges. Nonetheless, the management of this platform requires attention to various aspects such as actor motivation, risk management, and quality assurance to ensure long-term success.

Innovation platforms are important tools that encourage creativity and learning, providing a safe space for various actors to experiment and explore solutions to common problems. The platform can be set up at various levels, from village to national, to address specific challenges in the value chain such as access to high-quality seeds or common issues such as access to agricultural credit. Learning and Experimentation in Innovation Platforms Innovation platforms often encourage experimental learning among their members. In Uganda, for illustration, innovation platforms focused on the coffee value chain have been shown to increase experimental learning among farmers. Through participation in platform activities, farmers can solve problems faced in the value chain and generate new solutions relevant to their needs (Ochago et al., 2023). In addition, in Europe, multi-actor involvement in agricultural and forestry innovation platforms shows that cross-sector collaboration can strengthen the innovation process through shared learning and broader actor involvement in innovation systems (Fieldsend et al., 2021). Transformation from Informal to Formal Structure Innovation platforms can evolve from informal networks to more formal structures, such as public-private partnerships, with the ultimate goal of becoming a sustainable entity. In many cases, the platform's success in achieving its goals allows its members to take on new challenges and continue to grow. For illustration, platforms in agriculture in Rwanda have shown that structural organizations in the value chain can be an entry point for mainstreaming technology and innovation, by building synergies among participating actors (Yongabo, 2022). Inclusion in the Agricultural Value Chain Innovation platforms also plays an important role in making the agricultural value chain more inclusive, especially for smallholders and medium-scale processors. Digital technologies and innovations implemented in these value chains have helped overcome the barriers to entry that smallholders often face, as well as improved market access and the adoption of new technologies that increase productivity and

economic sustainability (das Nair & Landani, 2020). Formation of Standalone Entities Many innovation platforms eventually evolve into standalone entities that no longer rely on external support. This is seen in the action of the development of conservation-based agricultural systems in South Africa, where smallholders who are members of innovation platforms have been able to build sustainable relationships with other institutions and develop solutions that are more resilient to climate change (Kruger et al., 2022). Innovation platforms play a critical role in addressing organizational, technological, and institutional challenges at various levels of the value chain. Through shared learning, cross-sector collaboration, and the transformation of informal structures into formal ones, these platforms can become self-sustaining and sustainable entities, with a significant impact on increasing inclusivity and sustainability in agricultural systems and related sectors.

The innovation platform is an important means that enables the process of change dynamically and systematically through collective action.

1. Facilitating Dialogue and Understanding among Stakeholders The innovation platform facilitates effective dialogue among various stakeholders, such as governments, the private sector, and society, to achieve a common vision of mutual benefit. Studies show that collaboration among these actors is important in addressing complex challenges, such as in the urban planning sector in Serbia, where collaborative platforms have successfully promoted changes in more sustainable urban planning practices (Čolić et al., 2023).
2. Identifying Innovation Barriers and Developing Alternative Solutions The innovation platform allows partners to jointly identify barriers to innovation and develop a variety of alternative solutions. In the context of agricultural technology development, for illustration, this platform has helped farmers in Rwanda overcome agricultural value chain problems through collaboration and shared learning (Yongabo, 2022).
3. Creating Motivation and a Sense of Ownership Toward Solutions Innovation platforms create motivation and a sense of belonging among their members, which is essential for the successful implementation of solutions. In a study on innovation platforms in the German automotive sector, it was found that the integration of online and offline interactions in innovation platforms can improve the process of sharing knowledge and create a sense of shared ownership of the resulting innovations (Aalbers & Whelan, 2021).
4. Facilitating Communication to the Top Level The innovation platform also serves as an effective communication channel to a higher level, allowing better decisions to be made based on input from various actors. For

illustration, in a study on the development of innovation platforms in the Swedish public sector, it was found that the adoption of open collaborative practices allows for more effective communication with external stakeholders, despite cultural and organizational challenges that must be overcome (Linåker & Runeson, 2021).

5. Better Decision-Making through Shared Learning Innovation platforms enables learning and cooperation among different actors to solve problems that reduce uncertainty. In a study on the application of development evaluation in Australia's primary health innovation platform, the results showed that continuous reflection and learning improved the quality of decisions taken by platform members (Bailie et al., 2020).
6. Contribution to Capacity Building through Communication and Exposure to Diverse Ideas Innovation platforms increase members' capacity through increased communication and exposure to new ideas. For illustration, an innovation platform focused on labor market inclusion in the UK shows that collaboration among stakeholders delivers positive results in innovative service design and increases service user capacity (Lindsay et al., 2021).
7. Supporting Innovative Research Innovation platforms also support innovative research by providing space for experimentation and the development of new solutions. For illustration, an open innovation platform in the management of transfer technology in Germany allows companies to collaborate with external actors in the innovation process, resulting in more effective new technology solutions (Piller et al., 2021).
8. Impact on user business development through innovative solutions Finally, innovation platforms have a significant impact on user business development by providing innovative solutions that come from the collaboration of elements within the platform. For illustration, a study on innovation platforms in the context of smart city development in Finland shows that platform innovation can accelerate urban renewal and improve living conditions in urban centers (Parjanen & Rantala, 2021).

These overall benefits show that innovation platforms are powerful tools in driving systematic and collective change that support the development of sustainable technologies and social solutions.

The development of an innovation platform based on open innovation is increasingly important in facilitating the flow of knowledge and information from internal and external sources. These platforms are often in the form of website media that are connected to various related elements and include services ranging from innovation concept development, R&D, and incubation facilitation to marketing services. Improving Knowledge Flow Through Open

Innovation Platforms, open innovation-based innovation platforms allow companies to move from a closed innovation approach to a more open and collaborative model. In a study conducted by (Piller et al., 2021), the use of internet platforms allows companies to engage external problem solvers in the innovation process, which offers new potential in knowledge and technology transfer. Integration of Knowledge and Collaboration in Innovation Development, the integration among scientific databases and OIPs has shown great potential in supporting collaboration and the development of innovation networks. (Eito-Brun, 2022) explains how this integration can facilitate the creation of new knowledge through collaboration among organizations and innovators in a broader context. User-Centric Platform Design, the success of an open innovation platform depends on how it is designed with actual user behavior in mind. Research by (Digmayer & Jakobs, 2020) shows that community engagement and a focus on communication usability are key to creating an effective platform for collective-based product development. Facilitating Collaboration for Open Innovation, in a competitive knowledge-based economic environment, closed innovation is no longer enough to meet market demands. Therefore, companies need to build an open innovation ecosystem that integrates external resources. (M. Wang et al., 2022) emphasized the importance of building a collaboration platform that can facilitate the collection of ideas and external resources for innovation. Improving Business Performance through Open Innovation, open innovation is not only relevant for the development of new products but can also be used to improve overall business performance. A study conducted by (Avunduk et al., 2023) shows that open technology strategies act as an important mediator between external sources of knowledge and business performance, especially in the context of large companies in developing countries. The development of an open innovation-based innovation platform is an important strategy to facilitate the flow of knowledge and collaboration among various stakeholders. The platform can improve the innovation performance of enterprises and provide access to a wider range of resources and knowledge, as well as support the development of a strong collaboration network.

Open Innovation is an approach that allows organizations to access external partners to obtain Intellectual Property Rights (IPR) and accelerate innovation breakthroughs. This approach allows innovations to reach the market faster at the right time.

1. Market Push refers to the market push that directs companies to develop innovation. Innovation is driven by market needs and emerging trends. For illustration, in high-tech industries, innovation is often driven by rapid

changes in market demand and emerging new technologies, prompting companies to innovate to stay competitive (Niu, 2022).

2. An internal technology base is the foundation of technology that is owned and developed internally by a corporation. This includes the R&D resources that exist within the corporation. Research shows that although open innovation advises external collaboration, the success of innovation still depends on the strength of the corporation's internal technology base (Elia et al., 2020).
3. The external technology base includes technologies and knowledge acquired from outside the corporation. This can be through technology acquisitions, licenses, or collaborations with external partners. Studies show that the acquisition of external technology can improve the efficiency of a corporation's innovation, especially when companies choose to actively seek technology from outside (Wu, 2022).
4. Licensing, spin-outs, and divestiture are strategies to take advantage of the technology that has been developed. Companies can permit technology to third parties, form spin-out companies to further develop technology, or divest technology assets. Studies show that technology licensing can be a strong signal of innovation, although its impact on market value varies depending on the context and strategy of the corporation (Cabaleiro-Cerviño & Burcharth, 2020).
5. Internal and external business management in the context of open innovation involves the integration of internal knowledge with external sources. This requires an effective management strategy to coordinate scattered innovation activities. This management is important to ensure that internal and external resources are used synergistically to improve innovation performance (de Faria et al., 2020).
6. External technology outsourcing is the practice in which companies adopt technology from outside into their internal operations. This is often done to accelerate innovation and increase the competitiveness of the corporation. Studies show that outsourcing technology can improve a corporation's innovation performance, especially when companies can absorb and implement the technology (F. Liu et al., 2024).

Open Innovation allows companies to be more flexible and responsive to market changes by leveraging internal and external resources. This strategy requires effective management to maximize the benefits of external and internal collaboration and ensure that innovations can be commercialized successfully.

In the traditional pattern, technology developers and end-users work together to commercialize the technology. However, in the era of open innovation, this pattern has changed with intensive interaction among innovators such as governments, universities, R&D institutions, financial institutions, industry, and consumers in the process of commercializing research results. Changing Roles and Cross-Sector Collaboration, in open innovation, collaboration among universities and industry is the key to the commercialization of innovation. Studies show that this collaboration enables knowledge acquisition and talent recruitment, which significantly improves the commercialization performance of the technology (Hsu et al., 2021). This collaboration also advises the creation of innovations that are more relevant to the needs of industry and society. A Holistic Approach to Commercialization, a more holistic approach to open innovation can be seen in the model used by the Industrial Technology Research Institute (ITRI) in Taiwan. ITRI develops a platform-based system that integrates ideas, research, and commercialization in one coordinated system. This allows for more efficient management of innovations from ideas to commercial products (Y. chu Wang et al., 2021). Integration and Enhancement of the Role of Institutions, intermediaries Intermediary institutions, such as incubation institutions and accelerators, play an important role in connecting innovators with the market. This role includes helping SMEs to access public funding and improve their ability to commercialize new technologies (Longhini et al., 2023). Integrated Commercialization Model, another study proposes an integrated commercialization model that focuses not only on technical aspects but also on effective project management and economic value creation through technology transfer. This model has proven to be effective in overcoming obstacles that often arise in the process of transferring technology from the laboratory to the market (Malec et al., 2020). The Effect of Funding on Commercialization, differences in funding sources, such as government versus industry funding, have a significant impact on the commercialization process. Studies show that industry funding tends to encourage the commercialization of research results more than government funding, which focuses more on long-term development and academic exploration (Babina et al., 2020). Challenges and Solutions in Local Contexts: In the context of developing countries, such as Vietnam and Nigeria, the promotion of commercialization of research results is often faced with limited quality of research results, lack of connectivity among universities and industry, and limited access to financial resources. Proposed solutions include strengthening cooperation among universities and industry and providing sustainable funding mechanisms (Huu Xuyen et al., 2020). The era of open innovation has brought significant changes

in the way research is commercialized, by increasing cross-sector collaboration and utilizing external resources more effectively. Existing challenges can be overcome through a more integrated and collaborative approach, involving a wide range of stakeholders from the early stage to commercialization.

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Chapter 3
WHY INNOVATION PRODUCTS FAIL IN THE MARKET?

Yudi Widayanto, Warseno

3.1. Success and Fail Product Innovation in the Market

Product innovation is a key element in maintaining business competitiveness in a dynamic market. This innovation is a continuous process that includes the development of new ideas, product improvements, and meeting customer needs more effectively. Recent scientific articles emphasize the importance of product innovation in the face of increasingly fierce global competition and increasingly specific customer needs. For illustration, research by (Riesener et al., 2023) develops a framework for the implementation of sustainable innovation on technical products, which aims to improve the competitiveness of companies. In addition, research by (Timotius, 2023) shows that product innovation contributes by 53.1% to increasing the competitiveness of companies in small and medium enterprises in Indonesia. Furthermore, (Ahmed et al., 2020) highlighted that process and product innovation complement each other in increasing the speed and quality of innovation, which in turn improves the marketing performance and competitiveness of companies. In addition, another study by (Machmud et al., 2022) confirmed that information technology-based innovations are significant in increasing business competitiveness, especially in small businesses in Indonesia. Product innovation not only improves product quality, but also plays an important role in business strategy. A study by (Mandal, 2022) shows that product innovation and development are important strategies in a competitive business environment in the digital era. On the other hand, (Dewanti et al., 2023) emphasize the role of modulation-based innovation in increasing product competitiveness, which is evident from the increase in sales volume. Overall, product innovation is an essential process for companies to stay competitive in an ever-changing market. These innovations not only affect product quality but also play a role in broader business strategies, which can ultimately determine the long-term success of a corporation.

In the process of innovation, Joseph Schumpeter (1942) in (Malerba & McKelvey, 2020) divided into three important stages that explained how new superior technologies could enter and spread in the market. These stages include: Discovery Stage, innovation Stage, and diffusion stage. Each of these

stages plays a crucial role in ensuring the success of the new technology in the market.

1. The discovery stage is the first stage in which a new invention, be it a product, process, or technology, is first developed. At this stage, the main focus is on research and development (R&D) that enables the creation of innovation. Research by (Manji, 2022) emphasizes that invention is an integral part of an effective innovation strategy, where the development of new technologies is key to improving corporation performance.
2. The innovation stage occurs when the new product or process is launched to the market. Innovation includes not only product launches but also strategies to address challenges in a competitive market, such as determining the right launch time and effective marketing strategy. For illustration, (Timotius, 2023) highlights that successful product innovation can increase a corporation's competitiveness by up to 53.1%, showing how important this process is in business strategy.
3. The diffusion stage is the process by which successful innovations are widely spread and adopted by the market. This diffusion is the stage where innovation becomes an industry standard or is widely adopted by consumers. According to (Johanning et al., 2020), the success of diffusion is highly dependent on market acceptance and the integration of innovation into everyday practice, which ultimately expands the adoption of this new technology.

The process of discovery, innovation, and diffusion is a key component in innovation management. These three stages work together to ensure that new technologies or products are not only discovered but also widely adopted, thus providing a sustainable competitive advantage for the corporation.

The fail innovative products in the market is often caused by several key factors related to the lack of real value offered to customers, as well as weaknesses in development, implementation, and marketing. While a product may appear technically sophisticated, it will not succeed if it does not meet market needs or if the launch process is not supported by an effective strategy. One of the main reasons for innovation failure is the lack of a deep understanding of consumer needs and wants. Research by (Reshetilova & Kuvaieva, 2021) shows that more than 30% of consumer products and about 20% of industrial products fail in the market because these products are developed based on new knowledge without taking into account the actual market needs. This makes it clear that careful market research is the key to successful innovation. In addition, (D'Attoma & Ieva, 2020) highlight that marketing innovation, such as product design and promotion, plays an

important role in the success or fail technological innovation. For illustration, innovation in product promotion can have a negative impact on the success of innovation if not done correctly. This shows how important the role of effective marketing is in supporting innovative products. In addition, (J. Kim, 2022) found that companies that fail to innovate, especially when faced with financial constraints or lack of R&D intensity, tend to experience slower growth compared to companies that do manage to innovate. This shows that innovation failure can have a direct impact on a corporation's growth. On the other hand, (Rutkowski, 2022) notes that although there is a common belief that the failure rate of new products reaches 90%, empirical research shows that the actual failure rate is lower, but still significant, mainly due to ineffective new product strategies. This underscores the importance of a solid strategy in product development and launch. Innovative products can fail in the market due to several key factors, including a lack of understanding of consumer needs, failures in marketing strategies, and an inability to effectively manage product development and launch. To avoid these failures, companies need to ensure that their products actually provide real value, and that the entire development, implementation, and marketing process is well executed.

The real value that determines the success of an innovative product in the market depends largely on the extent to which it can meet the specific needs of consumers and provide significant benefits to them. This concept is often referred to as "consumer value" or "value proposition," where an innovative product must be able to answer a problem or need that cannot be met by other existing products. First, research by (Reshetilova & Kuvaieva, 2021) shows that the fail innovative products often occurs because they are not developed based on a deep understanding of the actual market needs. This means that the product must have value that is perceived by the consumer to be accepted in the market. Additionally, research by (Akhtar, 2023) highlights that a corporation's innovative capabilities, including the ability to understand and meet consumer needs, are key in ensuring innovative products can succeed in the market. Innovations that not only create new products but also maximize benefits for consumers tend to be more successful. Another study by (Aibar-Guzmán & Frías-Aceituno, 2021; García-Sánchez et al., 2021) found that innovative products that emphasize environmental sustainability can increase sales growth if consumers see real value in the environmental aspects of the product. This implies that the value offered by the product should be in line with the specific preferences and needs of consumers, including more abstract values such as sustainability. Research by (Hajar et al., 2022) also emphasizes that value innovation that focuses on customer satisfaction and loyalty plays an important role in ensuring the long-term performance of companies.

Successful innovation is one that is not only new and different, but also provides more value that is recognized and appreciated by consumers. The real value that determines the success of an innovative product in the market is the extent to which it can meet the specific needs of consumers and provide perceived benefits. Products that are able to bid concrete solutions to consumer problems, and whose marketing strategies are designed to highlight those benefits, are more likely to succeed in the market.

The fail innovative products in the market is often caused by several key factors related to product development, consumer understanding, as well as project management.

1. New products have no competitive advantage, fail to meet consumer needs, and are unable to differentiate themselves from competitors' products. Innovative products must have clear advantages and meet the needs of consumers to succeed in the market. Research by (ReshetiIova & Kuvaieva, 2021) shows that many products fail because they do not consider the actual market needs, so they cannot compete effectively.
2. New products are weak in the early stages of product development, which leads to a lack of adequate information regarding feasibility studies and new product concepts. Weak early stages of product development are often caused by a lack of adequate research, resulting in product failure. According to (Syhyda, 2022), many innovation commercialization models fail because they do not pay enough attention to the technical and commercial feasibility of innovation ideas.
3. Lack of input and insight from consumers, which causes new products not to match consumer needs and wants. Input from consumers is very important in successful product development. A study by (J. Kim, 2022) shows that fail understand consumer needs can hinder a corporation's growth, especially when consumer input is ignored in new product development.
4. Product specifications are unstable and slow in determining product definitions, which is often caused by a lack of complete information at the beginning of the process. The instability of product specifications often leads to delays and inefficiencies in product development. According to (Tsygankov et al., 2023), constant changes in product requirements during the development process can disrupt project schedules and final product quality.
5. The corporation is not focused, which happens because it does not consider the availability of resources when deciding to carry out the project, which results in poor product quality. The right focus and allocation of resources is critical to the success of an innovation project. A study by (D'Attoma &

Ieva, 2020) shows that failure in managing resources, such as insufficient focus on marketing innovation, can result in innovation failure.

6. The lack of competence, skills, and knowledge of project team members, which makes new product development projects difficult to implement. Team competence and knowledge are essential in executing complex innovation projects. According to (Forsman, 2021), innovation failures are often caused by a lack of competence in the development team, which can hinder the entire innovation process.

These six factors show that the fail innovative products in the market is caused by a combination of lack of competitive advantage, inadequate product development, lack of input from consumers, unstable specifications, poor resource allocation, and lack of team competence. Addressing these challenges is key to increasing the success of innovative products in the market.

3.2. Challenges and Failure Rates in the Innovation Process

The innovation process is holistic, which is divided into three main stages: R&D/Invention, innovation, and imitation/Diffusion. Each of these stages shows the various challenges faced by innovation projects, from technology creation to product diffusion to market. Figure 16 illustrates how the cost of innovation increases as the project progresses.

1. R&D/Invention stage: at this stage, about 60% of projects fail technically, which indicates that most innovations do not make it past the technology creation stage. Only about 22% of all projects have been successfully introduced to the market, while another 18% have been stopped due to casualty of economic potential.
2. Innovation stage: once a product is introduced to the market, the challenges do not stop there. As many as 60% of the products introduced have failed from the economic aspect, only 40% have succeeded economically. This shows how difficult it is to maintain a competitive edge and product relevance in the market.
3. Imitation/diffusion stage: only about 8.8% of all R&D projects make it to the diffusion stage, where the innovation is widely adopted by users. It emphasizes that although innovation is technically and economically successful, not all products can be widely adopted by the market.

Overall, figure 16 illustrates how high the failure rate in the innovation process, from the early stages to adoption by the market. This is also in line with the results of a survey conducted by the Association of University

Technology Managers (AUTM) in 2000 in the United States, which showed that out of 100 thousand inventions, only about 250 succeeded as startups.

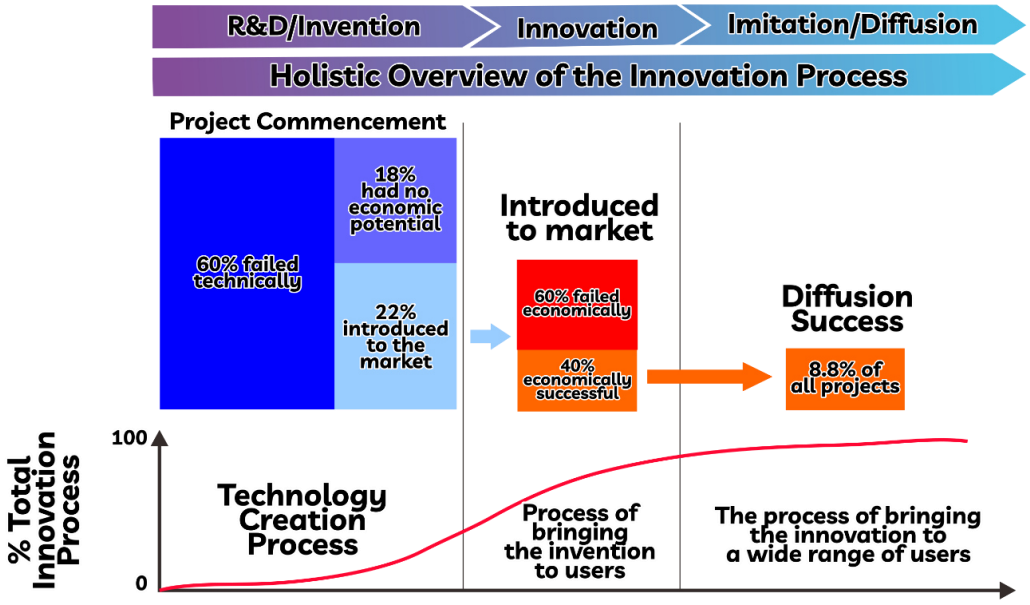

Figure 3.1. Outcome of innovation activities (source: Frank H. Maier 1998).

Figure 3.1. provides a comprehensive overview of the innovation process, which consists of several main stages: R&D / Invention, innovation, and imitation / Diffusion. This process illustrates that technological innovation involves a series of phases from creation to its diffusion or dissemination in a wide market. Here is a detailed interpretation of each section in this image:

1. Technology Creation Process

   The process of creating technology is a very important initial stage in the innovation journey. At this stage, companies or researchers focus on developing new ideas that have the potential to become innovative solutions or products. This stage includes everything from basic research to prototype development and concept testing, as well as the technical validation of an innovation. However, many challenges are faced at this stage that lead to a very high failure rate. In the earliest stages, innovation starts from ideas or concepts developed through R&D. These innovations are often born from scientific discoveries or endeavors to meet unmet market needs. This process involves the exploration of new theories, experiments, and the development of initial prototypes. Illustration: In the field of technology, the development of new hardware, algorithms, or raw materials is often the result of this stage. However, this process does not always run smoothly because it faces many challenges, such as technical

problems, high research costs, and a lack of expertise or adequate resources.

Statistics show that 60% of innovation projects fail technically at this early stage. The main causes of technical failure include:

- technology limitations: many innovations fail to achieve the desired results because the technology used is still too new or not mature enough to be commercialized.
- lack of funding: r&d of technology requires enormous costs. without adequate funding, many projects stall before they can reach a further stage.
- constraints in prototype testing: early prototypes often fail trials due to performance, quality, or conformance issues with the identified requirements.
- lack of infrastructure support: the development of technological innovations often requires highly sophisticated infrastructure, which may not be available everywhere.

As a result, the majority of innovation projects are unable to go beyond this early stage because they fail to solve technical problems or find effective solutions to the challenges they face.

Of the 40% of projects that successfully overcome technical challenges, 18% of these projects have no economic potential. This means that even if the technology developed is already functioning and operating well, these innovations are not attractive to the market or have no commercial potential. Some of the reasons for this economic failure include:

- mismatch with market needs: technology may be sophisticated and efficient, but if it does not meet consumer needs or does not match market trends, the product will be difficult to sell;
- high production costs: many technologies are expensive to produce, so even though they have market potential, their selling prices are too high and uncompetitive;
- regulation and licensing: in some cases, the products developed may face regulatory constraints, such as safety, health, or environmental rules, which make them difficult to market;
- lack of marketing strategy: innovation that is not accompanied by a good marketing strategy will have a hard time attracting the attention of potential customers, even if the technology is good.

Of the total projects started, only 22% of the projects were successfully introduced to the market. Innovations that make it to this stage are those that not only succeed in solving technical problems, but also show that there is a market interested in buying or using the technology. This stage involves:

- market validation: before a product is launched, companies typically conduct validation to find out if there is enough demand in the market. this often includes market trials, customer surveys, or pre-orders.
- technology commercialization: technologies that have passed the testing stage and have shown economic potential are beginning to be introduced to customers. this requires great effort in terms of production, distribution, and marketing.
- strengthening the business model: at this stage, the corporation develops a business model that supports the commercialization of the product, including pricing, distribution strategies, and business partners.

Illustration, companies that have succeeded in bringing technology to market, such as Apple with the first iPhone, have not only solved technical problems in the development of the device but have also managed to create a strong market demand for the product. Despite being successfully introduced to the market, not all technologies can survive in the long term. Innovation must be able to overcome market competition, continue to adapt to consumer needs, and adjust marketing strategies to remain relevant and competitive. Many technologies are initially accepted by the market, but then fail due to various reasons such as the emergence of competitors with better technology, or changes in market needs that are not anticipated.

The technology creation stage is the most critical phase in the innovation cycle as it determines whether the innovation can progress further to the commercialization stage and ultimately achieve market success. With the high rate of technical and economic failure, few innovations have been able to survive and be successfully introduced to the market. This is why the innovation process requires careful planning, sufficient resources, and good strategies to deal with various challenges that may arise at each stage.

This process also highlights how important it is to be able to not only create innovative technologies, but also ensure that those innovations have strong economic potential and are in line with market needs. According to research, marketing innovation has an important role in the success or fail technological innovation. The results of a study on companies in Germany

showed that innovation in product packaging and design was positively correlated with innovation success, while promotional innovation actually increased the likelihood of innovation failure (D'Attoma & Ieva, 2020). Proactive Marketing Orientation in Product Development in the High-Tech Sector This study highlights the importance of proactive marketing orientation in the high-tech sector to reduce the risk of market fail innovative products. This can be achieved by better understanding the latent and future needs of consumers through future studies and foresight (Grzegorczyk, 2020).

This study discusses how tolerance for innovation failure affects technological development. There are four pathways that can increase tolerance for innovation failure, namely through tolerance for technology, market, funding, and policy failure. Policies that encourage a more tolerant environment for innovation errors can increase the chances of technological innovation success (L. Wang, 2023). This study emphasizes the importance of policy combinations to address transformational failures in technological innovation systems, especially when new systems compete with existing systems. Case studies on electric vehicles show that careful policy interventions can help new systems compete with older systems (Raven & Walrave, 2020).

Network failures can affect collaboration between companies in the innovation process. By mitigating these risks, U.S. government policies help build new institutions to support strong and trusted networks of work in technological innovation (Block et al., 2020). Technological innovation failures often occur due to market, technology, and policy uncertainties. The combination of the right policies, proactive marketing orientation, and tolerance for failure can help reduce the risk of failure and drive innovation success.

2. The Process of Introducing Technology to Users

The process of technological innovation depends not only on technical success, but also on the ability to commercialize after the technology is introduced to the market. At this stage, many innovations are faced with the great challenge of adapting their products or solutions to market needs. Of the 22% of technologies that have reached the market, 60% of them have failed economically. This shows that even though the technology is technically proven, the ability to survive in the market and achieve profitability is often a major challenge. This failure can occur due to several factors, including the mismatch of the product with consumer needs or expectations, ineffective marketing strategies, improper pricing, and the corporation's inability to compete with similar products or

technologies. One of the main factors of technological failure in the market is the inability of such innovations to solve real problems for consumers. Studies highlighting the mismatch between new products and consumer needs state that it is important for companies to conduct in-depth market research before launching products. Identifying the right market segments and understanding their specific needs is key to ensuring new technologies are acceptable to terminate-users (P. Wang et al., 2021). Technology failures in the market are often caused by inadequate marketing strategies. A good strategy includes not only promotion and distribution, but also pricing, positioning, and adaptation to the local market. According to research, many innovations fail due to ineffective marketing strategies, especially in delivering the added value of new technologies to consumers appropriately (Z. Li & Wang, 2021). Pricing is often a critical factor in the commercialization of technology. Many innovations fail because their products are considered too expensive or do not provide value-for-money for consumers. In the context of technology, especially in a highly competitive market, cost is an important factor to attract buyers, especially when there are many technological alternatives available in the market (Grzegorczyk, 2020). Competitive pricing while maintaining sufficient profit margins is a major challenge for many technology companies. New technologies that are too complex or require significant changes to existing infrastructure can experience difficulties in market adoption. Even if the technology is theoretically technically superior, if the terminate-user finds it difficult to implement or use the product, then the adoption rate will be low. Implementation complexity is often the reason why new technologies fail to achieve the expected profitability (Block et al., 2020).

3. Technology Success Factors in the Market

An economically successful technology is one that can provide real solutions for consumers and answer specific needs in the market. By focusing on user experience and tailoring product features to daily needs, companies can increase customer adoption and satisfaction. Research shows that companies that have the flexibility to adapt technology according to consumer feedback have a greater chance of success (Brown et al., 2021). A technology that works in the market is one that is backed by a well-thought-out and well-planned marketing strategy. Proper promotion, clear positioning, and effective distribution are important factors in supporting the commercial success of new technologies. Additionally, research also shows that companies that can take advantage of digital media and modern marketing trends tend to be more successful in marketing their innovative technology products (Johnson, 2022).

Economically successful technologies usually have a competitive advantage that sets them apart from other technologies already on the market. This could be an innovation that provides a better solution, a more competitive cost, or more features that competing products do not have. In many cases, product differentiation is the key to success in a highly competitive market (Raven & WaIrave, 2020). Although many technologies have been successfully introduced to the market, more than half have failed to achieve economic success. Factors such as mismatch with market needs, poor marketing strategies, and uncompetitive pricing are some of the main reasons for such failures. On the other hand, successful technology is technology that can provide real value to consumers, supported by effective marketing strategies, and has a competitive advantage in the market.

4. Successful Diffusion

The process of diffusion of innovation is one of the most critical phases in the life cycle of a technology. Although an innovation may be successfully introduced to the market and economically profitable, not all innovations can reach mass adoption rates or become mainstream products that are widely used by the global market. According to the data shown, only 8.8% of the total innovation projects achieved successful diffusion, which is the phase in which innovation is widespread and adopted by the market on a large scale. One of the factors that affects the rate of diffusion is how quickly the technology is adopted by consumers. Technology adoption is influenced by several important elements such as complexity, compatibility, and the relative advantages of the technology over existing solutions. The easier the technology is to implement and the greater the advantages, the more likely it is to be widely adopted. For illustration, research shows that high technology adoption tends to occur in products that provide a significant competitive advantage and are easy to integrate into consumers' daily lives (Rogers et al., 2020). Not all innovations are widely accepted due to resistance in the market. Some technologies face challenges in terms of established consumer preferences, local cultures, or specific regulations. Resistance to change is a major obstacle to innovation diffusion, especially in sectors where users are already familiar with old technologies or methods. Research shows that cultural barriers and differences in market preferences are key factors that often hinder the diffusion of technology, especially in global markets that have different segments and dynamics (Xu & Zheng, 2021).

Technologies that require significant supporting infrastructure often experience diffusion resistance. For illustration, technologies that rely on

strong communications, electricity, or distribution infrastructure networks will not be easily adopted in less developed regions. Support from the government and regulations also greatly affects the success of diffusion of a technology. Strict regulations or a lack of policy support can slow down the pace of adoption of new technologies in different regions (Bai et al., 2022). Technology diffusion also often depends on the network effect, where the more users adopt the technology, the higher the value of the technology for new users. Illustrations of this network effect are technology products that rely on ecosystems such as smartphones and software that are only effective when many people use them. In addition, economies of scale in the production and distribution of technology allow for such technologies to become cheaper and more accessible, ultimately driving wider adoption (Grønhaug, 1978).

5. Successful Diffusion Technology: Successful Cases

Products that are able to solve specific problems more efficiently than existing technologies tend to achieve wider diffusion. Research shows that innovations that bring a clear competitive advantage have great potential to become mainstream, especially if they bring significant changes in the way of life or consumer productivity. An illustration of this success can be seen in the adoption of technologies such as smartphones and the internet of things (IoT) that are able to provide a better user experience and are more integrated with daily life (J. Li & Luo, 2020). Technologies that achieve successful diffusion are often supported by strong market penetration strategies, including effective promotion and distribution. Effective marketing is not only about promoting products, but also includes educating the market about the benefits of new technologies. In addition, collaboration with key players in the industrial ecosystem can accelerate the diffusion of these innovations. Research suggests that companies that collaborate with key stakeholders, including governments, industry players, and key consumers, are more likely to achieve successful diffusion (Murray & JiIani-Hyler, 2021). Although some technologies manage to achieve successful diffusion, most innovations fail at this stage due to the very high level of risk. Of the total innovation projects, only 8.8% actually achieved wide diffusion in the global market. This reflects that although the technology has successfully overcome technical and commercialization challenges, there are still very significant barriers to achieving global adoption. Technological innovations have a very high level of risk and failure from the early stages to achieving mass adoption. Factors such as market resistance, supporting infrastructure, network effects, and ineffective marketing strategies are often the main barriers to achieving

successful diffusion. On the other hand, successful technologies in diffusion are those that are able to meet market needs, supported by the right marketing strategy, and have adequate infrastructure support.

6. Stages in the Innovation Process

R&D, innovation, and imitation/Diffusion are the three critical stages in the cycle of technology development and innovation. Each of these stages has specific characteristics that can affect the success or fail the technology in achieving broad market adoption. The R&D stage is the initial stage where new ideas and technologies are created and developed. Here, the R&D team focuses on exploring new knowledge, experimenting, and developing innovative products or technologies. The main focus is on the technical and scientific aspects, which often involve laboratory trials, simulations, or prototypes. At this stage, the risk of technical failure is very high because the innovation is still in the conceptual stage or the beginning of technical implementation. Characteristics, exploration of new ideas and innovative technologies, experimentation and testing of hypotheses to determine the feasibility of the technology, and technical failures can occur frequently, especially when new technologies are immature or untested. Illustration Literature: Research by (Jin & Kim, 2021) found that R&D activities are critical in creating impactful technological innovations, but the results of this R&D do not always lead to successful innovations in the market due to major technical challenges.

Once the technology is technically proven in the R&D stage, the innovation enters the stage where the technology is introduced to the market. The main goal at this stage is to create economic value from technical innovation. Many technologies that are technically successful at the R&D stage may fail at this stage of innovation because they are not able to achieve economic success in the market, or do not meet the needs of the existing market. Challenges in this stage are often related to market acceptance, cost, and the ability to innovate to meet customer needs. Characteristics, technology is introduced to the market for the first time, the main challenge is related to the ability of technology to be accepted by the market and there is a risk of economic failure, even though the technology is technically successful. Illustrations of Literature: A study by (Ramirez, 2021) shows that the innovation process depends not only on technical success, but also on the ability of companies to effectively market and commercialize their technology. In addition, research by (Zhang, 2022) states that poor market dynamics and marketing strategies can result in innovation failures, even if the technology performs well in technical trials.

The final stage in the innovation cycle is diffusion, which is the process by which a new technology or product is widely adopted by users or markets. This diffusion is a measure of how far innovation can spread and be accepted by the market. At this stage, factors such as imitation by competitors, technological adaptation, and social and cultural acceptance play a significant role. Successful technologies at this stage are those that have successfully overcome technical and economic challenges, and are widely accepted by society and the global market. Characteristics, technology is beginning to be widely adopted by consumers or terminate-users, imitation by competitors is frequent and can accelerate the diffusion of technology, and market acceptance depends on social, cultural and economic factors. Literature illustrations: Based on research by (Alipanah et al., 2021), imitation by competitors and adoption of technology by early adopters play an important role in the process of diffusion of innovation. In addition, research by (Martin et al., 2003) highlights that technology diffusion is heavily influenced by marketing strategies as well as support from government and industry institutions. Each stage in the innovation cycle (R&D, innovation, Diffusion) has its own challenges and risks that affect the success of the technology in the market. Failure can occur at the R&D stage due to technical challenges, at the innovation stage due to economic challenges, or at the diffusion stage due to a lack of widespread market adoption. The success of technology depends on the ability to get through each of these stages with the right strategy. This image shows that the innovation process is fraught with challenges and a high failure rate. Only a small percentage of innovations have succeeded in achieving diffusion success after going through various stages, from R&D to widespread market adoption.

According to (Kotsemir & Meissner, 2013), the success rate of innovation is highly dependent on risk management and a strategic approach in the development of new products. (Eytan Sheshinski et al., 2021) shows that while there is great potential in technological innovation, the market often does not respond well if the product cannot create clear and measurable value for consumers. A study by (Khosravi et al., 2023) emphasizes that cultural and organizational barriers also play an important role in innovation failure, particularly in the diffusion stage. In this context, innovation management requires a comprehensive and strategic approach to address the various challenges that arise at each stage of the innovation process. Only then can the chances of innovation success be increased.

In recent decades, technological innovation has often been dominated by a technology push approach that focuses more on creating new technologies without adequate consideration of market needs. This leads to many inventions that do not have a clear target market and fail to understand consumer needs in-depth (Adiwijaya et al., 2021). In a study conducted by (Ibrahim et al., 2022), it was found that new products developed with a technology push orientation often do not have a strong competitive advantage in the market. These products are not able to meet consumer needs optimally and fail to distinguish themselves significantly from competing products. Furthermore, research conducted by (Jiang et al., 2023) shows that approaches that ignore market pull or market insights often result in products that fail in the market, due to the lack of a deep understanding of consumer preferences and market dynamics. This is in line with the findings put forward by (Kumar et al., 2021), where many new technology companies fail to survive in the market because they are unable to adapt their products to the actual needs of consumers. Furthermore, research by (X. Wang et al., 2022) confirms that the integration between technology development and market insights is essential for the commercial success of a product. They found that companies that are able to balance between new technologies and market needs tend to perform better in the long term. The dominance of the technology push approach in innovation often results in products that are not competitive and fail in the market. Therefore, it is important for companies to pay attention to not only the technological aspects but also a deep understanding of the intended market so the innovation to be commercially successful.

Eric Reis's statement in his book Lean Startup emphasizes the importance of a deep understanding of potential customers as the basis for determining product quality. This concept emphasizes that without proper knowledge of who our customers are, we will not be able to know what is considered a quality product by them. Therefore, the introduction to potential customers must start from the initial stage of creating innovative ideas to achieve an optimal Product-Market Fit. Recent research supports the view that understanding the needs and preferences of potential customers is key in creating quality products that are in line with the market. For illustration, a study conducted by (Brettel et al., 2012, 2014) shows that companies that actively involve customers in the innovation process tend to produce products that are more successful in the market. Customer participation in the early stages of product development allows companies to capture more specific needs and adjust product quality according to market expectations. Furthermore, research by (Köhler & Haferkamp, 2019) underlines that a strong Product-Market Fit can be achieved through a customer-centric approach,

where product innovation is aligned with the specific needs of the targeted market segment. They found that product failures were often caused by a lack of understanding of who potential customers were and what their needs were. Additionally, (Weir-Smith & DIamini, 2024) in their study emphasized that successful innovation is one that is driven by customer insights, where a deep understanding of customer demographics, behaviors, and needs guides product development from the start. This research shows that products tailored to customers' specific needs not only increase success in the market but also strengthen customer loyalty to the brand. Another study by (Chen et al., 2016) also highlights the importance of Product-Market Fit in ensuring the commercial success of products. They observed that products designed based on a strong understanding of the market and customers tend to be adopted more quickly by the market, as they are more relevant to the needs perceived by customers. In-depth knowledge of the customer is not only important for determining the quality of the product but is also essential in ensuring the product is acceptable and adopted in the market. The achievement of Product-Market Fit is highly dependent on the corporation's ability to recognize and adapt product innovations to the specific needs of customers.

3.3. Business Model Innovation and Its Role in Product Innovation Success

Successful product innovation often requires the support of adequate business model innovation. However, many product innovations fail due to the lack of changes in business models that match the ever-evolving industry trends. Business model innovation is a complex form of innovation and is often difficult to apply from one corporation to another. This is due to a variety of factors that require comprehensive changes, which involve not only technological and operational aspects, but also organizational elements and external relations of the corporation. Research by (Lindgren & Taran, 2022) shows that business model innovation plays a key role in the success of product innovation, especially in dynamic industries. They found that business model innovation can help companies adapt and maintain a competitive advantage amid rapidly changing industry trends. However, the main challenge in business model innovation is the need to make changes holistically, which involves many aspects within the organization and even involves collaboration with external parties. Furthermore, a study conducted by (Snihur & Bocken, 2022) discusses how business model innovation often requires fundamental changes in corporation structures and processes. This includes changes in the way companies create, capture, and deliver value to customers. Effective business model innovation must be able to navigate this

complexity by facilitating integrated changes in various organizational functions, including marketing, operations, and customer relations.

According to (Foss & Saebi, 2017), one of the main difficulties in business model innovation is internal resistance that often arises due to significant changes. They emphasized that success in business model innovation requires strong support from leadership and effective communication strategies to overcome obstacles that arise from within the organization. In addition, they also note that successful business model innovation usually involves a collaborative approach that involves all stakeholders inside and outside the corporation. Meanwhile, (Wirtz et al., 2021, 2023) highlight the importance of flexibility in business model innovation. They state that the business model must be flexible enough to adapt to market and technological changes, while remaining consistent with the corporation's long-term vision. In their study, Wirtz and Daiser emphasized that the difficulty in business model innovation often lies in the challenge of integrating change with existing processes, which can lead to conflicts and misalignments at various levels of the organization. While business model innovation is essential to support the success of product innovation, its implementation is not easy. The complexity of these innovations lies in the need to make profound and far-reaching changes across all aspects of the organization, which often requires a coordinated approach and strong support from all elements of the corporation. As such, the success of business model innovation depends not only on its design, but also on the corporation's ability to navigate and overcome the various internal and external challenges associated with it.

John Vyge's statement in his book "The Dragon's Den Guide to Real-World Business Models" emphasizes the importance of business models in determining the success of a product. Vyge revealed that although the product is the center of the business model, the product itself is not a business. The success of a product is not only determined by the quality or innovation of the product itself, but also by the business model that supports it. An effective business model will determine how the business operates, what products or services can be run, how much capital is needed, and how the business can make a profit. Research conducted by (Snihur & Zott, 2020) shows that business models function as interdependent systems that include a variety of integrated business activities. They argue that business models are not only about how companies create value, but also how that value is taken and maintained in the long term.

A strong business model allows companies to better respond to market dynamics and take advantage of new opportunities that arise (Snihur & Zott, 2020). (Foss & Saebi, 2017) in their study on business model innovation

emphasized that a good business model not only supports a product or service, but also allows companies to manage risk more effectively. They found that business model innovation is often the main differentiating factor between successful and failing companies, especially in an uncertain and competitive business environment. A well-designed business model provides a structure that allows the corporation to adapt to changes in the external environment and optimize its internal operations. In the context of startups, (Ries & Euchner, 2013) through the Lean Startup approach emphasizes the importance of validating business models from the beginning. Ries points out that many startups fail not because of a bad product, but because of an inadequate business model or not in line with market needs. This approach advises entrepreneurs to actively test and validate hypotheses about their business models before making large investments, thereby reducing the risk of costly failures. In addition, (Teece et al., 2022) highlights that an effective business model must include strategies to create and communicate a clear value proposition to customers. Without a business model that clearly describes how a corporation will generate and deliver value to customers, even the most innovative products will struggle to achieve market success. Teece also stated that a good business model must be flexible and able to adapt to changes in market demand and technological developments. A study by (Haefner & Gassmann, 2023) also shows that successful business models often involve innovative elements that disrupt the market or create new categories. They emphasized that innovation in a business model can be just as important as innovation in the product itself. For illustration, companies like Amazon and Uber are not only creating new products, but also introducing new business models that disrupt traditional industries. The business model plays a crucial role in determining the success of the product in the market. An effective business model not only supports the existence of the product, but also provides a framework for operationalization, risk management, and adaptation to market changes. Without a strong business model, even innovative products will struggle to achieve and maintain success in the market.

Technological aspects that have reached the Technology Readiness Level or TRL 7-9 often fail to reach the market due to a lack of attention to non-technological aspects such as marketing, manufacturing, management, and investment (figure 3.2.). At TRL 7-9, the technology is generally mature and no longer the main focus. However, to achieve success in the market, innovation must pass through the "Darwinian Sea," a metaphor for the great challenges that stand in the way of the transition from R&D to commercialization. Failing to pass this stage is often caused by management failures, technological

obsolescence, alternative business models, weaknesses in the legal process, acquisition conflicts, lack of capital, and other non-technical factors. At TRL stage 5-6, the technology is still in early development, and the main focus is on prototype upgrades and testing. As the technology advances to TRL 7-9, the focus shifts to the application of the technology on a larger scale and market readiness.

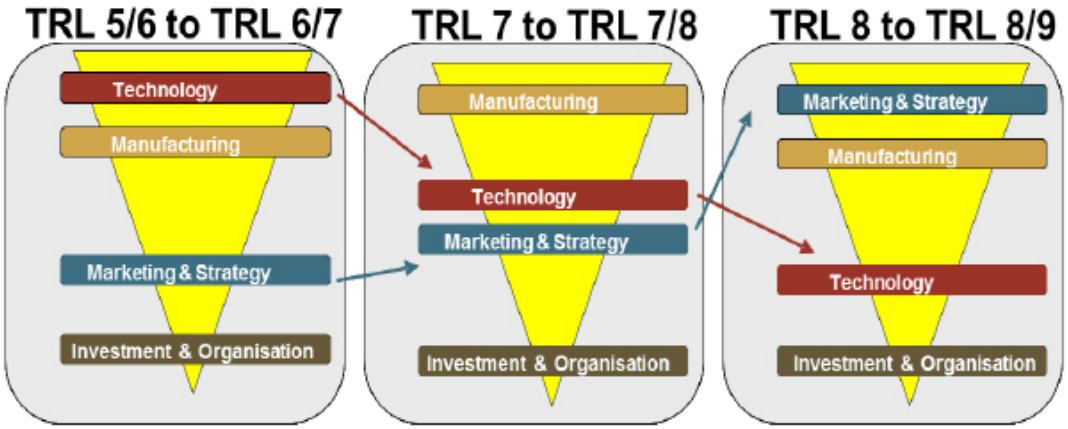

Figure 3.2. Characteristics of TRL 5 to TRL 9 (source: Duret D., et al., 2012).

However, as illustrated in the figure, technologies that have achieved TRL 7-9 often do not succeed in the market if the non-technological aspects are neglected. A study by (Mankins, 2017) shows that failures in innovation often occur not due to a lack of technological maturity, but due to the absence of adequate support in terms of marketing, manufacturing, and investment strategies. When the technology is ready, companies must focus on developing effective marketing strategies, ensuring manufacturing readiness, and securing sufficient investment to ensure commercial success. Research by (Blank, 2019) also supports the idea that successful innovations in the market are not only determined by technological aspects. Blank emphasized the importance of a strong and adaptive business model that can cope with market changes and competition. He also highlights that failures in innovation management are often caused by a corporation's inability to adapt to dynamic changes in the business environment.

In a more recent study, (Haefner & Gassmann, 2023) outlined that innovations that focus on technology alone without considering non-technological aspects can lead to failure in the market. They point out that companies must actively integrate marketing strategies, efficient manufacturing operations, and prudent investment management to ensure that the technologies developed can be accepted and adopted by the market. Research conducted by (Ries & Euchner, 2013) emphasizes the importance of

initial market validation and continuous iteration in business models to overcome challenges that arise at the TRL 7-9 stage. Ries notes that many technology companies fail because they do not focus on developing the non-technological aspects necessary to take advantage of mature technologies. In his comparison, (Teece et al., 2022) emphasizes that successful organizations in technology commercialization are those that are able to integrate technical knowledge with a comprehensive business strategy. Teece highlights that non-technological aspects such as marketing and investment often determine commercial success more than the technology itself, especially in the final stages of technology development. To successfully cross the "Darwinian Sea" and achieve success in the market, companies need to ensure that all aspects, both technological and non-technological, have been taken into account and managed properly. Fail do so will result in a product that, despite its advanced technology, still fails in the market because it cannot meet consumer needs and expectations.

Figure 3.3. Prototype of the N-250 aircraft developed by the Indonesian nation (source: PTDI, 1995).

The fail the development of the N-250 aircraft, which is one of Indonesia's ambitious projects in the aerospace industry, is often highlighted not because of its technical aspects, but rather because of some non-technical factors. Although the aircraft has been designed and engineered with highly advanced technology, several obstacles in financing, management, marketing, and politics are the main obstacles that prevent it from entering the market (figure 3.3.).

1. Financing aspect, the failure in the financing aspect of the N-250 project is largely due to the lack of policy support from the financial sector, especially from the banking sector, to finance the development and production of the aircraft. Research by (Bianchi et al., 2022) shows that strong policy support from the financial sector is essential for the successful commercialization of advanced technologies, including in the aviation industry. In the context of the N-250, the lack of capital and financing from national financial institutions hindered IPTN from continuing the development and production of this aircraft, which ultimately led to a failure in bringing this product to the market. In addition, (Calderon-Tellez et al., 2024) in their study highlight the importance of continuous financial support from the government for high-tech national strategic projects. They state that without adequate financial support, high-tech innovations often fail to reach the commercialization stage, especially in developing countries.
2. While the technology of the N-250 aircraft is highly advanced, failures in management and marketing are one of the main reasons why the aircraft did not succeed in the market. A study by (Tidd, 2023) emphasizes that good managerial skills, including in supply chain management and marketing strategies, are critical factors for the success of high-tech innovation in the global market. Furthermore, (Hertenstein & Williamson, 2018) in their research revealed that without an effective marketing strategy and qualified management, even highly innovative products can fail in the market. Limitations in the marketing of IPTN aircraft in domestic and international markets are significant obstacles that exacerbate this situation.
3. Political aspects also played an important role in the fail the N-250 project. Pressure from the IMF on the Indonesian government to stop funding IPTN projects, especially the N-250, is one of the most critical factors. (Gourevitch et al., 2012) stated that international economic policies often have a direct impact on the ability of developing countries to sustain high-tech projects, especially when they require large financial support from governments. Research conducted by (Bailey et al., 2019)

also shows that political intervention from international institutions often influences domestic policy, especially in the allocation of resources for innovation projects. In the case of the N-250, political pressure from the IMF led to the cessation of necessary funding, which ultimately halted the further development of this aircraft.

The fail the N-250 aircraft was not caused by weaknesses in technology, but rather by various non-technical obstacles that included aspects of financing, management and marketing, as well as politics. Each of these aspects plays an important role in determining the success of an innovation in the market. Recent research and scientific literature underscore the importance of adequate financial support, effective management, strong marketing strategies, and supportive political policies to ensure that high-tech projects such as the N-250 can be successful and sustainable in the market.

Understanding the lifecycle of an innovative product is one of the important aspects that inventors and innovators often overlook. The product life cycle describes the journey of a product starting from the stage of introduction in the market to finally experiencing a decline in demand and exiting the market. Ignoring the product lifecycle can be fatal, especially if the innovative product launched does not have a significant advantage over similar products already on the market. Therefore, the innovation strategy must be tailored to the product's position in its life cycle to ensure optimal market acceptance. The importance of understanding the product life cycle, The product life cycle consists of several stages, introduction, growth, maturity, and decline. Each stage has different characteristics and challenges, so it requires a different approach to innovation strategies. (De Wit et al., 2019) emphasized that companies must have a deep understanding of their product lifecycle to develop appropriate innovation strategies, especially in the context of rapidly evolving technologies such as the smartphone industry. Research by (Tidd, 2023) shows that shorter product life cycles, such as in high-tech products, require companies to continue to innovate and launch new products before existing products experience a decline in sales in the market. In the smartphone industry, for illustration, the product life cycle is generally only about 1-2 years, which means that companies must be ready with more advanced technology to be able to compete in this highly dynamic market.

The Right innovation Strategy in the product life cycle, in the introduction and growth phase, innovative products usually require strategies that focus on market education and product customization according to customer needs. (Verganti, 2017) stated that at this stage, radical innovation and technological breakthroughs are essential to create a competitive advantage. Products must

be launched at the right time, when similar products commence to show signs of declining sales, to maximize the chances of success in the market. Instead, in the maturity phase, the focus must shift to more incremental innovations, such as feature improvements or production cost reductions, to maintain market share. (Ziemer et al., 2018) in their study showed that in the maturity stage, innovations focused on efficiency and improved customer service can help extend the life of products in the market and delay their entry into the decline stage.

Impact on Product Launch and Timing, the timing of an innovative product launch is greatly influenced by the product's position in its lifecycle. (Blien, 2023) emphasizes that launching a new product at the right time—that is, when a competitor's product begins to decline—can provide significant strategic advantages. Products launched early may face an unprepared market, while late-launched products may struggle to gain significant market share. In addition, (Schilling, 2022) also highlights the importance of conducting competitive analysis to identify the downward trend of competitors' products and take advantage of the moment to launch new products that have technological advantages. This requires an innovation strategy that focuses not only on technology development, but also on a deep understanding of market dynamics and product lifecycles.

Understanding and managing the product lifecycle is critical in innovation strategies, especially in industries with short product lifecycles such as smartphones. The innovation strategy must be tailored to the stage of the product life cycle to ensure that innovative products can be launched at the right time, with significant technological advantages, so as to compete effectively in the market. Product launches carried out at the right time with the support of the right innovation strategy can provide a sustainable competitive advantage and increase product success in the market.

Charts of mobile phone sales from the three major companies: Nokia, Apple, and Samsung (figure 3.4.), from the first quarter of 2009 (Q1 '09) to the third quarter of 2011 (Q3 '11). The vertical axis shows the number of units sold in millions, while the horizontal axis shows the time divided into quarters from Q1 '09 to Q3 '11. Nokia, at the beginning of the period (Q1 '09), Nokia was the market leader with stable sales of around 20-25 million units per quarter. However, after peaking around Q1 '10, Nokia's sales began to experience a significant decline, especially from Q1 '11 to Q3 '11. Apple started with lower sales compared to Nokia, but showed a consistent and significant growth trend. Around Q2 '11, Apple managed to catch up with Nokia in terms of sales, reaching its peak sales around Q2 '11 before experiencing a slight decline in Q3 '11. Samsung started with relatively low sales, even below Apple and Nokia

at the beginning of the period (Q1 '09). However, Samsung showed very rapid growth starting from around Q3 '10. In Q2 '11, Samsung managed to catch up with Apple and Nokia, becoming the market leader with sales of more than 25 million units per quarter.

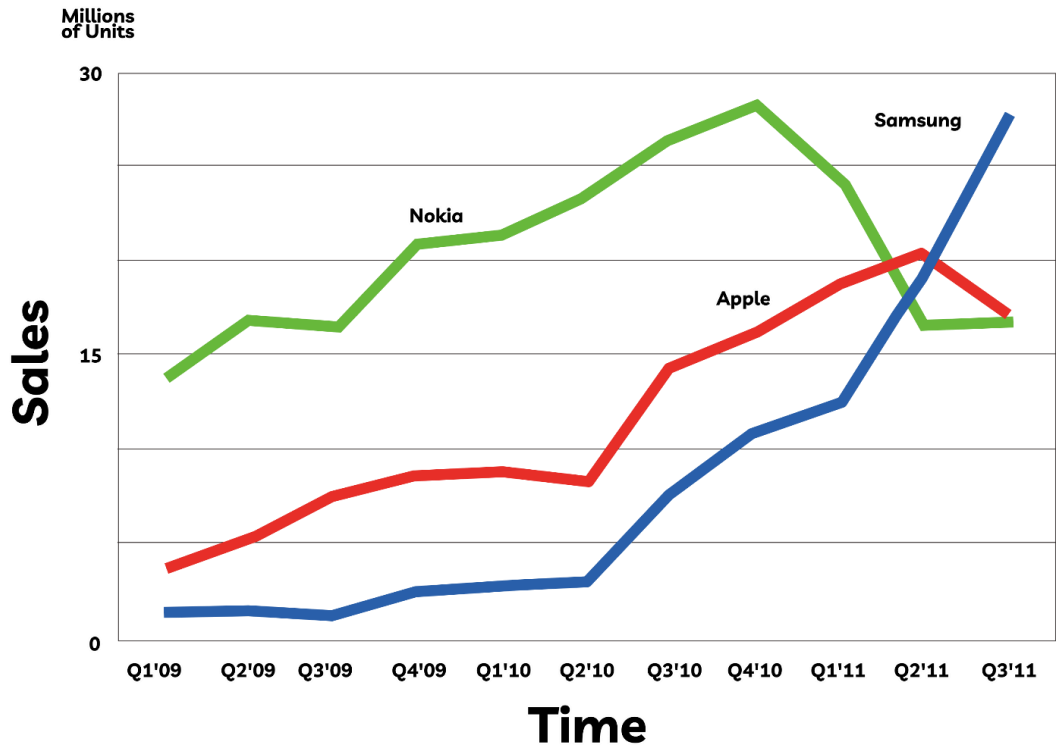

Figure 3.4. Sales development of Apple, Nokia and Samsung products in the market (source: Strategy Analytics, October 2011).

Nokia's declining sales can be attributed to its fail adapt to market trends that are increasingly dominated by smartphones, specifically with the entry of iPhones from Apple and Android-based smartphones from Samsung. The rise of Apple and Samsung reflects their success in technological innovation, marketing, and adaptation to consumer needs. Apple with its iPhone managed to attract the premium market, while Samsung managed to take advantage of the mass market with various variants of its products that use the Android operating system. Samsung's dominance, at the terminate of the period shown (Q3 '11), Samsung not only managed to catch up, but also beat Nokia and Apple, which showed its success in expanding its global market share with innovation and aggressive marketing. Figure 19 illustrates the dynamics of mobile phone market competition during the period 2009-2011, with the decline of Nokia as the traditional market leader and the rise of two new major players, Apple and Samsung, that revolutionized the smartphone market.

Based on the latest research, Samsung's dominance in the global mobile phone market in the first half of 2012 can be attributed to its effective product diversification strategy, aggressive market penetration, and consistent technological innovation. Samsung not only managed to beat Nokia and Apple in terms of sales, but was also able to expand its market share by offering a variety of products ranging from feature phones, smartphones, to tablets, which allowed them to reach a wider and heterogeneous market share. Research shows that Samsung has an advantage in terms of a more diverse product portfolio compared to its competitors. Samsung dominates the market by offering products in various cost segments, which allows them to reach different layers of consumers, from the lower terminate to the upper terminate (B. J. Kim et al., 2022). In addition, effective marketing strategies and continuous technological innovation also contributed to Samsung's growth, especially in the smartphone segment which was starting to grow rapidly at that time.

On the other hand, Nokia suffered a setback because it was late to adapt to the trend of touchscreen-based smartphones that began to dominate the market. Meanwhile, Apple, despite having a smaller market share than Samsung and Nokia, remains strong in the premium segment with a focus on exclusive product innovation and a closed ecosystem (Jia et al., 2023). Overall, Samsung's advantage in the mobile phone market in 2012 was largely due to their strategic flexibility, which allowed them to adapt quickly to market changes and consumer needs. Product diversification, innovation, and smart marketing strategies were key pillars of Samsung's success in beating Nokia and Apple in that period.

To analyze the causes of the bankruptcy of Apple and Nokia, several relevant scientific studies have been identified. Here are the results of a review of several scientific articles published after 2020 regarding the factors that led to the bankruptcy of large companies, especially in the context of Apple and Nokia:

1. Inferior technology quality, some studies highlight that the fail companies to keep up with technological developments is one of the main factors that lead to bankruptcy. In the case of Apple, although the brand is often associated with innovation, there was a period where the corporation lagged behind in terms of technology development compared to competitors such as Microsoft and IBM (Smith & Smith, 2022).
2. Arrogance of management, arrogant and inflexible management in responding to market changes is also considered a significant factor. Studies show that Apple, under certain leadership, fails to listen to the

needs of the market and consumers, ultimately affecting the corporation's ability to innovate (Johnson, 2022).

3. Weak corporation vision, unclear vision and lack of a strong long-term strategy can accelerate a corporation's decline. Apple had experienced a vision crisis where the corporation's focus became blurred and undirected, making it difficult for the corporation to compete in a highly competitive market (Miller-Day et al., 2013).
4. Stressful work culture, in the case of Nokia, a stressful work culture and temperamental leadership have been highlighted as significant causes of corporation insolvency. Research shows that stress in the workplace can reduce productivity, trigger irrational decisions, and increase contractor turnover, all of which contribute to a decline in corporation performance (Kaur & Kaur, 2012).
5. Ineffective leadership, leaders who are ineffective in navigating market challenges and managing internal change often accelerate bankruptcy. In the context of Nokia, leaders who tend to express temperamental behavior create fear among mid-level managers, hindering innovation and critical strategic decisions (Kolzow et al., 2021).
6. Strong technology competition, competition with more technologically advanced companies is also often a key factor. Both Apple and Nokia have to deal with competitors who are more adaptive and innovative in technology, which ultimately makes it difficult for these two companies to maintain their market share (De La Cruz-Alcudia et al., 2020).

The bankruptcy of Apple and Nokia can be seen as the result of a combination of several factors, including inferior technology quality, management arrogance, weak corporate vision, stressful work culture, and ineffective leadership. The combination of these factors creates an unstable and incapable environment of being able to compete in an ever-changing market, which ultimately leads to bankruptcy.

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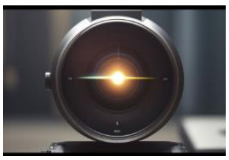

Chapter 4
THE HISTORY OF THE CREATION OF KATSINOV

Sania Diaurrahmi, Herni Widya Retno

"*Is there a tool to measure innovation readiness?*" This question, while simple, reflects the deep urgency in strategic innovation management at the national level. In this context, this question is common for the Study Team, including Suowo, who has long explored and implemented various models of readiness levels. These models include Technology Readiness Level (TRL), Manufacturing Readiness Level (MRL), Integration Readiness Level (InRL), and System Readiness Level (SRL). These models have long been used as a systematic and measurable evaluation framework to assess the extent to which an innovation, technology, or system is ready to be implemented, further developed, or applied on an industrial scale. Each level of readiness provides a unique perspective, from technology maturity to integration and manufacturing capabilities, all of which contribute to a more comprehensive mapping of risks and opportunities within the innovation ecosystem.

The questions asked by the officials highlighted the importance of the readiness framework as a data-driven decision-making tool in driving innovation growth. More than just a technical evaluation, this approach offers a reliable strategic guide to overcome the complexities of the innovation process, from the laboratory to the commercial implementation. It also affirms the crucial role of evidence-based innovation management to ensure success in designing, developing, and commercializing innovative solutions. The development of innovation readiness measurement tools in Indonesia is an important step forward, in line with the global trend of adopting an indicator-based approach to advancing technology and innovation. In this context, the exploration of innovation readiness models such as TRL, MRL, InRL, and SRL opens up new opportunities to formulate innovation strategies that are not only effective but also adaptive to local and global needs and challenges. Through a deep understanding and apply the innovation readiness framework, stakeholders can make better decisions, empower the innovation ecosystem, and ensure that the resulting technologies and systems are able to have a significant impact, both economically and socially.

4.1. Technology Readiness Level

TRL is a method designed to measure the level of maturity of a technology, from the conceptual stage to its implementation in the market. This method was first developed by NASA in the 1970s for the needs of space missions. TRL has a nine-tier scale, where level 1 indicates the basic concept of the technology, while level 9 signifies the readiness of the technology to be used in actual operations. The apply this scale has become a global standard because of its practicality in providing a uniform evaluation framework for cross-sector technologies (Olechowski et al., 2020a). The main reason for the development of TRL was to minimize the costly and complex technical risks in the development of technologies involving various subsystems. This scale allows stakeholders to systematically identify and manage risks and allocate resources more effectively throughout the technology lifecycle (Salazar & Russi-Vigoya, 2021). In addition, TRL provides strategic value in data-driven decision-making, especially in sectors such as aerospace, nuclear, and advanced technology manufacturing (Verma & Allen, 2024). Historically, the widespread adoption of TRL reflects the global need for a standardized framework for objectively evaluating technology readiness, facilitating collaboration across institutions and disciplines (Straub, 2021).

The TRL faces several limitations in its implementation. One of the main drawbacks is that TRL does not cover the complexity of integrating technology into larger systems, thus often ignoring the technical challenges associated with merging different subsystems and components (Olechowski et al., 2020b). In addition, TRL assessments are often subjective, depending on the evaluator's interpretation. This can result in inconsistent assessments, especially in the context of complex systems or technologies involving multiple stakeholders (Faidi & Olechowski, 2020). TRL is also not designed to assess human factors, such as user readiness (Human Readiness Level / HRL), or the social and environmental impact of technology implementation. This weakness makes TRL less effective at capturing non-technical aspects that are crucial to the successful adoption of the technology (Salazar & Russi-Vigoya, 2021). A study also noted that TRL is one-dimensional, only assessing the readiness of technology for production without considering quality or compliance with specific requirements in various application contexts (Archana Kumari et al., 2022). To overcome these limitations, some researchers propose the development of more scales, such as InRL and SRL, to address system integration and readiness holistically (Yu et al., 2021).

The implementation of the TRL is highly dependent on the needs of the sector and the type of technology being developed. The TRL scale is typically used to assess technological maturity from the conceptual stage to operational implementation. Table 4.1. summarizing the implementation of TRL in various sectors.

Table 4.1. Apply TRL in Various Sectors

Sector	Main Applications of TRL
Aerospace (Olechowski et al., 2020a)	Used to assess the readiness of technology before it is used in space missions and satellite systems.
Cybersecurity (Straub, 2021)	Assess the readiness of cybersecurity systems for implementation in real-world scenarios.
Health (Boccardi Vidarte & Bracamonte Bardález, 2023)	It is used to measure the readiness of medical technology development and biomarkers.
Nuclear (Verma & Allen, 2024)	Help identify technical and social risks in the development of nuclear technology.
Manufactory (Yu et al., 2021)	Assess the readiness of technology in the integration of production systems and processes.
Information Technology (Clawson, 2023)	Assess the readiness of blockchain technology for specific applications in the industrial sector.
Energy (Nilchiani et al., 2024)	It is used to assess the readiness of renewable energy generation technologies, such as wind and solar power.
Agriculture (Vieri et al., 2020)	Assess the readiness of precision agriculture technologies, including sensors and drones for increased agricultural efficiency.
Transportation (Yu et al., 2021)	Determine the technological readiness of autonomous vehicles and smart transportation systems.
Computing Systems (Lowe et al., 2024)	It is used to evaluate the readiness of supercomputers or artificial intelligence-based technologies for implementation.
Fisheries and Natural Resources (Cupp et al., 2023)	Monitor the readiness of technology for resource management, such as water quality monitoring tools or fish populations.
Medical Technology (Aksenova et al., 2021)	Assess the readiness of AI-based diagnostic and treatment devices for use in clinical practice.

Source: Author Search, 2024

From table 4.1., the apply TRL shows its flexibility in various technology sectors. In the aerospace sector, for illustration, TRL helps reduce technical risks in complex systems such as satellites. In cybersecurity and information technology, this scale provides a tool to measure the maturity of a technology before it is used commercially or strategically. However, the health and nuclear sectors highlight the need to involve social and environmental factors in the evaluation process, exposing the limitations of

traditional TKT. More scale developments, such as HRL and Integration Readiness Level (InRL), are relevant to address these limitations.

In the energy sector, TRL helps ensure that renewable energy technologies can be implemented safely and efficiently. In agriculture, precision agriculture technology becomes more reliable before it goes into operation. In the transportation system, TRL plays an important role in ensuring autonomous vehicles and intelligent infrastructure are ready for use by the general public. In the field of computing systems and medical technology, TRL allows complex technologies such as supercomputers or artificial intelligence-based devices to achieve an optimal level of readiness before being implemented. In the natural resources sector, TRL helps manage technology to monitor and preserve the environment more effectively. This development emphasizes the importance of TRL as an assessment tool that can be adjusted to the needs of various modern sectors. The apply TRL continues to evolve and provides significant benefits in managing risk and facilitating data-driven decision-making in the technology lifecycle. Integration with other readiness indicators can increase its effectiveness in handling the complexity of modern systems.

4.2. Manufacturing Readiness Level

MRL is a framework used to evaluate the readiness of manufacturing processes to support technology development from prototype to mass production. MRL includes an assessment of manufacturing infrastructure, processes, and capabilities to ensure an efficient and risk-free technological transition to the commercial production stage. This system is often used to identify risks associated with manufacturing capabilities before entering the market (Kedia et al., 2022). MRL was first adopted by the U.S. Department of Defense (DoD) as part of a holistic approach to evaluating technology and manufacturing readiness. This approach was developed in response to the need to reduce risk in complex technology procurement programs. Over time, MRL has been adapted by various sectors, including biomanufacturing and heavy industry, as a framework for assessing the readiness of technology on a wider production scale (Yu et al., 2021).

The importance of MRL lies in its ability to reduce uncertainty in technology development by ensuring manufacturing readiness from the beginning of the development cycle. This helps companies avoid more costs due to late-stage production failures, as well as allowing for a more effective and data-driven decision-making process. MRL also helps to establish better communication among technology development and

manufacturing teams, thus facilitating seamless integration from design to production (Ferreira et al., 2021). With a structured framework, MRL serves as an essential tool to support innovation and ensure that new technologies can be efficiently produced on a commercial scale.

The MRL has several limitations in its use as a tool for evaluating manufacturing readiness. One of the key limitations is that MRL is often too focused on the technical aspects, making it less able to capture the complexities of integrating technology into larger systems, including cross-sector challenges and specific industry-specific needs (Kedia et al., 2022). In addition, MRL assessments tend to be subjective, relying on the evaluator's experience, so consistency in their application is often a challenge. This evaluation also pays less attention to non-technical factors such as market needs, regulations, and social acceptance that can affect the success of technology in the market (Smanski et al., 2022). MRL also has weaknesses in dealing with the risks associated with mass production. Many studies note that this scale is less effective in identifying specific barriers during the transition from prototype to full-scale production, especially in the context of complex technologies such as biomanufacturing devices or renewable energy systems (Yu et al., 2021). The framework is also limited in its flexibility to accommodate rapid changes in modern technologies, such as artificial intelligence-based manufacturing and the Internet of Things (IoT). This requires further adjustments to remain relevant to future manufacturing challenges (Zhao et al., 2021). These limitations indicate the need to develop more models or more holistic frameworks, such as integration with the Regulatory Readiness Level (RRL) and Market Readiness Level (MRL) to cover regulatory and commercialization aspects more comprehensively.

The MRL is widely applied to evaluate manufacturing readiness in various sectors, from initial research to commercial production. This application helps identify risks and direct development endeavors to ensure a successful transition of technology to the production stage. The following table presents examples of MRL applications in various industry sectors. Table 4.2. demonstrating MRL's flexibility in various industry sectors. In biomanufacturing, MRL is used to ensure the production process complies with strict regulatory standards. In the aerospace and renewable energy sectors, MRL helps identify manufacturing risks early on, thereby reducing barriers to commercial production. In the electronics and medical device sectors, MRL's focus is on the use of smart manufacturing technologies to ensure safety, efficiency, and production effectiveness.

Table 4.2. Implementation of MRL in Various Sectors

Sector	Key Applications of MRL
Biomanufacturing (Kedia et al., 2022)	Measure the readiness of the production process of biologics and manage risks in biotechnology production.
Aerospace (Yu et al., 2021)	Assess the production readiness of aircraft components to ensure a smooth transition to mass manufacturing.
Renewable Energy (Smanski et al., 2022)	Evaluate manufacturing readiness for technologies such as solar panels and wind turbines.
Electronics (Zhao et al., 2021)	Developing electronic circuit integration using intelligent manufacturing technology.
Medical Devices (Seva et al., 2023)	Assess the readiness of medical device manufacturing to ensure the safety and effectiveness of mass production.
Road Infrastructure (BOANȚĂ et al., 2023)	Assess the readiness of the production of innovative construction materials such as high-tech asphalt.
Automotive (Yu et al., 2021)	Evaluate the production readiness of electric vehicle components such as batteries and electric motors.
Agriculture (Smanski et al., 2022)	Assess manufacturing readiness for precision agriculture technologies such as drones and automated sensors.
Blockchain Technology (BOANȚĂ et al., 2023)	Measure the readiness of hardware manufacturing to support blockchain infrastructure.
Nuclear Energy (Verma & Allen, 2024)	Assess the readiness of manufacturing high-tech nuclear waste management systems.
Logistics and Distribution (Zhao et al., 2021)	Developing manufacturing systems for warehouse automation and distribution based on the IoT.
Additive Manufacturing (Schneck et al., 2022)	Assess manufacturing readiness for metal-based 3D printing technology on an industrial scale.

Source: Author Search, 2024

This more application demonstrates MRL's ability to adapt to various modern industrial sectors. In the automotive sector, MRL helps ensure the readiness of the manufacturing of electric vehicle components that are increasingly in demand. In agriculture, MRL plays a crucial role in ensuring precision agriculture technology can be produced effectively and efficiently. For blockchain technology and nuclear energy, MRL helps manage risks in developing complex infrastructure and systems, ensuring security and reliability. In logistics and distribution, the implementation of MRL helps automation with IoT technology, improving supply chain efficiency. Meanwhile, additive manufacturing shows how MRL can support new technologies such as metal 3D printing to meet the needs of large-scale production. The diversity of the sector underscores the importance of MRL as a flexible evaluation tool to support innovation and manufacturing efficiency in the era of advanced technology.

However, the implementation of MRL often requires integration with other frameworks, such as RRL and Market Readiness Level (MRL), to address regulatory and market aspects as a whole. These adjustments will

become increasingly relevant as technology evolves and future manufacturing needs.

4.3. Integration Readiness Level

Integration Readiness Level (InRL) is a framework for assessing the readiness of a technology or system to be integrated with other elements in a larger system. InRL complements the TRL with a focus on risk assessment and readiness of technology integration, thus providing a holistic view of system maturity. InRL was developed in response to the emerging challenges in integrating technological components in complex systems, especially on high-tech projects such as space and military (Jesus & Chagas Junior, 2020). The concept of InRL was first introduced to complement TRL, which previously only assessed the maturity of technology individually without paying attention to the challenges of integrating such technology into the system. In its initial implementation, InRL was used in space projects and defense systems to identify integration risks and support project management decisions. InRL continues to evolve as the complexity of modern technological systems increases involving many interfaces and information-based architectures (Jesus & Chagas Junior, 2020).

InRL is here to answer the need for a systemic approach to evaluating integration readiness, which is often a major obstacle in the development of complex systems. InRL enables project teams to identify potential integration issues early, reduce the risk of project delays, and improve resource allocation efficiency. In addition, the InRL framework provides guidance for developing the necessary evidence in the evaluation process, ensuring transparency and objectivity in decision-(Jesus & Chagas Junior, 2020). InRL is also relevant in addressing new challenges, such as the integration of digital-based systems and the adoption of industry 4.0 technologies. This framework has been applied in a variety of contexts, from space to the manufacturing sector, demonstrating its flexibility in dealing with evolving needs (Rakiman et al., 2024). InRL is an important evaluation tool in ensuring the successful integration of complex technology systems. By adopting InRL, organizations can be better prepared to face the challenges of technological innovation and ensure the sustainability of strategic projects.

The InRL, although it is an important evaluation tool in integrating complex technologies, has several limitations that can affect its effectiveness in high-tech projects, but some limitations, including

1. Limited in accommodating system complexity, InRL often faces difficulties in evaluating the complexity of systems that are enormous, especially those involving many technological interfaces. Some researchers point out that InRL needs a more systemic approach to address these complexity challenges, especially on systems with highly complex information-based architectures (Jesus & Chagas Junior, 2020).
2. Limited documentation and evidence guidance, the InRL currently lacks specific guidelines regarding the proof vital at each level. This makes evaluations often subjective and dependent on individual interpretations, reducing consistency and accuracy in decision-making (Jesus & Chagas Junior, 2020).
3. The limitations of the use of modeling and simulation, modeling and simulation, which are supposed to be tools to accelerate InRL evaluation, are still not utilized optimally. Many organizations do not yet have an integrated framework in place to ensure that simulations can meet InRL requirements well (Jesus & Chagas Junior, 2020).
4. Reliance on external evaluators, InRL evaluations often involve external evaluators, which can lead to bias in the evaluation process. This is especially accurate when a check-based approach is used, which tends to be subjective and lacks depth in evaluating the maturity of the system (Koo & Jeong, 2024).
5. Lack of integration with other frameworks, InRL is sometimes less connected to other readiness frameworks such as MRL or SRL, so it does not provide a holistic view of overall system readiness. This limits the potential of InRL in assisting strategic decision-making in multi-system projects (Yu et al., 2021).
6. Constraints in applications on legacy systems, InRL is often less effective in evaluating the readiness of integration in older systems that have outdated architectures. This system requires special adjustments that are difficult to accommodate by the InRL standard approach (Jesus & Chagas Junior, 2020).

These limitations suggest that while InRL is a useful tool, further development is needed to improve its validity, consistency, and applicability in a variety of technological contexts. By improving this framework, integration readiness evaluations can become more accurate and relevant to support strategic decision-making. The InRL is applied to assess the readiness of technology integration in complex systems. These implementations are often used in various industries such as space, defense, manufacturing, and information technology.

Table 4.3 Implementation of InRL in Various Sectors

Sector	Project Examples	InRL Objectives	Key Results
Space (Jesus & Chagas Junior, 2020)	China-Brazil Earth Resources Satellite Program	Assess the readiness of satellite technology integration	Integration risk identification and strategy optimization
Defense (Savage-Knepshield et al., 2021)	Military software modernization	Integrating military technology capabilities	Evaluation of the integration of new technology interfaces into legacy systems
Manufactory (Rakiman et al., 2024)	Implementation of industry 4.0 in the manufacturing sector	Integration of digital technology with production processes	Identify barriers to technology adaptation such as HR and infrastructure
Information Technology (Syahputri et al., 2021)	Integrated Information Management System at the university	Measuring the readiness of the implementation of the e-learning system	Technology readiness assessment and integration risk management
Energy (Sabidussi & Wasser, 2024)	Evaluate the readiness of energy transition integration	Assess the readiness of companies in the adoption of new energy technologies	Identify gaps in resource readiness and integration strategies
Health (Ikwara et al., 2023)	Integration of ART therapy services in the primary health system	Improving the efficiency of HIV service integration	Determine readiness factors, such as staff training and facility availability
Transportation (Yasseri & Bahai, 2020)	Integration of electric vehicle technology	Assess the readiness of supporting infrastructure	Charging network readiness analysis and government policies
Education (Dludlu, 2020)	Development of digital integration curriculum	Assess the readiness of teachers and students for digital learning	Evaluate technology readiness, professor training, and student access to digital devices

Source: Author Search, 2024

Table 4.3. demonstrate that InRL is used in a variety of contexts to assess the readiness of technology integration. In space programs, InRL helps identify technical risks at an early stage, allowing for the optimization of integration strategies. In the defense sector, InRL plays a crucial role in software modernization by considering the compatibility of new technologies with legacy systems. In the manufacturing sector, the implementation of InRL helps companies understand barriers such as human resources and infrastructure, while in the education sector, InRL is used to evaluate the readiness of e-learning system integration. In the

energy transition, InRL helps companies map their readiness to adopt new, sustainable energy technologies. In the health sector, InRL ensures that HIV therapy integration services can be carried out efficiently, with a focus on training health workers and facility readiness. In transportation, InRL helps understand the readiness of support systems such as electric vehicle charging stations, while in the education sector, InRL is used to evaluate the readiness of teachers and students in digital learning. The implementation of InRL shows its flexibility as an evaluation tool. However, its success relies heavily on valid data collection, stakeholder engagement, and method adaptation based on the specific needs of the sectors involved.

4.4. System Readiness Level

SRL is an evaluation framework that measures the readiness of a system to operate effectively in its intended environment. SRL combines TRL and InRL to provide a comprehensive understanding of the readiness of technology and its integration in larger systems. It includes technical, organizational, and operational factors to ensure the system can function according to mission requirements (Olechowski et al., 2020a). The concept of SRL arose from the need to assess technological readiness in complex systems, particularly in space and military projects. NASA first introduced the TRL in the 1970s to evaluate the maturity of individual technologies. However, TRL has limitations in measuring the integration of technology into larger systems. Therefore, the InRL was introduced as a complement to TRL to assess the readiness of interfaces among different technologies (Straub, 2021). The combination of TRL and InRL ultimately results in SRL to provide a more holistic approach to assessing system readiness.

SRL is becoming relevant in a wide range of applications, including space, military, and manufacturing, where misintegration of technology can lead to a major impact on project success. By combining the factors of technology readiness and integration, SRL provides better guidance for strategic planning and decision-making (Jesus & Chagas Junior, 2020). SRL was created to address a variety of challenges in system development, including:

1. The complexity of modern systems, modern systems often involve many technological components with complex interfaces. SRL provides a structured approach to evaluating the overall readiness of the system, including technical, operational, and human aspects (Schwartz & Dodson, 2021).

2. Project risk reduction, by thoroughly evaluating system readiness, SRL helps identify potential problems early, thereby reducing the risk of integration failures and project delays (Olechowski et al., 2020a).
3. Better decision-making, with comprehensive data on system readiness, SRL enables decision-makers to allocate resources more efficiently and set the right priorities in technology development (Straub, 2021).
4. Improving operational success, by taking into account human and operational factors in readiness evaluations, SRL helps ensure that systems can function effectively and efficiently once implemented (Schwartz & Dodson, 2021).

The SRL is an important evaluation tool that provides a holistic approach to assessing system readiness in various aspects. By combining TRL and InRL, SRL enables organizations to reduce project risk, improve operational efficiency, and ensure successful implementation of complex systems. Its wide application demonstrates the relevance of SRL in various high-tech sectors.

The SRL, although it is a useful tool for assessing the readiness of complex systems, has several limitations that can affect its accuracy and implementation in various technological contexts, but there are some key limitations, including

1. Difficulties in evaluating system complexity, SRL often encounters obstacles in handling systems that have many complex technological elements and interfaces. Methods of combining readiness levels, such as combining TRL and InRL, sometimes result in assessments that do not reflect the overall state of the system (Yasseri & Bahai, 2020).
2. Limited in the subjectivity of assessment, SRL evaluation often relies on a check-based approach and input from the evaluator, which can result in subjective bias. This is a particular challenge in systems that require more impartial quantitative data-driven decisions (Koo & Jeong, 2024).
3. Unable to cope with obsolete technology, SRL is designed to assess system readiness in the early stages of development, but does not effectively address aging or becoming obsolete systems. This is an obstacle in the management of systems that operate in a long life cycle, such as in the defense and space industries (Nilchiani et al., 2024).
4. Lacking standards for the integration of new technologies, SRL does not always provide enough guidance for integrating new technologies in existing systems. This is an obstacle, especially in industries that require the rapid and safe apply disruptive technologies (Yu et al., 2021).
5. Limited in strategic decision-making, SRL often fails to provide holistic insights into risks and opportunities in a broader strategic context. This is

due to the lack of integration among SRL and other readiness frameworks, such as MRL or HRL (Schwartz & Dodson, 2021).

These limitations indicate the need for further development to improve the validity, accuracy, and apply SRL. By addressing these challenges, SRL can become a more effective tool in supporting strategic decision-making in various high-tech sectors.

Table 4.4. Implementation of SRL in Various Sectors

Sector	Project Examples	SRL Objectives	Key Results
Space (Jesus & Chagas Junior, 2020)	CBERS Satellite Program	Evaluation of technology integration in satellite systems	Identify systemic technology integration risks
Transportation (Wang, 2021)	Toll road intelligent transportation system	Assess the readiness of IoT and AI technology integration	Improving the efficiency of transportation systems through SRL-based models
Defense (Koo & Jeong, 2024)	Modernization of defense systems	Evaluate the readiness of the integration of new technologies in legacy systems	Identify risks of simultaneous operation of old and new technologies
Manufactory (Blayone & VanOostveen, 2021)	Implementation of industry 4.0 technology	Assess the readiness of integrating digital technology into production	Evaluate integration barriers such as infrastructure and HR
Information Technology (Straub, 2021)	Intelligent systems based on cybersecurity	Assess cyber system readiness for secure implementation	System vulnerability assessment and readiness to face cyber threats
Energy (Nilchiani et al., 2024)	Integration of renewable energy in the power grid	Assess the readiness of the integration of new energy technologies	Identify bottlenecks such as infrastructure limitations and technology compatibility
Health (Yu et al., 2021)	AI-based medical device development	Assess system readiness in the adoption of AI technology for diagnosis	Improve diagnostic accuracy and hospital operational efficiency
Education (Straub, 2021)	Implementation of the university e-learning system	Assess the readiness of online learning platform integration	Identify technology gaps and lecturer training needs
Infrastructure (Wang, 2021)	Development of smart transportation systems	Assess the readiness of IoT integration in transportation infrastructure	Improved operational efficiency and real-time traffic management

Sector	Project Examples	SRL Objectives	Key Results
Defense Technology (Koo & Jeong, 2024)	Military hardware modernization	Assess the readiness of new technologies to support military operations	Identify hardware compatibility and mitigate operational risk

Source: Author Search, 2024

SRL has been applied in various high-tech sectors to assess the readiness of complex systems. Its application includes the integration of new technologies, the management of old systems, and the evaluation of operational readiness in various scenarios. Table 4.4. summarizes some of the main applications of SRL. The table 4.4. shows that SRL is widely used in various sectors to manage the integration of complex technologies. In space projects, such as the CBERS program, SRL helps ensure that new technologies can be integrated without major risks, supporting mission success.

In the transportation sector, the implementation of SRL improves efficiency through the integration of IoT and AI technologies, demonstrating the ability of this framework to support digital transformation. In the defense sector, SRL addresses the challenges of technology modernization by providing guidance for the integration of new technologies into legacy systems, ensuring operational sustainability. In manufacturing, SRL facilitates the adoption of industry 4.0 technologies by helping companies understand their readiness to transition to digital production. In the field of cybersecurity, SRL is used to assess the readiness of technology against cyber threats, helping to create more secure and reliable systems. In the energy sector, SRL helps ensure that renewable energy technologies can be integrated with existing power grids, supporting environmental sustainability.

In healthcare, SRL enables AI-based device evaluation to improve the accuracy and efficiency of healthcare services. In the education sector, the implementation of SRL helps universities evaluate the readiness of e-learning infrastructure, identify technical challenges and necessary training. In transportation infrastructure, SRL supports the implementation of IoT-based intelligent systems to manage traffic effectively. In the defense field, SRL is used to evaluate the readiness of new military technologies, ensure compatibility with legacy hardware and reduce operational risks. This application demonstrates the flexibility of SRL in a variety of technological contexts, although it still requires development to overcome limitations such as subjectivity of assessment and lack of global standards.

4.5. Innovation Readiness Level

In 2017, one of the level II Officials of the Directorate General of Innovation Strengthening, Ministry of Research, Technology, and Higher Education (Kemenristekdikti) of the Republic of Indonesia (Dr. Ir. Ophirtus Sumule, DEA.) asked an interesting and strategic question to the Study Team: "***Is there a tool to measure innovation readiness?***" This question is not new for the Study Team, including Susalit Setya Wibowo, because they have been exploring and implementing various models of readiness levels for a long time. These models include TRL, MRL, Integration Readiness Level (InRL), and SRL. These models are used as a systematic and measurable evaluation framework to determine the extent to which an innovation, technology, or system is ready to be implemented, further developed, or applied on an industrial scale. The question reflects a deep concern for strategic innovation management, and emphasizes the importance of a readiness framework as a data-driven decision-making tool in the areas of innovation and technology.

At that time, Susalit Setya Wibowo confidently replied that a measurement tool known as the IRL was available. This statement is based on previous development endeavors which refer to the writings of (Wenkai Wang et al., 2010) in their article entitled Developing and Validating Service Innovation Readiness. The results of this research are the basis for initiating the IRL measurement tool as an approach to measure innovation readiness more comprehensively. The answer prompted level II Officials of the Directorate General of Innovation Strengthening, Ministry of Research, Technology, and Higher Education of the Republic of Indonesia (Dr. Ir. Ophirtus Sumule, DEA.), to hold a meeting with the Director General of Innovation Strengthening (Dr. Ir. Jumain Appe) to further discuss the potential implementation of IRL. A few weeks after the initial meeting, Susalit Setya Wibowo received an official invitation from the Director General to attend a meeting with the main agenda of discussing the framework and implementation of the IRL measuring instrument. The meeting also brought together Susalit Setya Wibowo with several colleagues who have been working on the TRL measurement tool for a long time. This collaboration opens up opportunities to integrate IRL with the TRL approach, forming a more holistic and strategic innovation measurement basis for national needs in the fields of research, technology, and Higher Education.

The meeting with the Director General of Innovation Strengthening, Ministry of Research, Technology, and Higher Education of the Republic of Indonesia was an important moment in the development of the Innovation Readiness Level (IRL) measuring instrument. In the meeting, Susalit Setya Wibowo had the opportunity to explain the concept of IRL that had been designed a year earlier. The presentation was carried out in a structured manner to show how IRL can be an important instrument in measuring innovation readiness, from the initial stage to implementation. The discussion session that followed the presentation took place with intense dynamics. The discussion involved arguments among Susalit Setya Wibowo and other Expert Teams invited to the event. Participants shared their critical views, including strengths, weaknesses, and potential for the development of the IRL concept. The atmosphere became even more interesting when various points of view were presented, covering technical, methodological issues, and the relevance of IRL to national strategic needs. In this discussion, the Director General acted as a careful listener. Without much comment, he noted every point conveyed by the parties involved, indicating his role as the final decision-maker. After nearly three hours of discussion full of constructive debates, the long-awaited moment arrived. The Director General gives decisions that determine the future direction of IRL development. He decided to accept the IRL concept presented by Susalit Setya Wibowo, with several notes for improvement. This decision not only reflects the acceptance of the scientific validity and applicability of the concept, but also demonstrates the belief that IRL can be a relevant framework to support national innovation.

However, this decision also comes with great responsibility. Susalit Setya Wibowo was given a deadline of two months to prepare a comprehensive Academic Paper related to the IRL measuring instrument. This document is expected to be a solid academic foundation, including theoretical elaboration, measurement methodologies, and applicable implementation guidelines. This challenge was received with enthusiasm, because this opportunity also opened up opportunities to validate the concept of IRL through a systematic academic approach. This moment became an important milestone in the development of IRL. For Susalit Setya Wibowo, the decision marks the beginning of a larger process to make IRL a standard measurement tool that can be applied widely. In the next two months, Susalit Setya Wibowo and his team worked hard to compile an Academic Paper that not only met scientific standards, but was also relevant to practical needs in the field. This process involves collecting

supporting data, in-depth literature studies, and consulting with experts in the field of innovation and technology.

The results of this process are expected to make a real contribution to strengthening national innovation, by the vision of the Ministry of Research, Technology, and Higher Education of the Republic of Indonesia. With positive initial acceptance and strong institutional support, the development of IRL is not only an individual project, but also part of a collective effort to improve the competitiveness of technology and innovation at the national and international levels.

In an effort to improve the quality and effectiveness of innovation readiness assessment in Indonesia, we have completed the preparation of an *Academic Paper* draft for the Innovation Readiness Level (KATSINOV) measurement tool within two months. This document is an important first step for the development of measuring tools, guidelines, and legal tools in the form of a Draft Ministerial Regulation that can support systematic implementation. KATSINOV, which stands for "Innovation Readiness Level," was born from intensive discussions and evaluation of several alternative names until a consensus was reached. This name not only represents the main purpose of this measuring tool, but also exudes an identity that is widely accepted by the academic community and research institutions in Indonesia. The KATSINOV measuring instrument is designed to provide a quantitative and qualitative approach in assessing the readiness of innovations from research and development results in Higher Education. In the early stages of its development, KATSINOV was embodied in the form of a simple Excel spreadsheet that served as a prototype (see Figure 20). However, as the need evolved, these tools were adapted into more modern and efficient web-based platforms (see Figure 21). This web-based development allows for wide accessibility and advises the implementation of an independent assessment system by universities throughout Indonesia.

Based on the principles of transparency and objectivity, KATSINOV contains key indicators that cover various aspects of innovation readiness, from technology testing, market validation, to readiness for integration into production systems. The platform is not only designed to support colleges in assessing their own innovations but also to provide data that is accessible to stakeholders, including ministries, research institutes, and industry partners. Through a web-based approach, KATSINOV is expected to be able to become an inclusive measurement tool, help collaboration among various parties, and encourage a structured culture of innovation. Each university can conduct an independent assessment, which reflects their

level of readiness for technology or innovation to be adopted more widely. In addition, the platform provides valuable input for policymakers to develop evidence-based innovation development strategies.

The apply KATSINOV on a national scale is expected to have a significant impact in identifying and promoting superior innovations from universities (figure 4.1.). Thus, KATSINOV is not only a measuring tool, but also a foundation to build a more advanced innovation ecosystem in Indonesia. This measuring tool is an integral part of the transformation of the national innovation system, by supporting the acceleration of the implementation of research results into real solutions that benefit society and industry. With this grand vision, KATSINOV not only serves as an assessment tool, but also as a driver for greater change, creating synergy among universities, governments, and the business world. In the long term, KATSINOV is expected to be able to contribute to improving the nation's competitiveness through measurable and directed knowledge-based innovation (figure 4.2.).

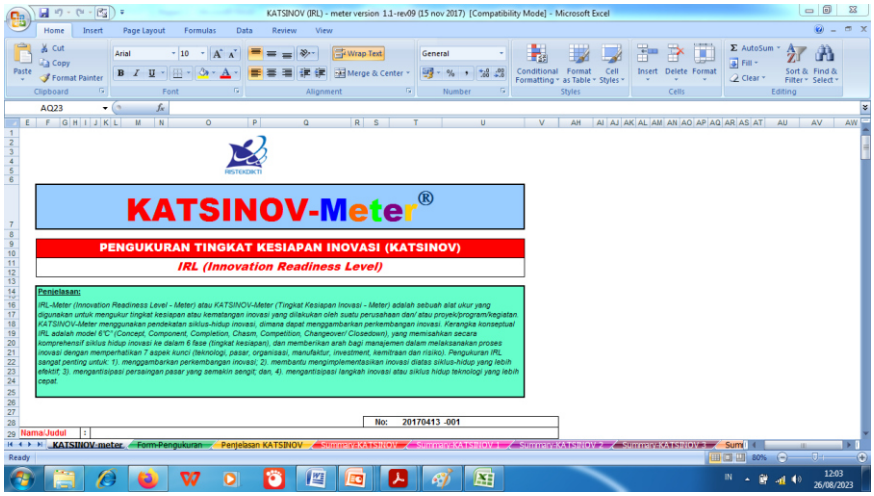

Figure 4.1.. KATSINOV measuring tool based on Excel Spreadsheet.

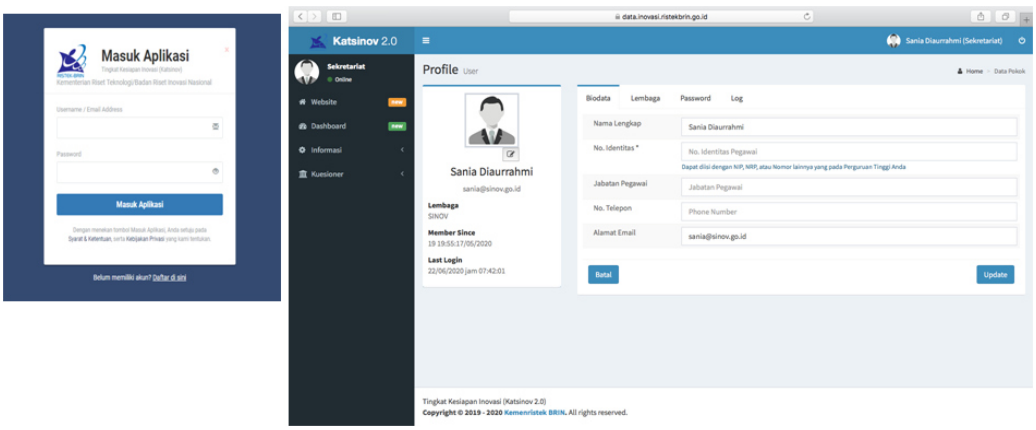

Figure 4.2. Web-based KATSINOV measuring tool.

The validation process of the Innovation Readiness Level (KATSINOV) measuring tool is carried out carefully at several leading universities in Indonesia, such as the Bogor Agricultural Institute (IPB), the Bandung Institute of Technology (ITB), and the University of Indonesia (UI). This validation aims to test the effectiveness and reliability of measuring tools in various research and innovation contexts. From the validation results, we received various constructive inputs that became the basis for the improvement of the KATSINOV measuring instrument. This process not only improves the quality of the instrument, but also provides new insights into the challenges faced by researchers in Higher Education. One of the key findings is the significant dichotomy among technological development and market evolution, which often runs separately. This emphasizes the need for an integrative approach in facilitating innovation readiness, so that research results can be more easily adapted and widely applied.

Figure 4.3. Validation of the KATSINOV measuring instrument at the Bogor Agricultural University (IPB).

In addition to validation, the Transfer of Technology (TOT) activity for KATSINOV is a strategic step in disseminating the understanding of this measuring tool to stakeholders (figure 4.3.). The TOT which was carried out within the Ministry of Research, Technology and Higher Education in 2017 has an important role in preparing experts to become facilitators of socialization and technical training. The program is designed to train experts in supporting the implementation of KATSINOV in all universities and research institutions in Indonesia. With a structured training method, TOT

managed to create a competent team to provide technical guidance to researchers, ensuring a thorough understanding of the indicators and evaluation process carried out by KATSINOV. The success of TOT has a direct impact on the acceptance of KATSINOV among academics and researchers. The program opens up interactive discussion spaces that help bridge the gap among theory and practice. Through this training, researchers were invited to understand the importance of balancing technological advances and market needs, as well as how KATSINOV can be used as a tool to bridge these two aspects. In addition, the TOT is also a platform to identify challenges in the implementation of KATSINOV, such as the need for continuous training and technical capacity building in several research institutions.

With comprehensive validation and implementation of TOT, KATSINOV has developed into a measuring tool that is not only relevant, but also adaptive to the needs of national research and innovation. These programs reflect our commitment to ensure that these measuring tools can be used widely and effectively, supporting universities and research institutions in independently assessing the readiness of their innovations. In the long term, we hope that KATSINOV can become an integral part of the national innovation system, helping to accelerate the transformation of research results into tangible solutions that provide economic and social benefits. This combination of academic validation and technical training confirms the important role of KATSINOV as a reliable and flexible measuring tool. As a result, researchers and institutions not only have the tools to evaluate the readiness of innovation, but also a deeper understanding of how to blend technology and markets to create greater value. This is a solid foundation for integrating innovation into a sustainable and competitive national ecosystem at the global level.

After going through a long journey since 2017, the entire team for the development of the National Technology and Innovation Readiness (KATSINOV) measuring instrument has succeeded in achieving a monumental milestone (figure 4.4.). This struggle culminated on May 15, 2019, when the Minister of Research, Technology, and Higher Education officially signed Ministerial Regulation Number 29 of 2019 concerning Measurement and Determination of Innovation Readiness Levels. This regulation is a strategic step in formalizing KATSINOV as an official measuring tool applied across all research and innovation activities in Indonesia, providing a solid framework for assessing the level of national technological and innovation readiness.

Figure 4.4. The implementation of KATSINOV TOT within the Ministry of Technology, Research and Higher Education in 2017.

This designation is not only an administrative success, but also a recognition of the urgent need for a standardized, evidence-based approach to innovation management. The KATSINOV measuring instrument now serves as an important guide for researchers, research and development institutions, and academic institutions in understanding, evaluating, and optimizing their innovations. Thus, KATSINOV is not only a measuring tool, but also a strategic instrument to encourage Indonesia's research and innovation competitiveness at the global level. The development process of KATSINOV includes intensive cross-sector collaboration, involving academics, practitioners, and policymakers to ensure that the tool is relevant, applicable, and able to respond to evolving research challenges. As part of the implementation of the Ministerial Regulation, the KATSINOV development team has a great responsibility to provide technical guidance to researchers at various universities and research institutions throughout Indonesia. This step aims to ensure a uniform understanding and apply the measuring instrument, as well as to increase research and innovation capacity by the needs of national development.

The technical guidance carried out covers various aspects, ranging from training in the use of measuring instruments to direct consultation on the development of research results-based innovations. This process is designed to empower researchers to accurately map innovation readiness,

identify gaps, and systematically design improvement strategies. With a holistic and in-depth approach, KATSINOV provides tangible benefits in building an inclusive and sustainable innovation ecosystem. It is undeniable that this success is the result of the hard work and dedication of the team that has been committed since the beginning to create a measuring instrument that suits the characteristics and needs of Indonesia. Ministerial Regulation Number 29 of 2019 not only gives legitimacy to KATSINOV, but also reflects the government's vision in strengthening the foundation of research and innovation as a driving force for national development. This measuring tool is an important pillar in endeavors to create innovations that can be applied in real terms and have a direct impact on society (figure 4.5.).

Figure 4.5. KATSINOV Socialization: (a). KATSINOV Socialization in Jakarta; (b). Socialization of KATSINOV at the University of Jember, East Java.

In the global context, standardized innovation measurement such as KATSINOV also plays an important role in building Indonesia's international credibility in the field of research and technology. The widespread use of KATSINOV is expected to strengthen Indonesia's position in various global innovation indices, as well as expand opportunities for international collaboration in the research and development sector. In the future, the challenges faced will not be light. The implementation of KATSINOV must be able to respond to the dynamics of technological changes that continue to develop, while meeting the expectations of stakeholders. However, with the support of various parties and the strong commitment of the development team, KATSINOV is expected to continue to be a strategic tool that advises the birth of superior innovations in Indonesia.

Technology and innovation play an important role in the development of complex systems, so readiness measurement is essential for assessing the maturity and integration of technologies effectively. TRL is a metric that has been widely used since the 1980s, originally developed by NASA to evaluate the maturity of a particular technology within the operational

framework of a system. Although TRL provides a solid foundation, there is a need to measure other aspects of readiness, such as manufacturing capabilities, integration, and overall systems (Jesus & Chagas Junior, 2020). The MRL was introduced to evaluate the manufacturing readiness of a technology, especially in identifying manufacturing risks and production capabilities. MRL supports decision-making by assessing the production capability of a technology at scale (Basu & Ghosh, 2017). Meanwhile, the InRL measures the readiness of technological elements to be integrated into larger systems, filling gaps that TRLs cannot address (Jesus & Chagas Junior, 2020). Furthermore, SRL is a composite metric that combines TRL and InRL to provide a holistic picture of overall system readiness. SRL was developed to address the need for integrated evaluation of complex systems involving various technological subsystems. Mathematical validation shows that SRL can be used effectively in systematically assessing the maturity and readiness of a system (Marlyana et al., 2018).

On the other hand, the IRL aims to go beyond technology measurement by focusing on innovation readiness more broadly. IRL considers not only technical and manufacturing readiness but also the potential for commercialization and adoption of innovations in the market. This provides more perspectives that are relevant to market-oriented innovation projects, including the development of data-driven products such as artificial intelligence and machine learning (Eljasik-Swoboda et al., 2019). Although each level of readiness has a unique focus, a comprehensive approach integrating TRL, MRL, InRL, SRL, and IRL has been proposed to create a multidimensional assessment framework. This combination allows decision-makers to evaluate risk, integration capabilities, manufacturing readiness, as well as innovation success potential from multiple perspectives (Zhumashov et al., 2023). In the context of system development and innovation in the future, this more integrated evaluation is crucial to encourage the successful implementation of technology and maximize the impact of innovation in various sectors. This multidimensional framework also allows policymakers and project managers to navigate complex challenges in technology development more effectively.

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Part 2

BASIC PHILOSOPHY OF KATSINOV

"I believe innovation is the most powerful force for change in the world."

- Bill Gates

Chapter 5
INNOVATION MANAGEMENT

Kusumawati Dewi Budiarti, Adhi Pramono

5.1. Definition and Importance of Innovation Management

Innovation is one of the most vital elements in maintaining an organization's competitiveness in the global market. In the ever-changing business world, the ability to innovate is a key determining factor in a corporation's success. Innovation management, as a structured process for organizing, developing, and implementing creative ideas, has become an important cornerstone for many large organizations such as Apple and Google. These two companies have consistently implemented innovation strategies to create revolutionary solutions that change the way people live. Apple, for illustration, has managed to transform the electronics market through products like the iPhone, iPad, and MacBook, while Google dominates the digital world with its search engine, YouTube, and cloud services. This success shows that innovation management not only improves operational efficiency but also creates a sustainable competitive advantage (Kurniawan et al., 2016). In practice, innovation management involves various strategic stages, ranging from idea generation to the implementation of solutions in the market. Idea generation is the initial step in which companies identify market needs and innovation opportunities. These ideas then go through an evaluation process to ensure their relevance and feasibility with the corporation's vision and resources. After that, the selected ideas are developed into prototypes and tested to ensure their effectiveness before being launched into the market. For illustration , Apple not only develops new products but also integrates innovation in its marketing and distribution strategies to ensure the successful commercialization of those products (Shenhar et al., 2020).

In addition, the importance of a culture of innovation within an organization cannot be overlooked. Visionary leadership plays a crucial role in driving innovation. Leaders who support risk and creativity are often able to create a work environment that allows employees to think outside the box. Studies show that a culture of innovation not only increases employee engagement but also accelerates strategic decision-making, especially in the face of global challenges (González López et al., 2023). Strategic investment is also an important aspect of innovation management. Companies that want to remain relevant in the global market must allocate resources to research and development (R&D), training, and new technologies. Research shows that

companies that strategically invest funds in R&D and employee development tend to be more adaptive to market changes and are able to produce high-value, innovative solutions (Babaeva & Grigorieva, 2020).

One of the biggest challenges in managing innovation is maintaining a balance among radical and incremental innovation. Radical innovations often bring major changes to the industry, such as what Tesla did in the automotive industry with its electric cars. However, incremental innovation, such as improvements to existing product features, also plays a crucial role in maintaining customer satisfaction and strengthening brand loyalty (Machuca-Contreras et al., 2023). With the adoption of the right innovation strategy, companies can not only survive in a competitive market but also create new trends that drive overall economic growth. In a global context, innovation management must be carried out strategically by taking into account technological changes, consumer preferences, and evolving market dynamics. Over time, companies that are able to effectively manage innovation will become leaders in their industry, demonstrating that innovation is a key element for business sustainability in the modern era.

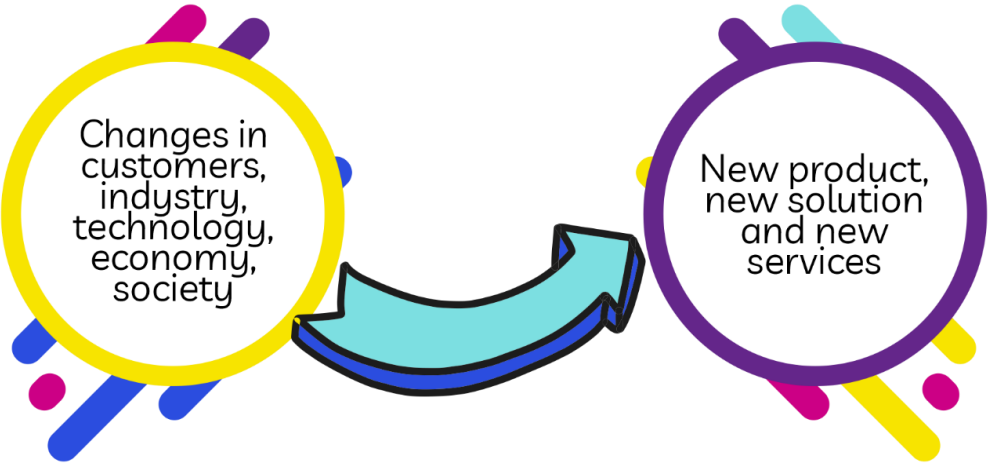

Figure 5.1. Scope of innovation management.

Changes in today's business world (figure 5.1.) are happening so quickly and include various aspects, such as customer behavior, industry developments, technological advancements, economic conditions, and social dynamics. These factors encourage companies to continue to adapt and create innovations in response to emerging challenges. Innovation is one of the main elements in building a competitive advantage in the global market. The innovation process begins by identifying those changes as opportunities, which then translate into new products, innovative solutions, and services that

are relevant to market needs. Changes in customer behavior, for illustration , are often the main driver of innovation. Today's consumers demand more personalized, fast, and technology-based products and services. For illustration , tech industries like Amazon are using customer data to create personalized shopping experiences, increasing their customer loyalty (Mohan Raj et al., 2018). In addition, technological developments have also allowed companies to introduce faster and more efficient innovations, such as the implementation of artificial intelligence (AI) and the Internet of Things (IoT) in their operations.

The industry is also undergoing significant transformations due to digitalization and automation. The manufacturing industry, for illustration , has changed by adopting technologies such as advanced robotics to improve productivity and efficiency. This phenomenon is known as the industrial revolution 4.0, which advises companies to create technology-based solutions to stay relevant in a competitive market (Sharma et al., 2021). Global economic dynamics also affect the need for innovation. Economic crises or changes in international policy often create uncertainty that forces companies to be more creative in seeking new opportunities. For illustration , the COVID-19 pandemic has prompted many companies to switch to digital-based business models, such as ecommerce and delivery services, to meet changing consumer needs (Ding et al., 2022).

From the social side, changes in people's values and expectations are also a catalyst for innovation. Consumers are increasingly concerned about sustainable and environmentally friendly products and services. Therefore, companies are encouraged to create green innovations that minimize environmental impact, such as the use of recycled materials or renewable energy in the production process (Delmas & Rana, 2017). An effective innovation process requires planned management. Companies must be able to identify external changes as opportunities, manage innovative ideas, and ultimately create solutions that are acceptable to the market. Apple, for illustration , has proven how changes in technology and customer behavior can translate into revolutionary products like the iPhone, which combines advanced technology with an intuitive user interface. This success shows the importance of implementing strategic innovations to win the global market (Shenhar et al., 2020). Through the right innovation, the corporation can not only meet the needs of the ever-growing market but also create new value for customers. By focusing on changes in customer behavior, technology, industry, economy, and society, companies can produce new products, solutions, and services that are relevant and sustainable. This strategy is key to the corporation 's sustainability and success in facing global challenges.

Innovation has become a key pillar in the corporation 's success in an increasingly complex and dynamic global market. Research shows that the success of companies like Apple and Google in creating strategic innovations provides important lessons about how innovation can change the face of business and shape new markets. Apple, through its revolutionary products such as the iPhone and iPad, is not only changing the way humans interact with technology but also creating new standards in the tech industry. Even after the demise of Steve Jobs, Apple remains committed to innovation, including the development plan of the i-Car, which is predicted to revolutionize the automotive industry with smart technology. Meanwhile, Google through innovations in services such as Google Search, YouTube, and Google Maps has created a digital ecosystem that enables global collaboration and strengthens its position as a leader in the information technology industry. Research supports the view that strategic innovation is the key to dominating the market. For illustration , a study conducted by (Yankovoy, 2023) highlights that the integration of technology, organization, market, and culture is essential in strategic innovation management. This article confirms that companies that successfully manage strategic innovations can effectively commercialize products and collaborate with various parties, including research institutions and customers. In addition, (Shelomentsev et al., 2021) show that strategic innovation helps companies adapt to changes in global value chains, especially through investments in R&D and international collaborations.

In supporting innovation, it is important for companies to invest in R&D. (Crupi et al., 2020) underlines that the strategic management of technology and innovation includes significant investment in R&D, proper selection of innovations, as well as external collaboration to ensure the sustainability of the corporation 's innovation. Furthermore, (Montero-Lobato et al., 2020) in their bibliometric analysis found that the trend of strategic innovation research in the last decade is closely related to endeavors to increase competitiveness through technological and market innovation. The success of innovation also depends heavily on a supportive organizational culture. (Jun et al., 2021) in the Scopus indexed journal emphasized the importance of a work environment that advises collaboration, experimentation, and learning from failure. The study shows that a strong culture of innovation allows companies to be more adaptive to market changes and respond more quickly to new opportunities.

In addition, companies like Tesla have shown how innovation is not only limited to products but also includes business models and marketing strategies. Tesla, for illustration , is changing the way electric vehicles are marketed by selling directly to customers, eliminating dealer middlemen, and

creating a better customer experience while improving profit margin efficiency. Strategic innovation underpinned by a strong organizational culture, investment in R&D, and disruptive business models are key elements that have enabled companies such as Apple, Google, and Tesla to dominate the global market. By integrating innovation into every aspect of operations, the corporation not only survives the competition but also becomes a pioneer who creates a positive impact on society and industry.

Innovation management is a strategic process that allows companies to effectively manage new ideas resulting in a sustainable competitive advantage. In an increasingly fast, diverse, and dynamic business environment, the ability to continuously innovate is a crucial element in maintaining a position in the market. As stated by (Kaplan, 2009; Preda et al., 2007), innovation management includes the management of the innovation cycle that involves the identification, development, and implementation of new ideas within an organization. This cycle aims to ensure that fresh ideas continue to flow at all times, responding to changing market needs in a timely manner. Sustainable competitive advantage results not only from product or service innovation but also innovation in processes, business models, and resource management. Recent research shows that companies that systematically implement innovation management have a better ability to deal with market uncertainty. For illustration , (L. Wang et al., 2019) emphasized that open innovation, namely cross-organizational collaboration in creating new ideas, plays an important role in improving the competitiveness of companies.

In addition, the implementation of digital technologies in the innovation process, such as AI and data analytics, further improves the efficiency of idea management. According to research by (Q. Zhang, 2022), the integration of digital technology allows companies to identify patterns of customer needs faster and develop products that match market preferences. In practice, innovation management includes several key stages. The first stage is the creation of ideas that involve the exploration of new opportunities and intensive research. The next stage is development, where the ideas are formulated into prototypes or more concrete concepts. After that, implementation becomes a critical stage that determines the success of the idea in producing real value for the organization. This stage requires cross-functional coordination within the organization, as well as support from top management. However, the success of innovation management cannot be separated from the organizational culture. A culture that advises creativity and tolerance for failure is essential to ensure that innovation continues to evolve. This is in line with the view expressed by (E. G. Anderson et al., 2022),

who emphasized that a supportive organizational environment plays a role in increasing employee motivation to innovate. Ultimately, innovation management is not only a tool to survive in the market but also to create a long-term positive impact. By strategically managing innovation, companies can build a competitive advantage that is not easily replicated by competitors. Therefore, investment in structured innovation processes, technological support, and the development of an innovative culture should be a priority for organizations that want to stay relevant in the era of globalization. In essence, the innovation management framework mentioned above is to develop and strengthen the process of transforming ideas into new products/ solutions/ services that are used by the community.

5.2. Stages in the Innovation Cycle

The innovation cycle reflects a series of strategic activities aimed at bringing an innovative product or service from the initial stage to successful marketing. Based on the view of (Preda et al., 2007), there are two main aspects that need to be considered in this process, namely the development of innovative products or services and the development of businesses to support the marketing of these products. These two aspects are intertwined and are the foundation for successful innovation in facing competitive market challenges.

The first stage in the innovation cycle is the creation of ideas. This stage often begins with an observation of the problem or opportunity that exists, both in the present and in the future (Figure 5.2.). Sites often arise from observing current or future issues. They can be inspired by organizational goals or by a new market situation that suddenly becomes an opportunity.. Innovative ideas can emerge from an in-depth analysis of an organization's objectives or a new market situation. For illustration , changes in consumer needs or the emergence of new technologies are often triggers for the emergence of opportunities that organizations can optimize. Recent research shows that an environment that advises creativity and collaboration plays an important role in creating innovative ideas. According to (Jun et al., 2021), companies that adopt a cross-functional collaborative approach can accelerate the process of developing ideas into concrete solutions.

After the creation of the idea, the next stage is the development of the product or service. At this stage, the ideas that have been identified are tested and refined through a process of prototyping, hearing, and validation. Technology plays a crucial role in accelerating this process. A study by (Shang et al., 2023) states that the use of digital tools such as AI-based simulations can improve accuracy and efficiency in developing innovative products. In this

case, the integration of technology with innovation strategies allows companies to reduce the risk of product failure and increase the speed to market.

Figure 5.2. Illustration s of innovation life cycles (Kaplan, 2009).

Once a product or service is developed, the final stage in the innovation cycle is business development to market the product. Marketing is not just about selling products, but it also includes broader strategies, such as understanding market segments, building brands, and creating a positive customer experience. (Y. Wang, 2016) highlighted the importance of a data-driven marketing approach in improving the effectiveness of business strategies. Data analytics allows companies to personalize their approach to consumers, resulting in higher value for customers.

The success of the innovation cycle relies heavily on cross-functional coordination within the organization. Effective collaboration among R&D, marketing, and top management teams can increase the chances of success in bringing an innovative product or service to market. Furthermore, an organizational culture that supports experimentation and risk-taking courage is also a key element. As affirmed by (M. B. Anderson, 2019), organizations that build an innovative culture are able to create an ecosystem that continues to generate new and relevant ideas to the market. Ultimately, the innovation cycle is not only a framework for product development, but also a foundation for maintaining organizational relevance in the midst of global market dynamics. By managing innovation in a structured and sustainable manner, organizations can create competitive advantages that are difficult for competitors to replicate. Therefore, investing in human resources, technology,

and innovative culture is a priority that cannot be ignored by companies that want to stay ahead in this digital era.

5.3. Factors Supporting Innovation Success

In an increasingly dynamic business world, competitive advantage no longer simply depends on low production costs, but on the ability of companies to continue to innovate. Innovation is the key to success, including value-added management, product quality, responsiveness to the market, and technology integration. These factors are interrelated, providing a foundation for business sustainability in the midst of global competition.

Increasing added value as the main strategy, added value is one of the fundamental elements that determine the competitiveness of products or services in the market. The process of creating added value is not only limited to production, but also includes the entire value chain, from design to distribution. Studies show that companies that are able to consistently create added value are more competitive in the global market (Liu et al., 2021). Value-added management through product innovation, service improvement, and customer relationship management provides its own advantages, especially in high-knowledge-based sectors.

Quality and responsiveness, the pillars of competitive advantage, product quality and the ability to respond quickly to market changes are other crucial pillars in building a competitive advantage. In a rapidly changing business landscape, companies need to develop a quality management system that is adaptive and responsive to customer needs. Recent research reveals that a corporation 's responsiveness to customer demand directly affects their sustainability in the market (Tortorella et al., 2021). Furthermore, the integration of customer feedback into the product innovation process can lead to higher customer loyalty and differentiation in the market.

The integration of technology as an enabler of transformation, the effective use of technology has become a key catalyst in achieving operational efficiency and innovation. Technology not only supports process automation, but also facilitates data-driven decision-making and better product development. A study from (Kanapathipillaii, 2021) shows that companies that integrate technologies such as AI and data analytics into their operations are able to increase efficiency by up to 30% and diversify products faster than their competitors. Competitive advantage in the modern era is determined not only by cost efficiency, but by the ability of companies to continuously innovate in creating added value, maintaining quality, and responding quickly to the market. Effective technology integration is also the main support for business transformation toward long-term sustainability. Therefore,

companies that want to survive and thrive in the global market must adopt a comprehensive, technology-based, and customer-oriented innovation strategy.

5.4. Illustration s of Successful Cases of Innovation

Innovation management plays a crucial role in the growth of companies and dominates the competition. Innovation has always been part of a manager's job, as innovation is often closely linked to change endeavors within an organization. Innovation is the key to the success of various companies in facing market challenges and changing consumer needs. In an increasingly competitive world, the ability to create and present different products or services is a strategic advantage. This article discusses four successful cases of innovation from various industries: Apple, Google, Sosro Bottled Tea, and Pepsodent, each of which provides valuable lessons on the importance of innovation in modern business. Apple is a perfect illustration of a corporation that consistently innovates to meet and even exceed market expectations. Through products like the iPhone and iPad, Apple has succeeded in revolutionizing the way people use technology. The iPhone, for illustration , is not only a communication tool but also a multifunctional platform for entertainment, work, and daily life. Apple's consistency in designing products that are intuitive and aesthetically pleasing proves the importance of understanding consumer needs in depth. According to research published by (An, 2023), continuous innovation focused on user experience is a key factor in Apple's success in the global market.

Figure 5.3. Google products.

On the other hand, Google has changed the way people search for information, learn, and interact online. Services such as Google Search, YouTube, and Google Maps are illustration s of how innovation can have a significant impact on people's lives. Google's success lies not only in the development of its technology, but also in the ecosystem it has built to support various services. Research by (Zhao et al., 2021) shows that Google's ability to ethically utilize user data to improve the quality of its services is one of the corporation 's competitive advantages.

Google is the corporation that has the most influence on our lives. Especially the internet. Since the beginning of Google's work by Larry Page and Sergey Brin in 1996 (Google.com domain name was registered in September 1997 and the corporation was formed on September 4, 1998), it has now been 15 years since Google changed the way we search for information (figure 5.3.). Here are some of Google's products that changed the world:

- **Google Search**. Let's start with the most obvious thing, which is Google's first product that is now synonymous with the way we search for information online. Namely search engines. Google Search is now the single most visited page on the internet.
- **Google bombing**. One of the best jokes on the internet is the Google bomb that pushes false, untrue, or satirical facts to the top of Google's search results through a series of search engine optimization tricks.
- **YouTube**. Although Google did not discover YouTube, it bought the video-sharing site less than 18 months after its debut in 2005. Currently, YouTube is translated in 56 countries and more than 100 hours of videos are uploaded to the site every minute.
- **Google Docs**. With Google Docs, people can collaborate on text documents, spreadsheets, and slideshows, no matter where they are. The software is already being used in classrooms, news agencies and helping people find a place to live after the Boston Marathon bombings earlier this year.
- **Google Personal Finder**. Compared to Google Docs, in an emergency, Google Person Finder may be more effective in tracking down missing people in disasters. Google launched this feature after the 2010 Haiti earthquake.
- **Hangouts.** Google+'s vaunted video conferencing feature. It is free, easily accessible, and has even been used by president Barack Obama. Musician Daria Musk successfully used Hangouts to boost her career by playing concerts for fans online in July 2011.

- **Google Maps**. Now even some people cannot find the road across from their housing without Google Maps. With the increasing need for public transportation information, Google Maps has become an absolute necessity. Especially now supported by the Street View feature (which is currently mapping the Surabaya area).
- **Google Earth**. An enhanced version of digital imagery from Google Maps, Google Earth satellites allow you to see almost every location on the planet. Including Area 51 which is touted as a secret facility.
- **Androids.** The smartphone's operating system is costing Google billions of dollars even though the code is released for free. Users in developing countries now have access to smartphone devices capable of connecting them to the rest of the world, without having to use a computer.
- **Google News**. Google News indexes minute-by-minute reports from around the world. This tool is invaluable for keeping track of a growing story. Google News are changing the way we consume news and learn what is happening.
- **Transparency**. Enter a specific keyword into Google Search and you may find yourself on a federal police watch list. Through the National Stock Agency (XKeyscore) program, federal spies can track internet activity in real time, so what you do can tell them about you.
- **Shared memory**. There is a negative impact if public information can be directly searched on Google. That is, the internet never forgets. And all it takes is a single Google Search to remind others of your mistake.
- **Self-driving cars**. Looking to the future, Google has some new projects that could impact the world over the coming decades. One of them is driverless cars, where computer-based vehicles can directly take passengers to where they want to go.
- **Google Glass**. As if a pair of screen frames were shot in front of your eyes, Google introduced Google Glass as an alternative to using the internet without touching it and under any circumstances.
- **Project Loon**. There are still vast areas of the world where data signals cannot be reached, let alone laptops connected with wireless connections. Google plans to change that with Project Loon. The idea is crazy, which is to use balloons to spread wireless dots. According to Google, this strategy allows people to get online cheaper and faster than traditional cable-based connections laid on the ground.

Meanwhile, Sosro Bottle Tea, as a pioneer of packaged tea in Indonesia, shows that innovation does not always have to be in the form of advanced technology. By utilizing wide distribution and consistency in maintaining

product quality, Sosro Bottle Tea has managed to build a strong brand. This strategy is supported by a deep understanding of local market preferences. As stated by (Purwanto et al., 2022), the success of local brands such as Sosro Bottle Tea shows the importance of combining product innovation with an effective marketing strategy.

Figure 5.4. Bud tea has managed to become one of the top brands that compete with well-known tea brands, namely Sosro Bottled Tea.

Sosro Bottle Tea is an illustration of a brand that has been developed and maintained for decades. Starting from the adoption of the jasmine tea brand produced by the Sosrodjojo family, which was then developed so that it became a brand that is very close to customers through the strategy carried out. As a result of these endeavors, Sosro is now a leader in the bottled tea category, even competing with multinational companies playing in this category. Sosro's Brand Equity has been formed through a long process. Sosro has successfully developed the Sosro Bottle Tea brand into a brand with strong brand equity (figure 5.4.). Some things that can be observed in the formation of brand equity are:

1. It can be said that the brand awareness of Sosro Bottle Tea has entered the peak of the level of thought. This can be seen from Sosro Bottle Tea becoming the market leader in the ready-to-drink bottled tea category.

2. The perceived quality of Sosro Bottled Tea has been proven for decades. Sinar Sosro has succeeded in maintaining the quality of this product so that it gets good reviews from consumers.
3. The Sosro Bottle Tea brand association is strong, it can be seen when people mention bottled tea, what they mean by bottled tea is Sosro Bottled Tea.
4. The Sosro Bottle Tea Loyalty brand is also strong. This is the result of the development of distribution channels, maintaining quality, and promotional strategies carried out with the jargon "Whatever the food, the drink is Teh Bottle Sosro".

Pepsodent, on the other hand, provides a lesson on the importance of diversification in product innovation. By presenting a variety of variants that address the specific needs of consumers, such as toothpaste for sensitive teeth, teeth whitening, and cavities protection, Pepsodent has managed to maintain its position as a market leader. This strategy is in line with the findings revealed by (Amgad et al., 2021), who emphasized that product diversification based on local consumer needs can significantly increase customer loyalty. From the four cases above, it can be concluded that innovation is an essential element in maintaining business sustainability. Whether through advanced technologies such as those done by Apple and Google, or through local approaches such as Sosro and Pepsodent Bottled Tea, the success of innovation depends on the ability of companies to understand market needs and respond creatively to them. As stated by (Porter, 2003), innovation is not only about creating something new but also about creating relevant value for consumers.

Figure 5.5. Pepsodent's position is compared to similar products on the market.

When in the growth stage, consumers are familiar with the products made by the corporation with rapidly increasing sales and profits coupled with strong promotions. More and more sellers and distributors will be involved to take advantage of the huge market demand. The growth of producers in the community continues to increase. Although many other toothpastes are available now, Pepsodent remains stable. The distribution of Pepsodent is also very wide. Today, Pepsodent does not only market toothpaste products (figure 5.5). There are several new products from Pepsodent, such as toothbrushes and mouthwashes. With all these new innovations, Pepsodent covers the entire range of oral health care for its consumers.

Figure 5.6. (a). White Pepsodent now; (b). Complete Pepsodent 8; (c). Pepsodent Gum Treatment; (d). Pepsodent Herbs; (e). Sensitive Pepsodent; (f). Updating Pepsodent; and (g). Fresh Pepsodent Center.

At the mature stage, the corporation 's products experience a saturation point, characterized by the number of existing consumers that do not increase so that the sales figure remains at a certain point and the amount of profit decreases and sales tend to decline if it is not accompanied by a strategy to attract the attention of consumers and traders. Because there are

already many competitors, traders are starting to leave the competition and new ones will not be involved much because the number of consumers remains and tends to decrease. In this condition, an affordable cost policy is applied for customers because there is cost competition in the market. In Indonesia, Pepsodent White Now is available in 100 grams with a selling cost of IDR 15,000 in stores in all major cities. Pepsodent White Now is here to complement other Pepsodent product lines, namely Pepsodent Complete 8, Pepsodent Gum Care, Pepsodent Herbal, Pepsodent Sensitive, Pepsodent Whitening, and Pepsodent Center Fresh and is a form of Pepsodent's commitment to always innovate and not only provide basic dental protection needs (figure 5.6.).

5.5. Strategies to Increase Innovation in Organizations

In the ever-changing business world, innovative organizations play a crucial role in maintaining a corporation 's growth and sustainability. One of the main strategies adopted is to focus on developing new innovations that will eventually replace old products or services. This step becomes important because the product life cycle shows that the growth of old products tends to slow down over time and may even start to decline. This phenomenon presents a challenge to the organization's ability to keep growing in a competitive market. The product life cycle consists of several stages, ranging from introduction, growth, maturity, to decline. In the downturn, companies often face growth stagnation or even a decline in revenue. To address this, organizations must be ready to deliver incremental innovation, which is a small but meaningful development of an existing product. Research by (An, 2023) highlights that incremental innovation allows organizations to maintain competitiveness and optimize profits at a relatively low cost compared to radical innovations that require greater investment.

Incremental innovation not only extends the product life cycle, but also provides companies with the flexibility to respond to changing consumer needs. For illustration , technology companies often introduce software or hardware updates that provide new added value without replacing the product as a whole. This strategy helps maintain brand relevance and minimize the risk of losing market share. While important, the process of managing innovation is not easy. Companies often generate more technical ideas and prototypes than they can effectively commercialize. This creates the need for structured innovation management, from the ideation stage to commercialization. (Kaplan, 2009) show that good innovation management involves systems that can evaluate, prioritize, and implement ideas based on their market potential and technical feasibility. One widely used approach is

the stage-gate model, where innovations are evaluated through a series of stages that include initial selection, development, testing, and launch to market. This approach helps companies allocate resources efficiently and reduce the risk of failure. According to a study by (Y. Zhang, 2023), structured processes such as stage-gates allow companies to increase innovation success by up to 30% compared to less organized approaches.

Innovation management must also consider the balance among the amount of technical innovation produced and the organization's capacity to bring that innovation to market. Not all ideas need to be realized into commercial products, but it is important to choose the one that has the greatest market value. (Amgad et al., 2021) explain that in-depth market analysis and feasibility assessment are critical steps in the innovation process. This ensures that any new product launched is not only relevant but also has a high chance of success in the market. For illustration , in the automotive industry, companies like Toyota use a highly structured process to assess the feasibility of each new prototype. Thus, they can introduce models that meet consumer needs while minimizing unnecessary development costs. Business sustainability is not only determined by the innovation itself, but also by the way the innovation is received by the market. Companies that successfully understand the product lifecycle and implement incremental innovations have a greater chance of staying relevant in the long run. According to (Porter, 2003), innovations that focus on creating value for consumers, such as efficiency, convenience, or competitive pricing, will be more likely to survive in a dynamic business environment.

Furthermore, innovation not only impacts products but also business processes and operational models. For illustration , ecommerce companies like Amazon are constantly innovating in logistics systems and AI technology to improve efficiency and customer experience. This shows that innovation can encompass all aspects of the organization to support sustainable growth. Innovation is an important element in maintaining the sustainability of organizational growth. In facing the challenges of the product lifecycle, companies must be able to manage innovation in a structured manner, from the ideation stage to commercialization. Through approaches such as incremental innovation and management models such as stage-gate, companies can optimize the potential of new ideas while ensuring the relevance of products in the market. In an ever-changing world, innovative organizations are not only surviving but also thriving by leveraging innovation as their primary strength. Thus, the role of innovation management has become increasingly important in determining the success and competitiveness of companies.

In the face of increasingly complex internal and global challenges, a new paradigm in technology development is an absolute necessity. Reliance on traditional economic development approaches that rely solely on comparative advantages, such as abundant natural resources, cheap labor, and strategic locations, is no longer relevant to achieve sustainable competitiveness. Changes in global conditions have shifted the perspective on how the competitiveness of a country or organization can be built and maintained. This transformation demands continuous innovation as a key element in maintaining a competitive position in the global market.

Comparative advantage was originally based on classical economic theory that took into account factors of production, such as land, labor, capital, and natural resources. However, in recent developments, this approach has undergone a significant shift. Government policies in the monetary and fiscal fields have become factors that affect the competitiveness of a country's economy. However, based on the latest research, this is no longer enough. For illustration , (Porter, 2003) shows that the success of competitiveness now lies in an entity's ability to adapt and innovate continuously, especially in the face of the challenges of a highly dynamic global market. This shift also reflects a paradigm shift from a "resource-based economy" to a "knowledge and innovation-based economy." This means that the competitive advantage of a country or corporation now depends more on mastery of technology, the quality of human resources, and the ability to integrate innovation in every aspect of operations.

In a world increasingly influenced by the technological revolution, innovation has become a key element in building a competitive advantage. Various studies show that companies that focus on sustainable innovation are better able to survive and thrive compared to companies that rely solely on traditional strategies. A study by (Y. Zhang, 2023) underlines that innovation not only drives operational efficiency but also creates new added value that is relevant to consumer needs. In this context, innovation is not only limited to products, but also to business processes, organizational models, and ways of interacting with the market. A real illustration can be seen from tech companies such as Google, which are constantly introducing new services such as AI and cloud computing to maintain their dominance in the market. Innovations like this have had a huge impact, both in creating a better customer experience and in strengthening the corporation 's competitive position globally.

In the past, competitiveness was often driven by factors such as low labor wages, government subsidies, or low interest rates. While these factors provide a competitive advantage in the short term, they cannot be relied upon

to create sustainable growth. (Amgad et al., 2021) highlight that low-cost-based strategies are no longer relevant in the era of globalization and digitalization, where quality, speed of innovation, and the ability to respond to change become more important. Instead, focusing on improving the quality of human resources and the apply advanced technologies has become a more effective strategy to build competitiveness. For illustration , countries such as Germany and Japan that do not have abundant natural resources but are able to become global economic powers through massive investments in technology and education.

The government has a strategic role in supporting this paradigm transformation. Policies that encourage R&D, strengthening digital infrastructure, and vocational education and training are important factors in creating an ecosystem that supports innovation. According to research by (Sadeh et al., 2021), government interventions that focus on the development of advanced technologies, such as AI and green technology, have a positive impact on national competitiveness. In addition, collaboration among the public and private sectors is also the key to success. By creating an environment conducive to innovation, such as special economic zones for technology or subsidies for research, governments can accelerate the adoption of this new paradigm.

In the face of ever-changing global dynamics, economic competitiveness can no longer rely on traditional comparative advantages such as natural wealth or cheap labor. A new paradigm that emphasizes sustainable innovation is an urgent need for organizations and countries. By focusing on technology development, improving the quality of human resources, and strategic policy support, organizations can create competitive advantages that are not only relevant for today but also for the future. The future of economic competitiveness lies in the ability to innovate continuously, create added value, and adapt quickly to change. This transformation requires close collaboration among governments, the private sector, and academia to ensure that innovation is not only an right of refusal but a strategic necessity for sustainable economic growth.

The changes in the globalization order that continue to occur should be an opportunity for every country or region to increase its competitiveness on the international stage. Michael (Michael E. Porter, 1998; Porter, 2003) explains that in the modern era, the traditional concept of comparative advantage—which relies on factors such as natural resource wealth, low labor wages, and low production costs—has been replaced by the dominance of technological progress and innovation. In this context, the ability to innovate and adapt to global changes becomes more important than relying solely on

basic factors of production. The special advantages possessed by each region are no longer limited to low costs, but also involve added value resulting from technological capabilities, creativity, and innovation. For illustration , developed countries such as Japan and Germany which have limited natural resources have managed to become global leaders through a focus on high-tech development and product innovation. This shows that innovation can provide a sustainable competitive advantage, even without relying on traditional comparative advantages.

Innovation includes not only new products and services, but also improvements in production processes, business models, and marketing strategies. In the digital era, innovations related to information technology, AI, and the IoT are key in creating operational efficiency while providing added value for consumers. For illustration , the technology sector in Silicon Valley has proven that innovation capabilities can create products and services that become global standards. Recent research by (W. Zhang, 2024) shows that the competitiveness of a country or corporation now depends on the ability to integrate innovation with existing technological infrastructure. This includes the use of big data for market analysis, automation in manufacturing processes, and the use of green technologies to create sustainable solutions.

To maximize the benefits of the changing globalization order, an innovation focused strategy needs to be implemented. Some important strategies include:

1. Investment in R&D: Governments and the private sector need to allocate significant budgets for research activities, especially those focused on new technologies and solutions relevant to the needs of the global market.
2. Human Resource Development (HR): Technology-based education and training should be a priority to create an innovative and adaptable workforce to change.
3. Global Collaboration: Partnerships with international organizations, universities, and multinational corporations can accelerate technology transfer and help the development of local innovations.
4. Improving Digital Infrastructure: Infrastructure that supports the adoption of technology, such as high-speed internet networks, is an important foundation for innovation in the era of globalization.

Comparative advantages that focus on low costs have now been replaced by a new paradigm that emphasizes innovation as a key factor in increasing competitiveness. In the face of changes in the globalized order, the ability to create and adopt innovations has become something that cannot be ignored. By strategically utilizing technological advances, each region has the

opportunity to create new competitive advantages that are not only relevant at the local level but also in the global market.

The apply technology management is an important element that can have a significant influence on the performance of a corporation or organization. With good technology management, various strategic benefits can be obtained. Technology management is not only about procuring technology, but includes how the technology is integrated and utilized to support various aspects of an organization's operations.

1. Value creation: increasing corporation added value, technology management allows companies to create added value in every process carried out. Technology not only helps speed up the work process, but also ensures that every activity makes a real contribution to the corporation 's goals. For illustration, technology companies such as Tesla have successfully utilized technology not only to produce environmentally friendly electric vehicles, but also to improve production efficiency through the use of robotics and AI.
2. Improvement of product and process quality, technology management can improve the quality of products and processes produced by the corporation . With the right technology, the corporation can eliminate production errors, ensure quality consistency, and meet international standards. For illustration , pharmaceutical companies often adopt advanced technologies to ensure their products meet global health regulations. Research from (W. Zhang, 2024) reveals that data-driven technology management helps companies achieve better and consistent quality.
3. Responsiveness to change, good technology management allows companies to be more responsive to changes in the market or customer needs. Information technologies such as big data analytics and AI-based predictions can help companies understand market trends faster than their competitors. With a faster response, companies are not only able to seize new opportunities but also avoid external threats.
4. Agility: intelligence and resilience in competition, In the face of the challenges of global competition, technology management gives organizations the ability to become more resilient, intelligent, and confident. Agile companies can adapt quickly to changes in the environment, be it regulations, new technologies, or market needs. For illustration , during the COVID-19 pandemic, many companies leveraged technology to switch to a remote work model, maintaining productivity despite the crisis.

5. Increased innovation, one of the main impacts of technology management is to spark innovation. Innovation is an essential element to win business competition. With technology management, companies can create new products or services that are relevant to customer needs. For illustration , the technological innovation carried out by Apple with the iPhone proves that creativity supported by technology can change the market globally.
6. Interfunctional integration in the organization, technology management allows for better integration among various organizational functions such as marketing, finance, production, and human resources. This integration ensures that all parts of the organization work synergistically to achieve common goals. An illustration is the use of an Enterprise Resource Planning (ERP) system that unites various operational functions in one technology platform, improving efficiency and communication among divisions.
7. Teaming: forming an effective team, with the support of technology, companies can form a more collaborative and effective team. Modern communication technology allows geographically separated teams to stay together efficiently. In addition, project management technology such as Trello or Slack makes it easier to collaborate in completing tasks together.
8. Creating fairness and honesty, the apply technology can also support transparency and fairness in organizations. Technology-based systems help ensure that each individual or team receives fair recognition and reward for their contributions. For illustration , the use of blockchain technology in supply chain management can increase transparency and ensure a fairer distribution of benefits.

The implementation of good technology management has a wide impact on organizational performance. From creating added value to improving equity, technology is a strategic tool that allows companies to continuously innovate and adapt to the changing business environment. To achieve these benefits, organizations must ensure that the technology is well managed, supported by skilled human resources, and implemented with a clear strategy. In this way, technology is not only a tool, but also a major driving force for the success of organizations in the modern era.

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Chapter 6
INNOVATION LIFE CYCLE

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In the ever-evolving era of globalization, technology has become an essential factor in various aspects of human life, including national development, business sustainability, and global competitiveness. Technological advances not only encourage the improvement of the quality of life, but also become the main driver of innovation in the industrial sector. Over time, the importance of mastering and utilizing technology is increasingly felt. Nations that fail to adapt to technological changes risk being marginalized in the international arena, experiencing what is often called a "technology crisis," which is a condition in which the technological tools and processes used become obsolete and no longer relevant (Markard, 2020). The life cycle of technological innovation, often illustrated using the S-curve, shows how technology goes through various stages of development from introduction to decline. This cycle provides a clear picture of the relationship among innovation and technology adoption, as well as how each phase requires a different strategy to maximize its benefits. Recent studies show that companies that adopt technology well tend to be more innovative and competitive in the global market (Blichfeldt & Faullant, 2021).

In the context of the life cycle of a technology product, stages such as introduction, growth, maturity, and decline reflect the complex dynamics among innovation, profitability, and market response. Research shows that in the early stages, the success of the technology is greatly influenced by early adoption by innovators, while in the maturity and decline stages, the sustainability of the product depends on the ability to adapt and innovate further (Cucculelli & Peruzzi, 2020). Furthermore, the adoption of digital technologies has become an important catalyst in supporting innovation and sustainability. Research shows that the well-planned adoption of digital technologies not only improves a corporation's economic performance but also supports sustainable development goals (Li et al., 2022). With a deeper understanding of the innovation lifecycle, organizations can identify the right strategy for each stage and plan for sustainability-oriented innovation.

6.1. The Role of Technology in National Development

Technology has become one of the key pillars in modern human life, playing a significant role in improving living standards as well as supporting business success. Technological advances allow operational efficiency,

product innovation, and improved quality of life, which ultimately drives the economic growth of a nation. In this era of globalization, technology is not only a tool, but a strategic imperative that determines a country's competitiveness in the international arena. Mastery of technology, especially science-based, is the difference among developed and developing countries (Markard, 2020). For illustration, developed countries such as the United States, Germany, and Japan have shown how technological innovation is the driving force of their economies. Investments in research and development (R&D) allow these countries to master advanced technologies, which not only increase domestic productivity but also create export opportunities for high-tech products. On the other hand, countries that fail to keep up with the dynamics of technological change tend to be trapped in a "technological crisis." In these conditions, the equipment and systems used become obsolete, thus hindering economic competitiveness and industrial innovation (Zhenpeng, 2021).

In the context of economic development, mastery of technology cannot be separated from the development of the National Innovation System (NIS). The system integrates the public, private, and academic sectors to create an ecosystem that supports innovation. A study shows that countries like China have effectively leveraged the NIS to create new technology markets and drive high-tech-based economic growth (Mohamed et al., 2022; Wen, 2023). The system also plays an important role in stimulating cross-sector collaboration, improving R&D efficiency, as well as accelerating the adoption of technology by industry. However, the main challenge in the development of NIS is the gap in resource allocation and technical capabilities. In developing countries, as research in Africa and South Asia shows, a lack of investment in STEM education (science, technology, engineering, and mathematics) is a major obstacle to technological progress. In addition, dependence on imported technology without strengthening domestic capabilities creates a dependency that is difficult to overcome (Ijeoma Ene, 2024; Omri, 2020).

In the digital era, technology also plays a role in supporting social and environmental sustainability. The adoption of digital technologies such as artificial intelligence (AI), the Internet of Things (IoT), and blockchain has provided solutions to global problems such as climate change and energy efficiency. Research shows that companies that adopt digital technology are effectively able to increase productivity while reducing negative impacts on the environment (Li et al., 2022). In the national context, the integration of digital technology with sustainability policies can create new opportunities for green economic growth, which supports the achievement of the Sustainable Development Goals (SDGs). However, success in the adoption of digital technology does not happen automatically. Policies that support digital

infrastructure, education, and access to technology are needed for all levels of society. The digital disparity among cities and remote areas, for illustration, is still a major challenge in many developing countries (Omri, 2020). To avoid a "technology crisis" and ensure relevance in the global market, countries need to adopt an integrated approach in technology development. This approach involves increasing investment in R&D, strengthening STEM education, and developing policies that drive innovation. In addition, cross-sector collaboration must be strengthened to ensure that the technology developed has direct relevance to the needs of society and industry.

Technological innovation has long been recognized as a key element that determines the nation's competitiveness. History proves that countries that succeed in economic development are those who are able to adopt and develop cutting-edge technology. China, for illustration, has transformed its economy from an agrarian-based country to one of the world's largest industrial and technological powers. This success cannot be separated from the government's role in building an effective NIS, integrating research, development, and technology application in various economic sectors (Zhenpeng, 2021). With policies that support R&D, China is not only increasing productivity, but also creating new innovations that strengthen its global competitiveness. China's success provides an important lesson for other countries, especially the developing ones, that investing in R&D is a strategic step toward achieving economic sustainability. Studies show that every dollar invested in R&D has a positive impact on economic growth, productivity improvement, and diversification of industrial sectors. In addition, this investment advises the development of more environmentally friendly technologies, which is a key need amid global challenges such as climate change (Mohamed et al., 2022).

Technological innovation plays a strategic role in creating a competitive advantage. In developed countries, technological innovation is the main foundation that drives operational efficiency, new product discovery, and global market expansion. For illustration, the United States and Japan, which consistently invest most of their Gross Domestic Product (GDP) in R&D. This strategy not only results in advanced technologies such as AI and biotechnology but also allows penetration into the global market through the export of high-tech-based products (Wen, 2023). However, it is important to remember that technological innovation is not just limited to the creation of new technologies. Innovation also includes improving existing technologies, making them more efficient and relevant to market needs. In the manufacturing sector, for illustration, digital technologies such as the IoT and automation have changed the way companies operate, creating cost

efficiencies, and improving product quality. Research shows that companies that adopt digital technology are not only able to increase productivity but also accelerate the time to market for new products, providing a significant competitive advantage (Li et al., 2022).

To encourage the adoption of technology and innovation, the role of the NIS is very important. The system integrates a variety of actors, including government, universities, and industry, in creating an ecosystem that supports R&D. Studies of national innovation systems show that countries with good coordination among these actors tend to be more successful in producing technologies that have an economic and social impact. In Europe, for illustration, integration among public policy and the private sector has accelerated the adoption of green technologies, supporting the transition to a sustainable economy (Markard, 2020). However, national innovation systems also face challenges, especially in developing countries. Lack of investment in STEM education (science, technology, engineering, and mathematics) and R&D infrastructure is often a major obstacle. Therefore, developing countries need to increase their priority on technology education and provide attractive incentives for R&D investment. Technology and innovation are not only tools to increase productivity, but also key to achieving economic, social, and environmental sustainability. With the right investment in R&D, the development of a NIS, and effective policy support, the country can ensure its competitiveness in the midst of rapid global changes. The experience of developed countries such as China, the United States, and Japan shows that technology not only creates economic opportunities but also becomes the foundation for achieving long-term sustainability. For developing countries, this strategy should be a priority to bridge the technology gap and ensure inclusion in global economic dynamics.

Technological innovation has become an important key to supporting sustainability in various sectors of life. Not only does it make a significant contribution to economic growth, technological innovation also plays an important role in realizing social and environmental sustainability. Developed countries have shown how the use of cutting-edge technologies can support sustainability goals, including energy efficiency, waste management, and carbon emission reduction. For illustration, the adoption of renewable energy technologies such as solar panels and wind turbines has helped many countries reduce their dependence on fossil fuels, thereby slowing the pace of climate change (Omri, 2020). Energy efficiency is one area where technological innovation has a huge impact. Technologies such as the IoT have enabled smarter energy management in households, offices, and industries. Smart sensors connected to the energy management system can

automatically adjust energy consumption based on real-time needs, thereby reducing energy waste. This technology not only saves operational costs but also helps to lower the carbon footprint of companies and individuals (Li et al., 2022).

In addition to environmental benefits, technological innovation also has a major impact on social sustainability. Digital technologies have revolutionized the education and healthcare sectors, allowing for wider access to basic services. In developing countries, for illustration, online learning platforms and telemedicine have made it possible for people in remote areas to access services that were previously unreachable. Thus, digital technology is a tool to reduce social disparities and improve people's quality of life. However, the benefits of this technology can only be felt optimally if it is supported by strong policies and the right investments. Research shows that in many developing countries, the lack of digital infrastructure and skilled human resources is a major obstacle in utilizing technology for sustainability goals (Omri, 2020). Therefore, governments need to play an active role in creating an ecosystem that supports technology adoption, including through tax incentives for tech companies and investment in STEM (science, technology, engineering, and math) education.

In the digital era, technology has become a key catalyst to drive sustainability on a global scale. The adoption of digital technologies such as AI, blockchain, and IoT has enabled higher operational efficiency, while reducing negative impacts on the environment. An illustration is the application of AI in waste management, where intelligent algorithms are used to optimize the recycling and waste treatment process, thereby reducing the amount of waste that ends up in landfills (Li et al., 2022). Additionally, blockchain has been used to increase transparency and accountability in global supply chains. With this technology, companies can trace the origin of raw materials and ensure that their production processes comply with sustainability standards. This not only increases consumer confidence but also helps companies meet the demands of increasingly stringent regulations related to sustainability. However, this digital transformation is not without challenges. Digital inequality, especially in developing countries, remains a major obstacle. Many communities do not yet have access to reliable internet or the necessary technological devices to take advantage of the benefits of digitalization. Therefore, governments and the private sector need to work together to accelerate digital inclusion, ensuring that no society is left behind in this technological era (Ijeoma Ene, 2024).

To ensure that technological innovation truly supports sustainability, a holistic strategy is needed. First, governments need to adopt policies that

encourage investment in green technologies, including through fiscal incentives and subsidies for renewable energy. Second, the private sector must invest in technology that supports operational efficiency and reduces environmental impact. Third, the community needs to be educated about the importance of sustainability and encouraged to adopt technologies that support sustainable lifestyles. Research also shows the importance of cross-sector collaboration to achieve sustainability. For illustration, partnerships among government, academia, and the private sector can accelerate the development of new technologies that support sustainability. On the other hand, international organizations can play an important role in providing funding and technical expertise for sustainability projects in developing countries (Omri, 2020). Technological innovation is an essential element in achieving social, economic, and environmental sustainability. With the right investments, supportive policies, and cross-sector collaboration, technology can be a catalyst for creating a greener, inclusive, and prosperous world. Developing countries, in particular, have a great opportunity to leverage digital technologies and renewable energy to improve the quality of life of their people while maintaining the sustainability of our planet.

In the midst of the era of digital transformation and globalization, technology has become one of the main pillars of economic and social development. However, many countries, especially the developing ones, face major challenges in making optimal use of technology. Therefore, a comprehensive strategy is needed to increase the use of technology, including the development of innovation infrastructure, strengthening cross-sector collaboration, and increasing investment in R&D. This approach has proven effective in various developed countries that have integrated technology as the core of their development strategies (Wen, 2023). One of the first steps in increasing the use of technology is to build an adequate innovation infrastructure. Innovation infrastructure includes research centers, technology laboratories, and access to digital technology. Developed countries such as the United States, Japan, and Germany have shown that investments in this infrastructure can accelerate the process of innovation and technology adoption. For illustration, Silicon Valley in the United States is a clear proof of how an integrated innovation ecosystem can attract global talent and encourage the creation of revolutionary technologies (Markard, 2020). However, in developing countries, lack of infrastructure is often a major obstacle. Many regions do not yet have access to reliable internet or adequate research facilities. Therefore, the government needs to increase the budget allocation for the development of innovation infrastructure, including in the provide high-speed internet networks in remote areas. In addition,

collaboration with the private sector can help accelerate the development of this infrastructure, for illustration through the Public-Private Partnership (PPP) model.

The next strategy is to strengthen collaboration among the government, academia, and the private sector. This cross-sector cooperation is very important to create an innovation ecosystem that supports technology development. In countries such as China and South Korea, collaborations among universities, companies, and government agencies have successfully resulted in advanced technologies that support their economic growth (Wen, 2023). Universities have a key role in producing quality research and producing technological talents who are able to compete at the global level. On the other hand, the private sector can provide funds and resources to commercialize research results. The government is tasked with creating regulations that support and provide incentives for this collaboration. For illustration, tax incentive policies for companies investing in R&D can encourage the private sector to be more actively involved in technology development (Ijeoma Ene, 2024). Investment in R&D is one of the most important elements in a technology use strategy. Countries that allocate large budgets for R&D, such as Israel and Sweden, have consistently been at the forefront of global technological innovation. These investments not only allow the development of new technologies, but also increase the country's competitiveness in the global economy (Li et al., 2022). However, in many developing countries, budgets for R&D are still very limited. This has resulted in slow adoption of new technologies and a lack of local innovation. Therefore, policies that encourage increased investment in R&D are needed, including through international cooperation. International organizations such as the World Bank and the United Nations can play an important role in providing funding for R&D projects in developing countries. In addition, the private sector also needs to be encouraged to invest more in R&D.

In the midst of the ever-evolving complexity of technology, STEM (science, technology, engineering, and mathematics) education is the main foundation for ensuring human resource capabilities. Studies show that countries with strong STEM education systems, such as Finland and Singapore, have significantly higher levels of innovation than other countries (Ijeoma Ene, 2024). The government needs to ensure that the educational curriculum is designed to meet the needs of future technology. Training and certification programs should also be provided for the workforce who want to improve their skills in the field of technology. In addition, access to education must be expanded, especially for communities in remote areas and underserved groups, to ensure inclusion in the technological revolution. Increasing the use

of technology requires a holistic and integrated strategy. Building innovation infrastructure, strengthening cross-sector collaboration, increasing investment in R&D, and STEM education are key elements that should be a priority. By implementing this strategy, the country can create a technology ecosystem that supports economic growth, increases competitiveness, and creates a more prosperous and sustainable society. The experience of developed countries shows that technological success is not only about having advanced technology, but also about how it is adopted and used to create added value for society.

6.2. Technological Development and Life Cycles

Technology is a dynamic element that continues to adapt to human needs. In its development, technology follows a life cycle pattern similar to that of biological organisms, namely the stages of introduction, growth, maturity, and decline. Each stage reflects the interaction among technology and societal demands, as well as its ability to maintain relevance in the midst of the times. This lifecycle not only illustrates the journey of technology adoption but also emphasizes the importance of continuous innovation to maintain a position in a competitive market. At the introductory stage, a new technology is introduced to the community. This stage often involves large investments in R&D as well as marketing to create awareness. For illustration, the adoption of Information and Communication Technology (ICT) in education not only accelerates the learning process but also improves student skills, as found in the research of (Budihartono et al., 2022), which shows that IoT training can broaden students' horizons about modern technology. The next stage is growth, where the technology is starting to be widely adopted. In this phase, the benefits of technology are more clearly visible, thus driving increased adoption. For illustration, MSMEs in Sagulung, Batam, have succeeded in increasing turnover through the adoption of digital promotion technology, which allows them to reach a wider market (Larisang et al., 2024). When the technology reaches the maturity stage, its use is stable, and further improvement becomes more difficult. In this phase, innovation is the key to maintaining relevance. For illustration, the development of web-based technology at PT Hikari Teknologi Indonesia has succeeded in improving the efficiency of their internal business processes, which reflects the importance of adaptation in the modern era (Wahyu Hidayat & Henny Dwi Bhakti, 2023). The final stage, which is decline, occurs when technology no longer meets market needs or is replaced by new innovations. However, this decline can be prevented with continuous innovation. This is shown in the research of (Muhammad Alfan Fitroni & Acep Samsudin, 2023), where business digitalization

allows MSMEs to survive in the era of digital transformation by increasing efficiency and competitiveness. The technology lifecycle provides a framework for understanding the journey of an innovation from start to finish. However, to ensure relevance and sustainability, innovation must not stop. Various studies show that technology that continues to be adjusted to market needs can provide sustainable benefits for society and the economy.

In the modern technology landscape, every innovation goes through a stage called the technology life cycle, which includes four main stages, introduction, growth, maturity, and decline. These stages reflect the dynamics of technology adoption by society and how new innovations can maintain relevance amid changing markets and user needs. The first stage, namely introduction, is a crucial moment when a new technology is introduced to the market or society. At this stage, the technology faces major challenges, such as user resistance to change, high production costs, and the need for large investments in R&D. Research shows that investment in R&D during this early phase is critical to driving technology adoption. (Kriswidiyanti et al., 2021) emphasized the importance of strategies that focus on market education and increasing user trust in new technologies. After passing the introduction stage, the technology enters the growth phase. At this stage, the adoption of the technology increased significantly, supported by better production efficiency and reduced costs. This stage also provides a great opportunity for companies to take advantage of aggressive marketing strategies and expand their user base. According to Huang et al. (2020), success in the growth stage is highly dependent on the organization's ability to improve operational efficiency through the adoption of modern technology that is aligned with market needs (Huang et al., 2020). The maturity stage is a period of stability in the use of technology. In this phase, the technology usually reaches the peak of adoption, with maximum profits. However, the main challenge at this stage is how to maintain relevance in the midst of fierce competition. One effective strategy is product differentiation, which is to create variations or improve the quality of existing technologies. This strategy not only extends the life of technology in the market, but also helps maintain customer loyalty (Markard, 2020). The final stage, which is the decline, occurs when the relevance of technology begins to decrease due to the emergence of new, more efficient and relevant innovations. In this context, continuous innovation is a key factor to extend the life cycle of technology. For illustration, the implementation of digitalization strategies allows technology to remain relevant and competitive even though it is in a phase of decline (Muhammad Alfan Fitroni & Acep Samsudin, 2023). The technology lifecycle is an important framework for understanding the dynamics of innovation in society. By integrating good innovation

management at every stage, companies can maximize the potential of their technology. Early R&D, followed by differentiation and digitalization strategies in the maturity and decline stages, have proven to be effective in extending the life of the technology and maintaining its competitiveness.

Sustainable innovation is an important element in maintaining technological competitiveness in the midst of changing global market dynamics. More than just business strategy, sustainable innovation also plays a role in supporting social and environmental goals. By integrating sustainability principles, the corporation not only extends the life cycle of products but also creates a positive impact on society and the environment. In the energy industry, continuous innovation has resulted in a variety of technological solutions that are more efficient and environmentally friendly. For illustration, the development of new-generation solar panels and high-capacity wind turbines shows how technology can address sustainability challenges and meet the world's clean energy needs (Binz, 2020). In addition, the global adoption of renewable energy such as solar and wind has shown great potential in reducing carbon emissions and improving energy efficiency (Muslimin et al., 2024). However, sustainable innovation is not free from challenges. High development costs and market uncertainty are often constraints, especially for companies in developing countries. According to the research, this obstacle can be overcome by creating a supportive innovation ecosystem through cross-sector collaboration among government, industry, and academia. For illustration, tax incentive policies and research funding can be an important tool to encourage companies to allocate resources for green technology R&D (David Nizharadze, 2024). Another concrete illustration is the community renewable energy program in India, which uses technological innovations to increase community participation in clean energy solutions. This approach not only addresses energy poverty but also strengthens social sustainability through the involvement of local communities (E. Johnson et al., 2022). Nonetheless, the integration of innovative technologies requires a supportive policy framework. A study on the management of energy innovation in Poland highlights the importance of supportive regulations and technology development focused on local needs to accelerate the adoption of renewable energy (Sitek & Tvaronavičienė, 2021). Sustainable innovation is not only an right of refusal, but an urgent need in the face of global challenges such as climate change and resource scarcity. With the right policy support and cross-sector collaboration, innovation can be the key to creating a better future, where technology not only supports economic growth but also environmental sustainability.

Technology lifecycle management is a strategic approach used to manage every stage of a technological development, from introduction to decline. With a deep understanding of these lifecycle patterns, companies can make strategic decisions regarding investment, development, and marketing. In industries such as smartphones, large companies such as Apple and Samsung have used lifecycle analysis to plan well-coordinated product launches to maintain their competitiveness (Calvosa, 2020). The first stage in the technology life cycle is introduction. At this stage, the main focus is on creating market awareness of new technologies. However, challenges such as user resistance and high production costs often arise. In this context, investment in R&D is a key element to accelerate technology adoption. Research shows that the implementation of AI-based technologies, such as the digital assistant feature on Samsung smartphones, can improve connectivity and efficiency in this early stage (Prabhu et al., 2020). The growth stage is the phase where the technology starts to gain wider adoption. At this stage, production efficiency and cost reduction are the main focuses. An illustration is how IoT technology integrated with cloud computing has enabled products such as Apple HomeKit and Samsung SmartThings to provide more affordable and effective smart solutions (Sharma et al., 2020). At the maturity stage, technology adoption reaches its peak, and companies must find ways to maintain their relevance in the market. Strategies such as product differentiation are essential to extend the life of technology. Samsung, for illustration, is leveraging AI in their products such as Bixby to improve the user experience and bid significant added value (Stahl et al., 2023). The final stage in the technology life cycle is the decline, where the relevance of technology begins to decline due to the emergence of new innovations. In this phase, companies can extend the technology lifecycle by adopting a strategy of digitalization and continuous innovation. For illustration, the deployment of edge-cloud-based platforms to support smart IoT can improve efficiency and update the relevance of technologies nearing the terminate of their lifecycle (Rong et al., 2021). Technology lifecycle management is a critical element in maintaining competitiveness and relevance in the market. With a planned strategy at every stage, including initial investment in R&D, product differentiation in the maturity stage, and continuous adoption of innovation in the decline stage, companies can maximize the benefits of their technology. This model provides guidance for organizations to continue to innovate and respond effectively to market dynamics.

6.3. The S-Curve Model and Stages of PLC

The Product Life Cycle (PLC) is an important framework used to understand how a product moves through the various stages of its existence in the market, from development to finally experiencing a decline. The product lifecycle image shows the relationship among sales volume, profitability, and time, dividing the product journey into five main stages, development, introduction, growth, maturity, and decline. Each stage has unique characteristics and requires different strategies to maximize value for the corporation .

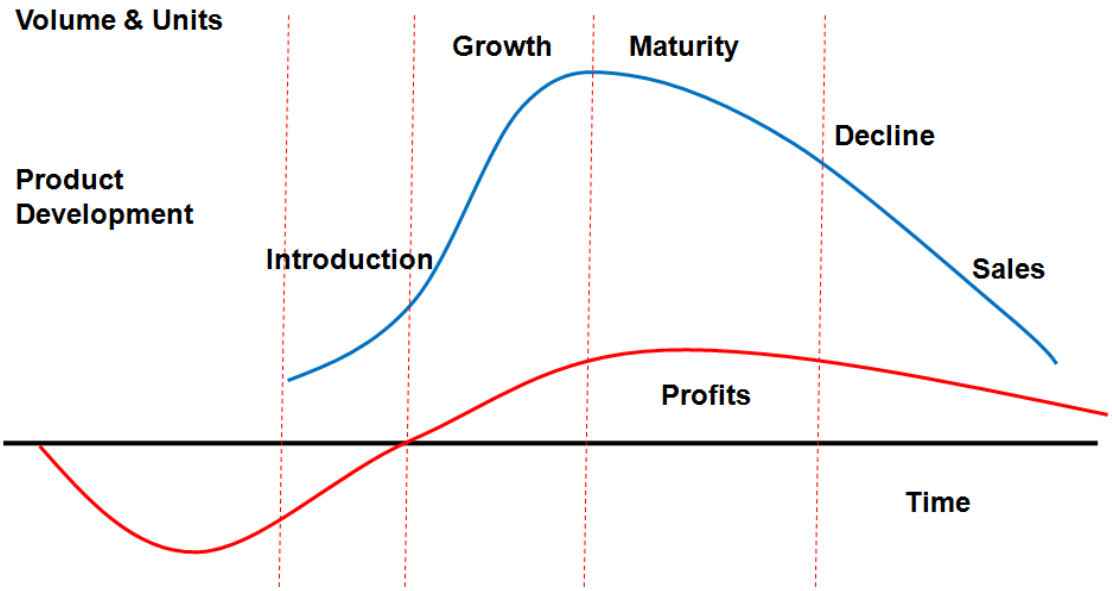

Figure 6.1. Product Life Cycle (PLC)
(Audretsch et al., 2021; Levitt, 1965; Subramoniam et al., 2021)

The life cycle of a technology product can be described by the S-curve (Figure 6.1.). From the perspective of profit over time, the S-curve can generally be classified into four stages as follows:

1. Product Development

   The development stage is a crucial first step in the PLC. At this stage, the corporation focuses on activities that involve research, design, testing, and preparation before the product is launched to the market. In general, this stage is characterized by large investments in the absence of income because the product has not been sold commercially. Therefore, the development phase is often a risky period for companies, given the large costs vital for R&D and the uncertainty of the product's success in the market. Innovation is a key element in the development stage. As stated by (Kotler dan Keller, 2016), the level of innovation applied in this stage greatly determines the potential success of the product in the market.

Innovation includes not only technological aspects, but also new approaches in understanding consumer needs. By creating unique and relevant value, companies can increase the chances of the product being well received in the market. For illustration, a study by (Meyer et al., 2021) shows that products developed based on direct feedback from customers tend to have a stronger competitive advantage. The study also emphasizes that a deep understanding of customer needs can help companies create products that are more relevant and appealing to the target market.

The development stage not only focuses on technological innovation, but also involves careful strategic planning. One of the main strategies is to conduct thorough market research. By understanding market trends, consumer preferences, and competitor analysis, companies can identify existing opportunities while also anticipating challenges that may arise. Research by (Li et al., 2022) highlights the importance of market research in reducing the risk of product failure. This study reveals that companies that actively utilize market data for decision-making have a greater likelihood of success than companies that rely solely on intuition. In addition to market research, companies should also invest in relevant technologies. The use of advanced technology in the development process can help speed up production times while improving product quality. A study conducted by (Zhang et al., 2021) shows that companies that utilize technologies such as data analytics and digital simulation can reduce costs as well as increase efficiency during the development stage.

The development stage also brings various challenges that the corporation must face. One of the main challenges is the high cost. The development process, which includes research, design, and testing, often requires a large budget, while the product has not yet contributed to the corporation 's revenue. Therefore, companies must manage their resources wisely to ensure that the investments made provide maximum returns. Another challenge is uncertainty regarding the success of the product in the market. Even with in depth market research and solid innovation, there is no guarantee that the product will be successful when it is launched. A study by (Chen et al., 2021) highlights that many products fail in the market despite going through a long and expensive development process. Therefore, companies need to have a risk mitigation strategy, such as conducting product trials on a small group of consumers before launching broadly.

Success in the development phase not only determines the launch of the product, but also affects the performance of the product in the later stages of its life cycle. A product that is well-designed and based on

consumer needs has a greater chance of success in the introduction and growth stages. Research by (W. H. A. Johnson et al., 2023) found that products that undergo innovative development have a longer life cycle and are more profitable than products that are less than optimally developed. In addition, an efficient development process can give companies an edge in time to market. In competitive industries, such as technology and pharmaceuticals, the ability to launch products faster than competitors can be a determining factor in success. The development stage is a critical phase in the PLC that requires significant investment in research, design, and testing. Success in this stage is highly dependent on the corporation 's ability to innovate, understand consumer needs, and manage resources effectively. Despite the challenges, companies that are able to manage the development stage well can increase the chances of their products succeeding in the market, as well as create long-term value for the corporation . By leveraging strategies such as market research, technology investments, and risk mitigation, companies can ensure that the products they develop are not only relevant but also competitive in an increasingly dynamic market.

2. Market Introduction

The PLC is a concept that describes the journey of a product from development, introduction, to withdrawal from the market. One of the stages that most determines the success of a product is the introduction stage. At this stage, new products are introduced to the market with the aim of creating consumer awareness, attracting interest, and building a foundation for long-term success. However, major challenges often arise, including high marketing costs, consumer resistance to innovation, and competition with substitute products. Research shows that the success of the introduction stage is highly dependent on marketing and distribution strategies. A study by Carter and Schmidt (2020) revealed that the effectiveness of marketing communication is one of the main determining factors in this stage. In addition, the use of digital technology and customer data is a very important element to understand consumer needs in depth (Jones & Baker, 2022). This essay will discuss the key strategies implemented in the introduction stage, the challenges that are often faced, and solutions that can increase the chances of success of a new product.

At the introduction stage, the right marketing strategy is an important foundation for creating awareness and influencing consumer behavior. One of the key elements in this stage of marketing is communication. Companies must be able to convey the value message of the product in an effective way to attract consumers' attention. Smith et

al. (2021) explained that the use of digital media, such as social media and influencer-based campaigns, is very effective in increasing product visibility. In addition to communication, cost is an important factor in determining consumer adoption. Some companies use a penetration pricing strategy, which is setting low prices to attract early customers, while others opt for premium prices to reinforce the perception of quality. Zhang et al. (2021) showed that low-cost strategies at the introduction stage increase consumer adoption by up to 20%, especially on products that are functional or utilitarian. However, this strategy must be tailored to the target market and product type.

Market segmentation is the process of dividing the market based on consumer groups with similar needs and preferences. Proper segmentation can help companies target potential customers who have a high probability of buying a product. A study by Kim and Lee (2020) emphasizes that data-driven market segmentation can increase the effectiveness of marketing campaigns by up to 30%. Additionally, this approach allows companies to allocate resources more efficiently. Distribution penetration is also a key element in the introduction stage. Companies must ensure that products are available on distribution channels that are relevant to the target market. Carter and Schmidt (2020) show that a combination of physical and digital distribution can improve product accessibility, especially in a highly competitive market. In the digital era, ecommerce platforms are becoming an increasingly important distribution channel to accelerate market penetration.

The introduction stage is often faced with some challenges. First, consumer resistance to new products is a common obstacle. This is usually caused by a lack of understanding of the value or benefits of the product. The solution to this challenge is to increase consumer education through information and persuasive marketing campaigns (Jones & Baker, 2022). Second, competition with substitution products can hinder market adoption. In this situation, product differentiation becomes very important. Zhang et al. (2021) suggest that companies focus on unique product features that competitors do not have to create added value. In addition, providing incentives such as discounts or loyalty programs can also increase consumer interest. Third, high marketing costs often burden companies in the early stages. One practical solution is to use a digital marketing approach that is more cost-effective than traditional methods. Research by Meyer and Utterback (2021) shows that companies that adopt digital marketing strategies are able to reduce operational costs by up to 15% while increasing the reach of their campaigns. The introduction

stage is a very decisive phase in the PLC. Success at this stage depends on an effective marketing strategy, proper market segmentation, and the corporation 's ability to meet challenges. By leveraging digital technology, customer data, and value-based approaches, companies can increase the chances of new product success. In a competitive business environment, adaptability and innovation are key to ensuring new products can survive and thrive in the market.

3. Growth

The growth stage is the second phase in the PLC that marks the initial success of the product in the market. At this stage, the product began to be accepted by consumers, which was reflected in the significant increase in sales and a surge in the corporation 's revenue. In this phase, the corporation has the opportunity to strengthen its position in the market, but also faces new challenges such as increased competition. According to Lee et al. (2022), the growth stage provides momentum for companies to take advantage of economies of scale and operational efficiency, so that profitability can increase substantially. However, challenges in the form of the presence of new competitors who are trying to take market share are threats that must be anticipated. Therefore, effective management of marketing strategies, product innovation, and distribution is essential to ensure sustainable growth. This essay will discuss the opportunities offered by the growth stage, the key challenges that arise, and the strategies that can be implemented to address those challenges and extend the growth period. The growth stage is characterized by some characteristics that distinguish it from other stages in the PLC. Increased consumer acceptance of the product is a key indicator of this stage, which is reflected in the rapid growth of sales. Profitability is also starting to increase due to lower fixed costs per unit of product due to economies of scale and production efficiency. However, this stage also presents competitive challenges. As the market for those products expands, new competitors start coming in, offering similar or even more innovative products to take a portion of the market share. This increases the pressure on companies to maintain consumer loyalty. A study by Kim and Park (2021) shows that companies that manage to build a strong brand identity at this stage have a greater chance of maintaining their position in the market, despite facing stiff competition.

To capitalize on growth potential and overcome the challenges of competition, companies often adopt strategies such as product diversification and brand strengthening. Product diversification can involve introducing new variants of the unique product or adding features that suit

consumer preferences. Research shows that innovations that focus on consumer needs can strengthen product appeal and prevent consumers from switching to competitors. For illustration, research by Zhang et al. (2020) found that product diversification carried out by technology companies was able to increase their market share by up to 15% in a three-year period. In addition, investment in branding is an important element to create consumer loyalty. Strong branding not only helps to increase product recognition but also creates a higher perception of value in the minds of consumers. A study by Kim and Park (2021) shows that strengthening a brand image can extend the growth period of a product by up to two-fold, especially in highly competitive industries such as technology and consumer goods.

Distribution is one of the important aspects of growth that is often overlooked. Distribution expansion is a key strategy to increase product accessibility to a wider market. Lee et al. (2022) showed that wider distribution, both through physical and digital channels, can increase sales by up to 20% in the first year of the growth stage. Digital platforms, such as ecommerce and social media, provide a great opportunity for companies to reach consumers in previously difficult to access locations. A study by Zhang et al. (2020) shows that companies that switch to digital-based distribution strategies are able to significantly increase their market penetration. On the other hand, companies must also ensure that their physical distribution channels remain optimal to meet the needs of consumers in traditional markets.

Despite the many opportunities offered by the growth stage, companies must overcome various challenges to maintain their momentum. One of the biggest challenges is the increasing level of competition. New competitors entering the market often bring innovations or bid more competitive prices, forcing companies to maintain the relevance of their products. In addition, maintaining a balance among demand and production capacity is an operational challenge that often arises. According to a study by Carter and Schmidt (2021), companies that fail to increase their production capacity during the growth stage often miss out on opportunities to expand their market share. Therefore, investments in production technology and supply chain management are essential to support the increasing demand. Another challenge that is no less important is maintaining consumer loyalty. When consumers are faced with more choices, they tend to move on to other brands that bid higher value. Therefore, companies must invest in loyalty programs and provide a great customer experience to retain their consumers.

The growth phase is a phase that offers great opportunities for companies to strengthen their position in the market, but it also presents significant challenges. Strategies such as product diversification, brand strengthening, and distribution expansion are steps that can help companies maximize their potential during this phase. Additionally, companies must be prepared for competitive, operational, and consumer loyalty challenges to ensure long-term success. Research shows that companies that are able to innovate and adapt quickly have a greater chance of surviving and growing in an increasingly competitive market. With the right strategy, the growth stage can be an important stepping stone to achieving success in the next stage of the PLC.

4. Maturity

The maturity stage is one of the important phases in the PLC, which is characterized by peak sales and the onset of market saturation. At this stage, the sales growth rate begins to slow down, and the product reaches a saturation point in the main market. Product profitability remains stable or begins to decline due to increasing pressure from cost competition, the emergence of substitute products, and changes in customer preferences. Therefore, companies need to develop mature strategies to survive in the market, extend the PLC, and maintain its profitability. When the market begins to become saturated, companies often face challenges in the form of increased cost competition and decreased customer loyalty. This advises the corporation to focus on operational efficiency and incremental innovation. According to Johnson and Wang (2023), one of the key strategies at this stage is to improve operational efficiency through automation and reduction of production costs. Companies can adopt new technologies to keep costs down and maintain profit margins (Johnson & Wang, 2023). In addition, incremental innovation plays an important role in maintaining product appeal. Yan et al. (2021) noted that small innovations, such as feature improvements, new designs, or more support services, can increase product value without the high costs typically associated with radical innovations (Yan et al., 2021). These innovations help companies to attract the attention of new customers and renew the loyalty of old customers.

Market diversification is also a very relevant strategy during the maturity stage. He and Zhang (2020) revealed that expansion into international markets or new customer segments can open up significant growth opportunities. For illustration, companies can target emerging markets that may not yet have similar products or introduce products to previously underreached demographic segments. This strategy allows

companies to expand their geographical reach or increase market penetration, which can ultimately extend the life of products in the global market (He & Zhang, 2020). During the maturity stage, the corporation can also increase its focus on intensive promotion and product repositioning. According to Lee and Kim (2022), effective promotions can include discounts, product bundling, or marketing campaigns targeting specific segments. Additionally, product repositioning through rebranding or adjusting communication strategies can create new appeal for both existing and new customers (Lee & Kim, 2022). For illustration, a product that was originally marketed as a high-tech solution could be repositioned as a user-friendly product for the general consumer. This approach has been successfully implemented by many technology companies, such as the transformation of tablets from professional work tools to family entertainment tools. At the maturity stage, cost competition becomes more intense as more and more competitors enter the market. To overcome these challenges, companies can adopt strategies such as value-added offerings. A study by Taylor et al. (2023) shows that companies can increase value for customers by offering more services, such as longer warranties, loyalty programs, or free technical support, without compromising the product's prime cost (Taylor et al., 2023). In addition, product bundling strategies are also a popular choice. By selling multiple products as a single package at a discounted cost, companies can encourage customers to buy more, increase the average value per transaction, and reduce cost pressure from competitors.

In the digital era, the use of data analysis is also the key to managing products at the maturity stage. By leveraging big data and predictive analytics, companies can study customer buying patterns, identify underserved market segments, and adjust their marketing strategies. Research by Kim and Park (2021) shows that companies that use data analytics are effectively able to increase promotion efficiency by up to 30% and extend the PLC by more than two years (Kim & Park, 2021). The maturity stage in the PLC is a crucial moment where companies must adopt smart strategies to stay competitive. Through operational efficiency, incremental innovation, market diversification, intensive promotion, and the use of data analysis, companies can extend the life of their products in the market and optimize profits. Although the challenges are increasing at this stage, the current literature shows that these strategies have proven effective in managing products at the maturity stage. Therefore, it is important for companies to adapt and continue to innovate to survive the increasingly fierce competition.

5. Decline

The downgrade stage is the last phase of the PLC where the sales and profitability of a product commence to decline significantly. This is often due to a variety of factors, including the emergence of new technologies replacing old products, changes in consumer preferences, or increasing competition from more innovative products. At this stage, companies are faced with a major challenge to maintain the relevance of their products or minimize the financial impact of the decline. There are several main causes that push a product into a decline phase. One of them is technological change. When new technologies emerge, old products often become obsolete. For illustration, electronic products such as mobile phones or computer hardware are often replaced by new models with more advanced features. Research by Hernandez et al. (2020) notes that technological developments are rapidly shifting consumer preferences and creating great pressure for companies to innovate or face declines (Hernandez et al., 2020). In addition, changes in consumer preferences also play an important role. Consumers tend to look for products that suit their ever-changing needs, especially related to new lifestyles or trends. A study by Li and Chen (2021) shows that companies that fail to keep up with market trends often lose market share, which ultimately pushes their products into a downward phase (Li & Chen, 2021).

Managing products at the downturn stage requires careful strategies to minimize losses. One of the main approaches is operational efficiency. By reducing production and marketing costs, companies can maximize profit margins from the remaining products. According to Hernandez et al. (2020), this approach involves eliminating unprofitable product lines, optimizing production processes, and focusing on markets that still have demand for these products. Additionally, companies often choose to discontinue products entirely or sell related assets, such as patents or production facilities, to allocate resources to more profitable projects. For illustration, technology companies often sell old patents to companies that can leverage the technology in a niche market.

In some cases, companies seek to extend the life cycle of products by introducing new variants or repositioning products. This strategy involves adjusting the design, function, or target market to make the product more relevant to today's consumer needs. Research by Park and Kim (2022) shows that product repositioning accompanied by the right marketing campaign can provide a temporary increase in sales, even in the decline stage (Park & Kim, 2022). For illustration, fast-food companies often introduce new variants of their old products, such as adding new

flavors or expanding menu options, to capture the attention of existing customers while reaching new segments. Niche markets also bid opportunities for products that are entering a downward phase. By identifying market segments that have specific needs, companies can market their products to a smaller audience but remain loyal. Studies by Zhang and Huang (2021) show that this strategy has been successfully implemented in industries such as collectibles, where older products are valued for their historical or aesthetic value (Zhang & Huang, 2021).

While radical innovation is usually rare at this stage, some companies choose to invest in incremental innovation to extend the relevance of their products. For illustration, adding new features, design updates, or developing more services that support legacy products. This strategy can help attract the attention of existing customers while providing added value for new customers. The downturn phase is a challenging period in the product lifecycle, but companies that are able to implement the right strategies can better manage this transition. Through operational efficiency, product repositioning, focus on niche markets, and incremental innovation, companies can minimize losses and even create new opportunities for future growth. In the ever-changing business world, adapting and responding to market dynamics is the key to success at every stage of the product lifecycle.

6.4. Characteristics of the PLC

In the world of technology business, the PLC plays an important role in determining marketing, production, and innovation strategies. PLC consists of four main stages, introduction, growth, maturity, and decline. Each stage has special characteristics that affect the managerial decisions of technology companies (Fandy Tjiptono, 1997).

Table 6.1. The characteristics of each technological product last the life cycle.

No.	Indicators	PLC Stage			
		Introduction	*Growth*	*Maturity*	*Decline*
1	Sales	Sales are low	Sales are increasing	rapidly Peak sales	Decline in sales
2	Cost	High cost per customer	Medium cost per customer	Low cost per customer	Low cost per customer
3	Profit	Negative	Profits increase	High profit	Profits decrease
4	Customer	*Innovators*	*Early adopters*	*Middle adopters*	*Laggards*
5	Competitor	Slightly	The number is increasing	The number is constant even	The number is decreasing

No.	Indicators	PLC Stage			
		Introduction	*Growth*	*Maturity*	*Decline*
				though it is starting to decrease	
6	Marketing Purpose	Create product awareness and hearing	Maximize market share	Maximize profit and maintain market share	Reduce costs

Source: (Fandy Tjiptono, 1997).

The characteristics of the four stages of the life cycle of technology products can be seen in Table 6.1. An understanding of the life cycle of a technology product is essential in planning a business strategy. Each stage has challenges and opportunities that must be taken advantage of by companies to achieve optimal business sustainability.

1. Level of Introduction

   The introduction stage in the life cycle of a technology product is a critical phase that determines the future of the product in the market. At this stage, the corporation introduces new products in the hope of creating consumer awareness and building a brand image. Technology products often require large investments in research, development, and marketing. Therefore, companies must ensure an effective marketing strategy so that the product does not fail in the market (Fandy Tjiptono, 1997). Fail create market awareness at this stage can lead to huge losses, even stopping production before breaking even. To succeed in the introduction stage, companies need to develop a comprehensive marketing strategy. One important approach is to build a brand through innovative and persuasive marketing campaigns. According to (Muhammad et al., 2021), effective branding can increase consumer buying interest by creating a positive image in the market. Attractive promotions such as discounts, rewards, and loyalty programs can also accelerate market penetration. Additionally, the use of digital technologies such as social media, websites, and mobile apps allows companies to reach a wider audience at a relatively low cost (Pravitelia Boer & Rah Utami Nugrahani, 2020). Efficient product distribution is the key to the success of this stage. Companies must ensure that products are available in the right markets with an extensive and reliable distribution network. According to (Purbowo et al., 2022), innovative packaging also plays an important role in creating more appeal for products, improving the perception of quality in the eyes of consumers. Proper market segmentation is an important step in the introduction stage. Technology products should be focused on early innovators and adopters who tend to be more open to new products. Market penetration is carried out through product launches in regions with high demand potential. For illustration, Alvaro Production's business has succeeded in expanding their market by

utilizing branding and digital technology to create an online catalog and develop a presence on social media (Falah et al., 2024).

Challenges often arise in the introduction stage, including high marketing costs, lack of consumer awareness, and competition with established products. Solutions to these challenges include strategic collaborations with business partners such as cafes, marketplaces, and retailers to introduce products more widely (Muhammad et al., 2021). In addition, product differentiation is also an effective strategy. For illustration, Frozen Seas SMEs increase the competitiveness of their products through eco-friendly packaging, flavor differentiation, and competitive pricing strategies (Triyastuti et al., 2021). The introduction stage in the life cycle of a technology product requires an innovative, adaptive, and comprehensive marketing strategy. Success in this stage largely depends on the corporation 's ability to create brand awareness, reach the market with effective distribution, and utilize digital technology for promotion. A well-designed strategy will form the foundation for the long-term success of technology products in the global market.

2. Growth Stage

The growth stage in the life cycle of a technology product is a crucial phase where companies can expand their market share and increase profitability. At this stage, the product begins to gain market recognition, which is characterized by a significant increase in sales. Companies need to capitalize on this momentum to strengthen their brand image, optimize distribution, and expand their customer network. Success at this stage will determine the sustainability of the product in a competitive market (Fandy Tjiptono, 1997). To maximize market potential at this stage, companies must adopt a targeted and adaptive marketing strategy. One effective strategy is consistent branding and strengthening brand identity through digital marketing campaigns. According to (Muhammad et al., 2021), strong branding can increase consumer buying interest and expand market reach. Product distribution must also be expanded through collaboration with strategic partners such as retailers and digital platforms to accelerate sales growth (Falah et al., 2024). Social media plays a crucial role in strengthening interactions with customers and building brand loyalty (Pravitelia Boer & Rah Utami Nugrahani, 2020).

Market segmentation at the growth stage should focus on a wider range of early adopters, including users looking for new innovations. Companies need to aggressively penetrate the market by expanding their marketing areas and reaching new segments through digital media. According to (Purbowo et al., 2022), attractive and innovative packaging

can increase the attractiveness of products in new markets. Thus, market penetration must be accompanied by strengthening effective distribution and promotion. Some of the common challenges faced in this stage are increasing competition, the need for greater production capacity, and complex distribution management. Applicable solutions include increasing production capacity through technology investment and operational efficiency. For example, Alvaro Production's efforts have successfully overcome this challenge by utilizing digital technology to expand the market and create attractive online catalogs (Falah et al., 2024). In addition, collaboration with business partners such as local cafes and retailers can also help increase product visibility (Muhammad et al., 2021). The growth stage is the perfect time for companies to expand their market and strengthen their brand image. Success in this stage requires a combination of aggressive marketing strategies, effective distribution management, and continuous product innovation. With the right strategy in place, companies can achieve sustainable growth and prepare themselves for the maturity stage in the global market.

3. Maturity Stage

The maturity stage in the life cycle of a technology product marks the peak of business success, where the product reaches maximum sales before stabilizing or experiencing a decline. Success in this stage is crucial because it determines whether the product can maintain its position in an increasingly competitive market. Products that survive at this stage usually have a strong brand and an extensive distribution network. If companies are unable to cope with competitive pressures, they will lose market share, which ultimately affects the corporation 's profitability (Fandy Tjiptono, 1997). Effective marketing strategies at maturity include product diversification, improved customer service, and the development of new markets. According to (Muhammad et al., 2021), consistent branding can strengthen consumer loyalty. Companies can also adopt marketing communication strategies through social media to strengthen relationships with customers and increase product visibility, as PT. Pertamina in promoting Bright Gas products through Instagram (Pravitelia Boer & Rah Utami Nugrahani, 2020). Innovation in packaging and product design can also be a new attraction for consumers (Purbowo et al., 2022). At this stage, companies should focus on existing market segments, especially loyal consumers. Market expansion can be done by reaching new geographical areas or introducing product variations tailored to consumer preferences. For illustration, Alvaro Production has managed to

expand its market by creating an online catalog and utilizing digital technology for branding (Falah et al., 2024).

The main challenges in this stage are increasingly fierce competition, market saturation, and changing consumer preferences. Applicable solutions include increasing production capacity and implementing new technologies to improve operational efficiency. Frozen Seas, for illustration, adopts eco-friendly smoking technology to increase the competitiveness of its products (Triyastuti et al., 2021). Additionally, it is important to strengthen digital marketing strategies to retain and attract new customers (Firdaus et al., 2022). The maturity stage requires a marketing strategy that focuses on innovation, differentiation, and strengthening relationships with customers. Companies must be able to adapt to market changes, improve operational efficiency, and continue to develop products to remain relevant and competitive. A well-planned strategy and effective execution will help maintain market share and extend the PLC.

4. Decline Stage

The downturn stage in the life cycle of a technological product is the final phase that determines the future of the product, whether it will be withdrawn from the market or renewed. Sales are declining due to the emergence of new technologies or changes in consumer preferences. Profits decreased drastically even though the cost per customer remained low. At this point, the corporation must make strategic decisions to reduce costs, update products, or develop new product lines (Fandy Tjiptono, 1997). Success in this stage can extend the life of the product or create new business opportunities. Marketing strategies in the downgrade stage focus on cost reduction, promotional sales, and product repositioning. According to (Muhammad et al., 2021), the implementation of a rebranding strategy can increase buying interest even though the market is saturated. Companies can also introduce products in new variants to increase their appeal. The use of social media and digital marketing as carried out by PT. Pertamina in promoting Bright Gas shows that digital communication remains effective even in the decline stage (Pravitelia Boer & Rah Utami Nugrahani, 2020). Market segmentation should be focused on loyal and reluctant customers (laggards). Market penetration can be done by distributing products in previously underserved markets or by entering foreign markets. According to (Falah et al., 2024), the use of digital technology and ecommerce platforms allows companies to reach the global market at minimal cost, extending the life of products that are starting to decline in the local market.

The main challenges are declining market demand and increasing product storage costs. Effective solutions include reducing production costs through innovative technologies such as those carried out by Frozen Seas SMEs in smoking skipjack fish using energy-saving technology ((Triyastuti et al., 2021). In addition, product diversification can increase market value. (Firdaus et al., 2022) suggested the use of digital marketing strategies to reduce operational costs and expand new markets. The downturn stage requires an adaptive, innovative, and cost-efficiency-oriented marketing strategy. Companies must take advantage of digital technology, develop new products, and expand untapped markets. Success in this stage will provide an opportunity to create new product lines that are more relevant to the future market.

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Chapter 7
DESIGN THINKING AND BUSINESS MODEL CANVASS

Andjar Prasetyo, Susalit Setya Wibowo

In the world of innovation, the ability to create creative and innovative ideas is an important foundation for innovators. This process not only produces new products, but also provides solutions to problems faced by the wider community. Design thinking (DT) as a systematic approach has proven to be an effective tool in this ideation process. On the other hand, an innovative product will not succeed in the market without a solid business model. Therefore, DT is often combined with the Business Model Canvass (BMC), a visual framework that allows entrepreneurs to visualize, create, and refine their business models. DT is an iterative method that focuses on a deep understanding of users, problem redefinition, and the creation of innovative solutions. The five main stages of DT—empathize, define, ideate, prototype, and test—play an important role in producing relevant and high-value products (Hoffmann & Drath, 2022). This method applies not only to technology or product design, but also to the development of sustainable business solutions. For illustration, research by (Prima Imanuela Putri & Dahlia, 2023) shows how these stages are applied in creating an innovative IoT-based product, namely an automated animal feeder. This study emphasizes the importance of combining DT with the BMC to ensure business sustainability. The BMC is a strategic tool that makes it easy for entrepreneurs to map out key elements of their business, such as customer segments, value propositions, and revenue streams. By using BMC, organizations can ensure that their innovations have a strong business foundation (Pepin et al., 2024). (Avdiji et al., 2020) noted that the integration of BMC with DT makes it easier for cross-team collaboration to solve strategic problems visually. This allows innovators to identify untapped market opportunities while reducing the risk of product failure. The combined use of BMC and DT has been applied in various business contexts. A study by (Asmaraningtyas et al., 2024) shows that this combination can be used to create a sustainable business model that is aligned with the principles of Islamic business ethics. In another case, (Hoffmann & Drath, 2022) explored the application of BMC in academic project management to help doctoral students overcome their research challenges. In addition, research by (Das & Rastogi, 2022) shows how this approach can be applied in the construction industry to support digital transformation and increase competitiveness in the Industry 4.0 era. The advantage of integrating DT and BMC lies in its flexibility and ability to be applied in various sectors. However, challenges that often arise are the complexity in cross-functional team coordination and the

need for intensive training to understand these frameworks (D. Sharma et al., 2023). Therefore, simpler training and guidance are needed to ensure a successful implementation. Combining DT with BMC is an effective strategy to produce innovative solutions that have high business value. These two approaches complement each other, with DT focusing on product innovation and user experience, while BMC ensures business sustainability from a strategic perspective. With the right adoption, this combination can help entrepreneurs meet the challenges of the modern market and create a successful and sustainable business.

7.1. Design Thinking

Since its introduction by Stanford University in 2008 (Oberer & Erkollar, 2023), DT has become a recognized method of thinking in many parts of the world. This method is known for its speed and responsiveness in the face of dynamic changes. DT is considered a new approach to solving problems creatively, balanced among intuition and logic, art and business, and concept and execution. Today, DT is applied not only in the business world, but also in the social and educational fields, providing innovative solutions that are practical and fun.

DT is a user-driven approach that focuses on creating innovative solutions by understanding the deep needs of users. Its five main stages—Empathize, Define, Ideate, prototype, and test—ensure an iterative, human-centric approach. This method has been shown to be effective in solving complex problems, both in business and education (Kanova et al., 2024). In the context of business, DT is used to increase competitiveness through product and service innovation that is relevant to market needs. Research by (Santhosh Palavesh, 2024) shows that this method can increase user engagement and develop more effective prototypes for relevant market solutions. In the field of education, DT helps students develop creativity and collaborative skills that are essential for facing the challenges of the 21st century (Hatt et al., 2023). In the business world, DT is used to create new business models that are more relevant to customer needs. Research by (Sandhyavi* & Lalitha, 2020) highlights how this approach has brought innovation in management education, helping institutions align their curriculum with international standards. In addition, the DT app allows companies to better understand market needs and create high-value products. One illustration of real-world application is the executive training program at Newcastle University Business School, where this approach is used to develop innovative solutions for corporate clients (Hatt et al., 2023). By involving participants in collaborative projects, DT can increase participants' creativity and empathy in solving complex business challenges.

In education, DT has been adopted to improve the learning experience of students. (Ortega-Tudela et al., 2021) examined the application of this method to prospective teacher students. The results show that DT improves student motivation, communication, and creativity, while providing a more enjoyable learning experience. In addition, (Vallis & Redmond, 2021) showed that the application of DT in online learning can improve students' creative and collaborative thinking skills. This approach is also relevant to solve educational challenges in the digital era, such as ensuring inclusion and accessibility in learning. In the social sector, DT is used to solve societal problems with an empathy-based approach. For illustration, (Melles, 2020) highlights how this approach has succeeded in creating innovative solutions to social challenges through social entrepreneurship. This process involves in-depth exploration of community needs, development of creative ideas, and testing of solutions directly with beneficiaries. This approach is also applied in community development projects to improve social inclusion and sustainability. For illustration, a study by (Schmidberger & Wippermann, 2023) suggests that DT can be used to identify new strategies in education that focus on specific target groups.

Although there are many benefits bided, the application of DT is not without challenges. According to (Meisiek et al., 2021, 2023), the success of this method is highly dependent on the support of the organization and the skills of the facilitator. In addition, there is a need to ensure seamless integration among DT and existing business or educational processes. However, this challenge also opens up opportunities for further innovation. With the right training and the development of more user-friendly tools, DT can be a more inclusive and efficient tool in a variety of contexts (Revano & Garcia, 2020). As a method of thinking-based on empathy and innovation, DT has proven itself to be an effective approach in business, education, and society. By combining creativity and logic, these methods are able to create relevant and sustainable solutions to modern challenges. Despite the challenges in its implementation, DT bids great potential to shape a more innovative and inclusive future.

DT has become known as a user-centric approach to innovation. This method combines a systematic approach with deep empathy for the user, resulting in solutions that are relevant to human needs. (Mootee, 2011) states that DT is a strategic framework for innovation, which creates value in the era of ever-changing technology. In addition, this approach is not only applied in the business field but also in improving the efficiency of public, production, and health services, all of which aim to provide more adaptive and responsive services. DT is an iterative approach that involves five main stages: Empathize,

Define, Ideate, prototype, and test. These stages are designed to ensure that innovation is not only problem-oriented, but also centered on human needs (Matthews & Matthews, 2021). In a business context, DT enables companies to better identify customer needs, create products so, and improve operational efficiency. A study by (Siricharoen, 2023) shows that a combination of human-centered design and DT can improve business success. This combination allows entrepreneurs to deeply understand user needs and produce relevant and effective prototypes.

In business, DT has been applied to create profound innovations. For illustration, research by (Verganti et al., 2020) found that the use of artificial intelligence (AI) in the framework of DT can increase creativity and produce more specific solutions for each individual. This research shows how AI can reinforce DT principles such as iteration and focus on humans, enabling faster and more relevant innovation. Additionally, (Patrício, 2022) show that companies can use this approach to increase digital adoption and develop a more flexible environment. By understanding the needs of customers and employees, companies can align business goals with the technology used. In public service, DT has been proven to increase transparency, efficiency, and responsiveness. Research by (Lyon & J. Magana, 2020) highlights how this approach can be applied to redesign psychosocial interventions, improving service acceptance and effectiveness. In addition, (Göttgens & Oertelt-Prigione, 2021) found that human-based design in healthcare can result in more effective and patient-based solutions.

Despite the many benefits bided, the implementation of DT often faces challenges, such as a lack of understanding of these methods and resistance to change. (Fischer, 2015) suggest the integration of DT principles with evidence-based research to address this challenge. Approaches such as AHEAD (Approach to Human-centered, Evidence-driven Adaptive Design) bid practical guidance for creating creative, data-driven solutions. As a human-based approach, DT bids great potential for creating innovative solutions in a variety of fields, including business, production, and public services. With a focus on empathy and iteration, this method can produce significant changes in the way problems are solved and human needs are met. While implementation challenges remain, integration with evidence-based methods and modern technologies can significantly improve their effectiveness.

In the ever-changing modern era, innovation is the key to success in creating relevant and sustainable solutions. One approach that has proven effective is DT. This method not only blends elements of design and creativity, but also harmonizes human needs (desirability), technology (feasibility), and business (viability).

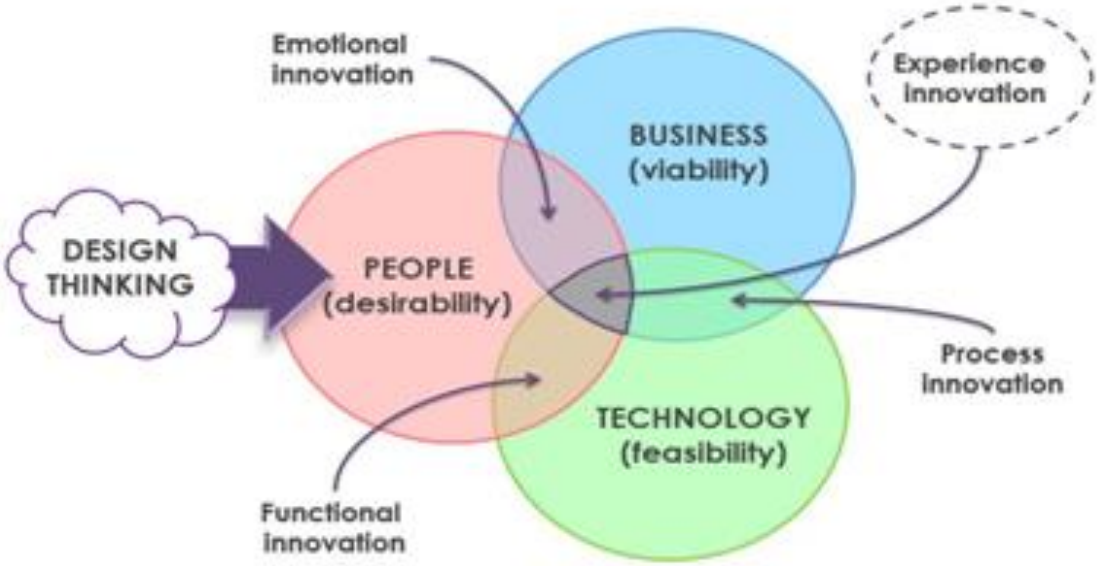

Figure 7.1. DT Scheme (S. D. Gupta et al., 2023; M. Sharma et al., 2021).

The DT (figure 7.1.) scheme as shown in the image (M. Sharma et al., 2021) illustrates how the interaction among these three elements can create emotional, functional, experiential, and process innovations. The Sharma scheme (2020) explains that the DT approach includes three core elements:

1. Human (desirability), this element focuses on the needs and desires of the user. DT puts humans at the center of innovation to ensure emotionally and practically relevant solutions. In this context, emotional innovation can emerge through deep empathy for the user experience. According to research by (Patrício, 2022), understanding customer behavior and needs is a crucial step in creating a successful product.
2. Technology (feasibility), technology provides the foundation to realize creative ideas into executable forms. This element also ensures that the resulting solution is realistic and workable. For illustration, a study by (Verganti et al., 2020) shows how digital technologies such as AI strengthen DT's ability to create data-driven innovations.
3. Business (viability), a business dimension ensures that innovation is not only relevant but also financially sustainable. The study of (Lyon & J. Magana, 2020) emphasizes the importance of adapting innovation to a solid business model to generate optimal value.

These three elements work synergistically to create a holistic innovation that is not only oriented to one aspect but covers all relevant dimensions. Application of Innovation in Various Fields, for illustration

emotional innovation, This innovation focuses on improving the user's emotional experience. For illustration, product design that prioritizes personal interaction can create strong emotional attachment. (Göttgens & Oertelt-Prigione, 2021) highlight the importance of a human-based approach in the healthcare sector to improve the patient experience. Functional Innovation, This dimension involves developing products or services that meet practical needs. (Fischer, 2015) show that a DT-based framework can overcome challenges in the product and work system innovation process. Experience and Process Innovation, Business process adjustment using DT principles can create a better user experience. For illustration, a study by (Siricharoen, 2023) emphasizes the importance of leveraging technology to improve the user experience holistically in business.

Although it has many benefits, the application of DT is not free from challenges. The biggest challenge often lies in resistance to organizational change and a lack of understanding of these methods. (Siricharoen, 2023) suggest the use of data-driven approaches such as AHEAD to ensure the successful implementation of DT. DT is a strategic approach that can create human-based innovation by integrating desirability, feasibility, and viability. By focusing on these three key elements, organizations can create innovative solutions that not only meet the needs of users but are also technologically relevant and financially sustainable. However, successful implementation requires a structured and adaptive approach to face emerging challenges.

In the midst of ever-changing global dynamics, organizations need to adopt a responsive and flexible approach to maintain their relevance and competitiveness. One approach that is increasingly being adopted is DT, which is not only a tool for creating innovative solutions, but also a framework for changing organizational culture. In organizations, DT can form a work culture that is people-oriented, flexible, and innovative, thereby creating an environment conducive to sustainability and growth. DT stands out for the cognitive flexibility it bids, which is the ability to tailor approaches and processes to the specific needs of each challenge. This is essential for creating organizations that can adapt quickly to changes and remain relevant in a competitive market. According to (T. Brown, 2020), organizations that implement DT not only utilize the creative process but also build an internal framework that balances structure and freedom of thought. An organizational culture based on DT can change the mindset of employees, encouraging them to be more proactive, innovative, and adaptive. Research by (Mason, 2022) shows that the application of DT advises better cross-functional collaboration, creates a more inclusive work environment, and maximizes the potential of employees to generate new ideas. Organizations that successfully implement

DT can be described by some unique characteristics that are pillars of their culture, including:

1. Human-centered, DT's main focus is to understand the needs of users in-depth. Organizations that adopt this approach have a work culture that puts people at the center of all decisions. This creates solutions that are relevant and have a positive impact.
2. Speed and agility, organizations that use DT are known for their speed in responding to challenges. This is achieved by using rapid prototyping and iteration that allow testing of new ideas before they are widely implemented (Patrício, 2022).
3. Adaptable and Flexible, The ability to change as needed is the key to this approach. Organizations with this culture are able to face uncertainty with more confidence because they understand that innovation is often born from uncertainty itself.
4. Creative and Innovative, DT-based organizations are always looking for new ways to solve problems. A study by (Siricharoen, 2023) shows that cognitive flexibility in these organizations provides space for the emergence of innovative creative ideas.
5. Connected and Flat, A connected and flat organizational structure allows for better collaboration among teams, minimizing hierarchies that can hinder creativity.
6. Disruptive: Organizations with this approach often redefine the rules of the game in their industry, resulting in unexpected but highly relevant solutions (Verganti et al., 2020).
7. Fun and High Energy, The application of DT creates a fun and energetic work environment, encouraging employees to work with high enthusiasm and enthusiasm.

However, not all organizations are able to adopt this approach right away. The main challenge is resistance to change and resource limitations. (Fischer, 2015) suggest that the successful implementation of DT depends on top management's commitment to support cultural change. In addition, continuous training and learning are necessary to ensure that all members of the organization understand the core principles of DT. DT is more than just a method or tool of innovation; This is a new paradigm that can change the way organizations work. By putting people at the center, DT helps organizations to become more flexible, adaptive, and creative, creating a work culture that supports continuous innovation. Organizations that successfully implement this approach have a strong competitive advantage in an ever-changing world. In an increasingly competitive era, innovation has become a

fundamental necessity to ensure organizational sustainability. One approach that has proven effective in creating innovation is DT. This approach teaches us to observe, understand, and dig up information from small aspects that are often missed. Additionally, DT enables organizations to solve problems systematically, human-centeredly, and minimize the risk of failure. DT is a design-based innovation approach that helps organizations identify, define, and solve problems faced by customers and other stakeholders. This approach not only bids technical solutions but also emphasizes the importance of the human element in creating relevant and sustainable innovations.

DT has changed the innovation paradigm by putting people, technology, and business on an equal footing. Where traditional innovations tend to focus on technical or business aspects, DT advises organizations to prioritize user needs. This approach helps to increase the acceptance of innovative products in the market, as the resulting solutions are more relevant to the real needs of customers. For illustration, research by (Liedtka & Ogilvie, 2021) shows that organizations that apply DT succeed in increasing customer interaction, creating products that are more in line with market needs, and strengthening customer loyalty. This is because this approach involves customers at every stage of the innovation process, from problem identification to solution development. In practice, the implementation of DT bids some significant benefits to organizations:

1. Encouraging continuous innovation, DT creates a creative mindset that continuously advises organizations to generate new ideas. According to (T. Brown, 2020), this approach allows teams to think outside the box and develop solutions that are disruptive yet relevant to market needs.
2. Increasing Differentiation from competitors, In an increasingly competitive market, the ability to create differentiation is the key to success. DT helps organizations come up with unique solutions that set them apart from competitors. This is supported by the research of (Verganti et al., 2020), which shows that this approach strengthens the competitive value of organizations through customer needs-based innovation.
3. Increasing customer satisfaction, By putting the customer at the center of the innovation process, DT ensures that the resulting solutions are relevant and in line with customer expectations. This increases customer satisfaction and strengthens the relationship among the organization and their customers (Patrício, 2022).

The DT process consists of five main stages: Empathy: In this stage, the organization seeks to understand the needs of users in-depth by observing, interviewing, and interacting directly with them. Problem Definition: Problems

identified in the empathy stage are formulated to be the focus of innovation. Ideation, This stage involves developing various creative ideas that can be used to solve problems. Prototypes, Selected Ideas are realized in the form of prototypes or initial models that allow for hands-on testing. Testing, prototype testing involves engaging users to get feedback and iterate on the solution. According to (Kelley & Brown, 2018), these five stages are iterative, allowing organizations to continuously learn and refine their solutions based on test results. Although it bids many benefits, the application of DT also has its own challenges. Resistance to change, lack of resources, and skills limitations are some of the main obstacles organizations face. (Fischer, 2015) suggest that the successful implementation of DT depends on management support, adequate training, and active involvement of all parties in the organization. DT is a human-based innovation approach that helps organizations create relevant, sustainable, and impactful solutions. With its benefits that include increased innovation, differentiation, and customer satisfaction, DT has become a key strategy in creating value and sustainability in today's competitive era.

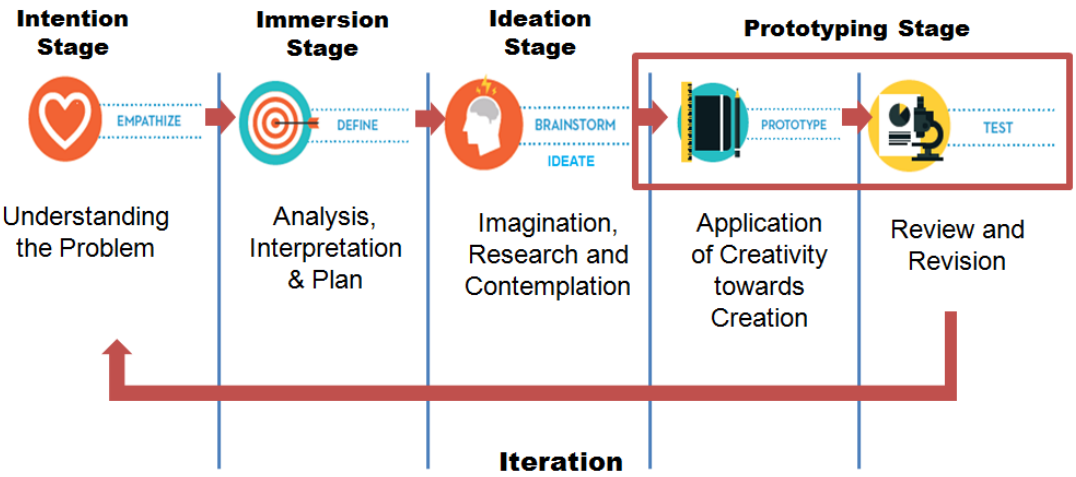

Figure 7.2. Steps to DT.

In the process, there are five steps to DT, namely empathy, defining, ideing, prototyping, and testing (Figure 7.2.). All of this explains that DT basically puts forward a human-centered approach, where the thought process focuses on the human being itself. DT is an innovation approach that focuses on solving problems creatively, human-based, and iteratively. This process is widely used in the world of business, education, and various other sectors to create relevant, sustainable, and impactful solutions. The images presented show the main steps in the DT process, namely Empathize, Define, Ideate, prototype, and test. Each step is interconnected in an iterative

framework, which allows for the refinement of the solution through hearing and continuous learning.

1. Stage 1: Intention Stage – Empathize, The first stage in DT is Empathize, which aims to understand the problem from the user's point of view. In this stage, designers must develop empathy through observation, interviews, and direct interaction with users to identify their needs, desires, as well as obstacles. According to (T. Brown, 2020), the empathy stage is at the core of DT because the success of innovation is highly dependent on a deep understanding of the user. For illustration, a study by (Cooper et al., 2021) found that teams that use empathy-based methods in product development successfully increase customer satisfaction by up to 35%. Therefore, empathy not only helps to define the problem more accurately, but also creates a solution that is more relevant and accepted by the user.
2. Stage 2: Immersion Stage – Define, After collecting information in the Empathize stage, the next step is Define, which is to formulate a problem based on the data that has been collected. This stage involves the analysis, interpretation, and preparation of a focused work plan. A clear formulation of the problem is a guideline for the team to develop a targeted and effective solution. According to a report by (A. Smith & Fressoli, 2021), a good problem definition has three main characteristics, specific, data-driven, and user-needs-oriented. In this process, the use of tools such as problem statements and journey maps is often used to help teams in understanding problem patterns and prioritizing the most important elements.
3. Stage 3: Ideation Stage – Ideate, The third stage is Ideate, where the team begins to develop various creative ideas as potential solutions to the problems that have been formulated. This phase advises the exploration of ideas without limits, using techniques such as brainstorming, mind mapping, and SCAMPER to expand the scope of the solution. Imagination and research are important aspects in this stage. A study by (Wijayanti et al., 2022) shows that organizations that apply ideation techniques systematically are able to increase product innovation by up to 40%. Furthermore, this stage also emphasizes the importance of cross-functional engagement to create more diverse and comprehensive ideas.
4. Stage 4: Prototyping Stage – prototype, The prototype Stage is the first step in realizing an idea into a real form. The prototype serves as a preliminary model or simulation of the solution to be developed. In this stage, it is important to create prototypes quickly and at low cost so that various iterations can be carried out according to user feedback. According to a study by (A. K. and A. Rana, 2021), the use of prototypes in DT helps teams to identify product weaknesses early, thereby reducing the cost of

repairs in the final stages. Techniques such as rapid prototyping are often used to ensure solutions remain relevant and fit market needs.

5. Stage 5: Prototyping Stage – test, The last stage in the DT process is test. The prototype that has been created is tested to the user to get feedback. This stage is important to understand the extent to which the developed solution can meet the needs of users. According to (K. Chen et al., 2023), testing not only helps to refine the solution, but also provides more insights into user needs that may have been missed in the previous stage. Good testing involves an iterative cycle, where feedback from users translates into iterative improvements to the prototype.

Iteration in DT, One of the key elements of DT is its iterative nature. Each stage is designed to be interconnected and allow for revision based on new findings. For illustration, the results of the test can encourage the team to return to the ideation or problem definition stage. This iteration ensures that the resulting solution is not only relevant, but has also been tested under a wide range of conditions. A study by (Maier & Fadel, 2009) emphasizes that iteration is the foundation of continuous innovation because it allows teams to learn from mistakes and improve solutions systematically.

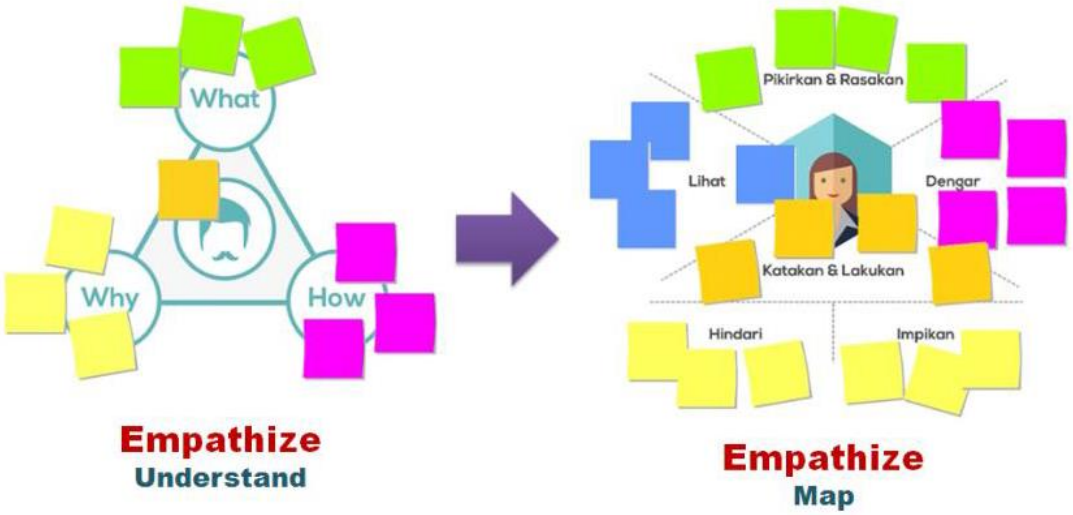

Figure 7.3. Illustration of the empathy process.

DT is an innovation approach that puts humans at the heart of the process. By following the five stages—Empathize, Define, Ideate, prototype, and test—organizations can develop solutions that are relevant, sustainable, and impactful. In addition, the iterative framework in DT allows for flexible and adaptive processes, so that it can answer a variety of complex challenges faced by modern organizations. This approach not only helps create better

products, but also creates a culture of innovation that empowers all team members to continue to grow. In this context, DT is not only a tool, but also a new paradigm in creating value in an era that is constantly changing. The five steps of DT can be explained as follows :

1. Be empathetic. Empathy is the first process in creating a business idea. In a sense, by understanding what our target market really needs (i.e. other people), we can create a product that is really needed by many people. An illustration of the empathy process is shown in Figure 7.3.

   In the innovation process, the DT approach is one of the most effective methods to produce human-centered solutions. The process consists of five main steps: Empathize, Define, Ideate, prototype, and test. Each step has a crucial role in ensuring that the resulting solution is not only innovative but also relevant to the needs of users. In this section, each step will be further explained and developed, including its implementation in a real context based on the latest literature.

   a. Empathize Step, The first stage in DT is Empathize. The goal is to understand the user, including their needs, expectations, and challenges. In the image shown, the Empathize process involves the use of tools such as the empathy map, which helps the team to understand what users are thinking, feeling, seeing, and hearing. According to research by (E. L. Brown et al., 2020), empathy is an important step that allows teams to better identify innovation opportunities. They found that the use of empathy maps in the early stages of a project can increase the relevance of the solution by up to 45%. In addition, the study also emphasizes the importance of user interviews and field observations to gain in-depth insights. For illustration, a team designing a health app can use an empathy map to understand how users view app features, experience the user interface, or hear reviews from their community. This process helps the team define user needs in more detail.
   b. Step Define, After understanding the user, the next step is Define, which is to define the problem based on the information that has been gathered. At this stage, the problem is formulated so that it becomes a guideline in the development of ideas. For illustration, teams can use problem statements that contain the user's context, needs, and goals. The literature by (Lindberg & Naxer, 2021) states that this stage is very important to avoid solutions that are "unique to try." They emphasized that a specific problem definition can increase the success of the project by up to 30%. In practice, tools such as personas and user journey maps are often used to aid in this analysis process. For illustration, a team

developing an online education solution might define the problem as: "Students need an interactive and easy-to-use learning platform to keep learning motivated during distance learning."

c. The Idea Step, the Ideate Step is at the heart of the creative process in DT. Here, the team creates as many ideas as possible to solve the problem that has been defined. The images given earlier show that this step involves imagination, research, and extensive exploration. According to research by (Armstrong & Johnson, 2019), ideation sessions involving various techniques such as brainstorming and mind mapping can produce more innovative solutions than individual thought processes. The study also shows that cross-disciplinary collaboration provides a richer diversity of ideas, which ultimately increases the chances of innovation success. For illustration, teams working on eco-friendly apps can use brainstorming techniques to come up with various features, such as a carbon footprint calculator or a reward system for sustainable lifestyles.
d. Prototype Step, After the ideas are developed, the next step is prototype. This stage involves creating a preliminary model or simulation of the designed solution. The goal is to test the feasibility and get early feedback from users. (S. K. Rana, 2022) in their study emphasized that prototypes must be fast and inexpensive to allow for frequent iterations. They found that the use of iterative prototypes can reduce the risk of product failure by up to 40%. In addition, the study also highlights the importance of engaging users during prototype testing to ensure the relevance of the solution. For illustration, a team developing an educational app can prototype a simple interface that allows students to try out key features, such as lesson schedules or online quizzes. Feedback from students will help the team to refine the design before launch.
e. Test Step, The last stage is test. In this stage, the prototype that has been created is tested by the user to evaluate its effectiveness. This stage is iterative, which means that the test results can encourage the team to go back to the previous step to improve the solution. (T. J. Chen et al., 2022) in their study found that iterative testing can significantly improve product quality, with user satisfaction rates increasing by up to 50%. The study also shows that testing that engages users directly provides deeper insights than internal testing. For illustration, in the development of a health app, users may be asked to try out the physical activity logging feature. Their feedback on ease of use or lack of features will help the team to fine-tune the app before the final release.

One of the strengths of DT is its iterative nature. This process is designed to allow for iterative improvements so that the resulting solution is more mature and relevant. According to (Maier & Fadel, 2009), iteration is the key to success in sustainable innovation. They deed that this approach helps organizations to continuously learn and adapt to changing user needs. For illustration, a team developing a logistics solution might have to repeat the process starting from the Define stage after finding that the problem identified initially was less relevant to the user's situation. DT is a human-centric approach, designed to create innovative and relevant solutions. The five main steps—Empathize, Define, Ideate, prototype, and test—form a flexible, iterative framework, allowing teams to continuously learn and refine solutions. This approach has been shown to increase effectiveness and efficiency in a variety of contexts, from product development to social problem solving. By focusing on user needs, DT is not only an innovation tool but also a new paradigm in creating value in the modern era.

2. Determine. After understanding the problems, wants, and concerns of the target market, the startup begins to define what the main problems are as a result of its empathy. An illustration of the definition process is shown in Figure 7.4.

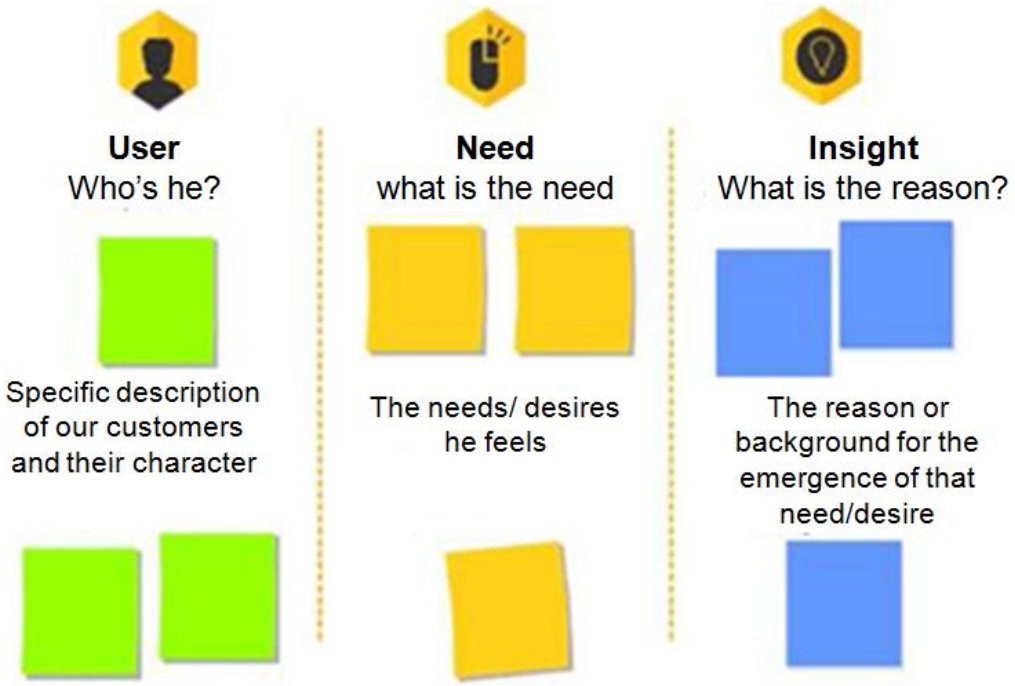

Figure 7.4. Illustration of the definition process.

The process of understanding customer needs, wants, and concerns is an important initial stage for any startup in defining the key issues facing the target market. Figure a illustrates the definition process through three main steps, identifying the user, understanding the need, and digging for insight. These three steps form a framework to create solutions that are relevant and by market needs. With a customer-centric approach, startups can increase the chances of success in solving significant problems. The first step in this process is to define who the users or target market is to focus on. A deep understanding of customer characteristics, demographics, behaviors, and needs is essential. This involves identifying elements such as age, profession, lifestyle, and consumer habits. The literature shows that mapping customer characteristics using methods such as personas can help startups create more specific profiles. For illustration, research by (S. Gupta et al., 2019) highlights the importance of analyzing user behavior in creating products that focus on customer experience.

After understanding who the user is, the next stage is to dig into their needs or wants. These needs can be functional, emotional, or social needs. In the competitive business world, customer needs are often dynamic and constantly evolving. Startups must be able to identify the key needs that customers feel to bid relevant solutions. Research by (Armstrong & Johnson, 2019) shows that a DT approach can help companies explore customer needs through an iterative process that involves direct feedback from users. The last stage is to dig into insights that are the background of customer needs or desires. This process includes an in-depth analysis of the underlying cause of the problem or previously identified desire. Startups can use data-driven approaches, in-depth interviews, and market trend analysis to find relevant patterns and correlations. For illustration, a study by (T. Brown, 2020) shows that the use of data analytics helps organizations understand customer motivations more deeply and improve the accuracy of predicting market needs.

In its implementation, these three steps do not run linearly but as an iterative cycle. Startups often need to repeat these steps to perfect their understanding of customer problems. An illustration is an educational technology startup that continues to innovate to meet relevant online learning needs during the COVID-19 pandemic. Research by (Kim, 2022) shows how iterations in the definition process can result in more adaptive solutions to changes in the external environment. The definition process is an important foundation in creating relevant solutions for the market. By understanding who users are, what their needs are, and why those needs arise, startups can design products or services that actually solve customer

problems. In the ever-evolving digital age, an empathetic and data-driven approach will be key to success. As various studies have shown, the definition process is not only about understanding customers but also about creating deep relationships with them.

3. Idete. Ideas are generally done through brainstorming ideas to provide solutions to the main problems of our target market. It does not matter whether the solution is executable or not, just focus on the solution that you feel can answer the problem. Then, in the next stage, we group the solution into three things, namely feasible, feasible, and desirable. An illustration of the idea process is shown in Figure 7.5.

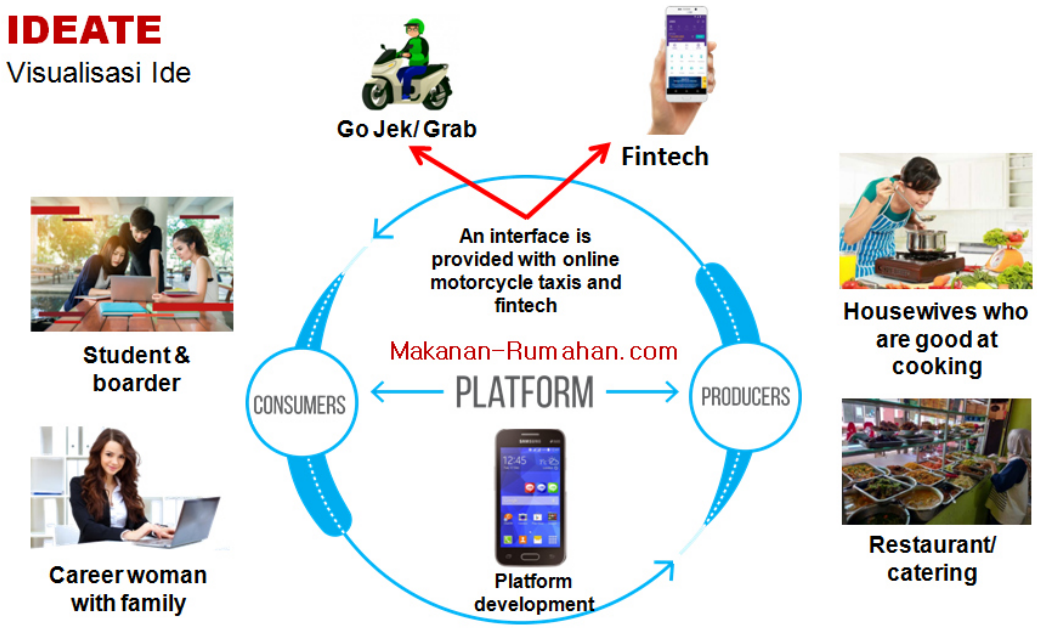

Figure 7.5. Illustration of the Idea Process.

Ideation is an important step in the innovation process that aims to create creative solutions to the main problems of the target market. This process usually begins with brainstorming, where teams focus on various ideas without considering their initial feasibility. This stage is at the core of an innovative design approach that is often used in the development of new products or services. In the terminate, the ideas collected are organized and classified based on three main criteria, feasible, viable, and desirable. Figure b illustrates how the ideation process can be developed, particularly in a "Makanan-Rumahan.com" platform that connects consumers and food producers through technology.

Brainstorming is an initial stage that focuses on freedom of thought without any restrictions or criticism of emerging ideas. The team seeks to explore as many solutions as possible to answer the main problems faced

by the target market. In the context of platforms like "Makanan-Rumahan.com," the initial idea might include developing an app that makes it easier for consumers to order home-cooked meals from local producers such as housewives or caterers. Research by (T. Brown, 2020) confirms that effective brainstorming requires an environment that supports cross-disciplinary collaboration and is solution-oriented. This technique allows innovative ideas to flourish, even when solutions seem impractical at first.

Solution Grouping: Feasible, Viable, Desirable, Once the ideas are gathered, the next step is to group the ideas based on three main categories, feasible, viable, and desirable. Feasible, In the context of food platforms, technical feasibility includes the development of applications that are integrated with online motorcycle taxi services such as GoJek or Grab, as well as the use of financial technology (fintech) to help compensation s. According to a study by (P. Wang, 2021), technology integration is the key to improving the efficiency of logistics and compensation systems in the digital ecosystem. Viable, Solutions must have the potential to create sustainable business models. In this case, the platform can charge a commission on each transaction or bid a premium subscription to food producers. A study by (V. Kumar et al., 2021) underscores the importance of validating business models through market testing before official launch. Desirable, Consumer appeal is the top priority. The platform should provide an easy-to-use interface and provide added value such as access to healthy and home-cooked food. Research (Armstrong & Johnson, 2019) highlights that the success of digital products is highly dependent on a positive user experience and the relevance of the product to their needs.

Case Study: Implementation of Ideation on Platform Makanan-Rumahan.com, In Figure 36, the "Makanan-Rumahan.com" platform is designed to connect consumers, such as college students, career females, and families, with local producers such as housewives or caterers. This interface utilizes online motorcycle taxi technology for logistics and fintech for compensation . The ideation process illustrated in Figure b shows how each element (consumer, producer, technology) is interconnected. A study by (Kim, 2022) shows that community-based platforms that focus on local needs, such as home-cooked food, can create significant social impact by increasing the income of local producers and supporting microeconomic sustainability. The ideation process is an essential first step in creating innovative solutions that focus on the target market. By using brainstorming methods, grouping solutions based on technical feasibility, business, and consumer appeal, as well as validation through market

research and testing, startups can build relevant and impactful solutions. The illustration in Figure 36 illustrates how this approach is applied in the development of the "Makanan-Rumahan.com" platform, which bids connectivity among consumers and producers through technology. This process shows that effective ideation requires collaboration, creativity, and in-depth analysis of market needs.

4. Prototype. If we have found the most feasible, feasible and desirable solution, the next thing to do is to do a prototype, starting from the sketch, wireframe, to the 3D mockup stage. An illustration of the prototype process is shown in Figure 7.6.

Figure 7.6. Illustration of the prototyping process.

Prototypes are a key step in the innovation design process, especially after a viable, market-viable, and desirable solution has been identified. This process helps turn ideas into real representations that can be tested and validated. Prototypes allow teams to evaluate concepts, identify risks, and receive feedback from users before the final product is developed. Based on Figure 37, the prototype process can start from basic ideas with no risk to simulations using props and real scenarios with low risk. According to (D. Jones et al., 2024), prototypes help bridge the gap among theory and practice in product development, allowing teams to understand user needs more deeply and create relevant solutions. Stages of prototyping, risk-free prototyping focus on concepts and solutions, the initial stage in prototyping is designing concepts that focus on the user's needs and solutions. At this stage, teams can use methods such as

sketching or storyboards to illustrate key ideas without requiring large resources. For illustration, at this stage, designers often use the DT method, where ideas are poured into simple visual forms to get an initial understanding. A study by (Zhang, Liu, et al., 2023) underlines that this simple initial prototype allows for rapid iteration and provides flexibility in exploring different solutions. Low risk prototypes use of props and scenarios, once the initial concept is accepted, the next step is to develop a more complex prototype using props and scenarios. For illustration, physical mockups or digital wireframes can be used to simulate the user experience. This helps teams to test user interactions with products or services under conditions that resemble real-world usage. Research by (A. D. Smith et al., 2022) shows that the use of props and scenarios provides better insight into how users interact with the product, improving the accuracy of design evaluation before entering the full development stage.

Prototyping is not a one-time step, but a process that requires repeated iterations. From each stage, input from users or stakeholders should be used to improve and optimize the design. These iterations also help identify and mitigate risks before a product or service enters the market. According to a report by (Ozola et al., 2023), prototype iterations allow for more efficient development, as potential errors can be discovered early and development costs can be kept down. Case Study: prototype implementation on digital platforms, as an illustration, a startup developing a digital platform such as a "Makanan-Rumahan.com" app can start by creating a simple wireframe that shows the user interface. After that, the next stage can include testing with interactive mockups, where users are asked to provide feedback on their experience. These prototypes can be designed in low risk, such as simulations involving props and scenarios, to further understand the user's needs. A study by (S. Lee et al., 2007) states that this approach allows development teams to validate ideas with users under near-real conditions, creating a final product that is more in line with market needs. The prototyping process is a crucial step in innovation design, allowing developers to test ideas in more detail before launching them to the market. From risk-free concepts to low risk simulations, each stage provides valuable insights that can improve the quality of a product or service. The iterative approach in the prototype, as described in the latest literature, ensures that the resulting solution is relevant and effective for users. Thus, prototyping is not only an idea exploration tool but also an essential design validation mechanism.

5. Test. Next, create a product/application based on the prototype created. After that, the final stage is testing, where the product is tried in our target

market. Take deed of suggestions and opinions during ongoing testing or validation, and correct any errors before the product/app is actually launched in the market. Figure 7.7. shows the testing or validation process.

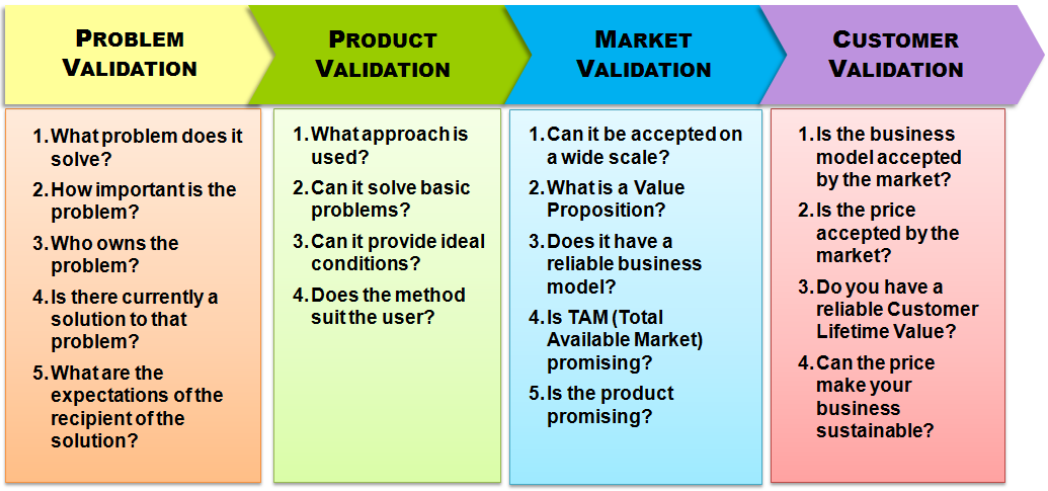

Figure 7.7. Illustration of the idea validation process.

Idea validation is an important process in product development to ensure the solutions bided are in line with market needs and expectations. This step includes several stages, from understanding the problem to ensuring the product is accepted by the customer. Comprehensive validation can help minimize the risk of product failure in the market. For illustration, the development of a digital application or product requires a systematic approach to testing and refining prototypes before they are officially launched. In this paper, we will discuss the four stages of idea validation, namely problem validation, product validation, market validation, and customer validation. Each of these stages has specific goals and steps to ensure the success of the product in the market.

Problem Validation, The first stage in idea validation is problem validation. The goal is to understand and identify the problem that the product or application is developing to solve. Important questions in this stage include: "What problem is being solved?" and "How important is the problem to the user?". Additionally, it is important to know who has the problem and whether there are already solutions available in the market. According to the literature, problem validation helps developers understand user needs in-depth, so that the resulting product is more relevant (Blank & Dorf, 2012). For illustration, in the development of health applications, problem validation may involve interviews with doctors and patients to understand key challenges in day-to-day health management.

Product Validation, Once the problem is identified, the next stage is product validation. This validation focuses on assessing a solution or prototype designed to solve the problem. Some of the key questions in this stage include: "Is the approach being used effective?", "Can this solution meet the basic needs of the user?", and "Is the method used suitable for the user?". The prototype is tested on a small group of users to get initial feedback. The literature shows that this rapid iteration based on feedback is the key to producing products that fit the needs of users (Ries & Euchner, 2013). For illustration, in the development of educational apps, developers can test features such as user interfaces and learning modules to ensure they are easy-to-use and effective.

Market Validation, The third stage is market validation, which aims to evaluate whether the product is acceptable to the market on a large scale. This involves analyzing the value proposition, business model, and market potential. Some of the key questions are: "Does this product have a clear value proposition?", "Is the business model reliable?", and "Is the Total Available Market (TAM) promising?". Research shows that products with a strong business model and a clear value proposition are more likely to succeed in the market (Osterwalder et al., 2014). For illustration, before launching an ecommerce app, developers must ensure that revenue models—such as commissions from sales or advertising—can generate sustainable profits. Customer Validation, The final stage is customer validation, which focuses on ensuring that customers accept and use the product. Important questions in this stage include: "Is the business model accepted by the market?", "Does the product cost match the market?", and "Can the product cost make the business sustainable?". This validation often involves testing the product in the target market through a limited launch or beta hearing. According to research, direct testing with customers is an important step to identify the last deficiencies before a full launch (Croll et al., 2021). For illustration, the initial launch of a financial management app can be used to gauge the market's response to premium features or paid subscriptions.

Once the validation at each stage is complete, the final step is to integrate all the feedback to improve the product before the official launch. Final testing on the target market includes an assessment of the product's functionality, user experience, and overall appeal. During this process, it is important to take deed of all user suggestions and opinions and make any necessary improvements. This approach not only improves product quality but also increases the chances of product success in the market. Studies show that testing conducted carefully at the final stage can reduce product

failure rates by up to 50% (Zhu et al., 2016). Idea validation is an important step in the development of a successful product or application. By following the validation stages of the problem, product, market, and customer, developers can ensure that their products are relevant to market needs and have a great chance of success. In addition, continuous testing and iteration based on user feedback is key to reducing risk and improving customer satisfaction. Therefore, it is important for every developer to invest time and resources in this validation process before launching a product to market.

An illustration of the application of DT is shown in Figure 7.8. regarding the option of visualizing ideas in the form of product prototypes. The DT approach has become one of the effective methods in creating innovative products, including in the health industry and the nutritional needs of breastfeeding mothers. In its implementation, DT involves several main stages, understanding user needs, collecting ideas, making prototypes, to testing and improving products based on user feedback. An illustration of the application of this method can be seen in the development of herbal products for breastfeeding mothers as depicted in the idea visualization option in the form of a product prototype.

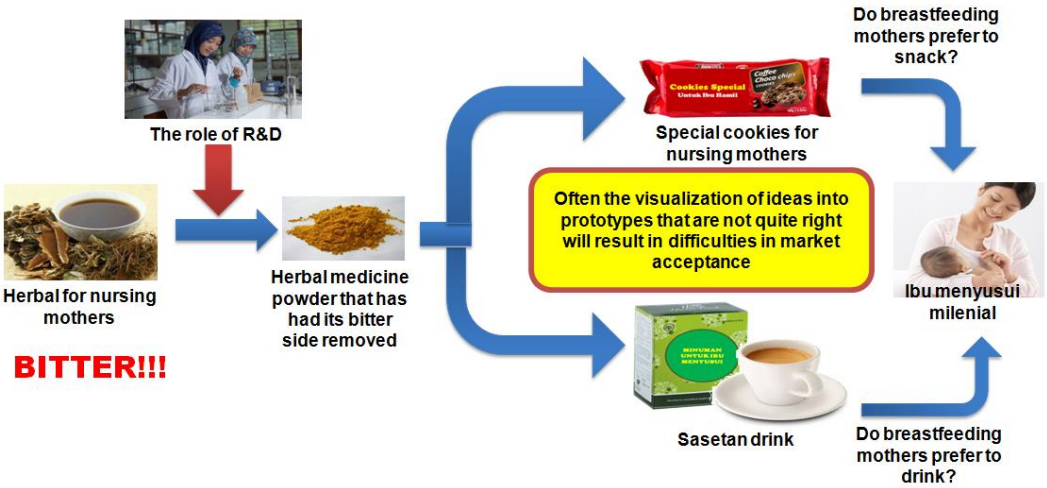

Figure 7.8. Idea visualization options in the form of product prototypes.

Problem Identification and Research and Development (R&D) Role: The product development process begins with the identification of the problems faced by the user, namely breastfeeding mothers. At this stage, it is found that herbal products for breastfeeding mothers available in the market often have an unpleasant bitter taste. The role of R&D is crucial in overcoming this challenge. R&D teams can work to find new formulations that reduce bitterness without eliminating the herb's properties. Research

may also include exploring other natural ingredients that can enhance flavor, such as honey or fruit extracts, to increase the appeal of the product. For illustration, a study by (Liu et al., 2023) showed that a combination of properly formulated herbal ingredients not only enhances the taste but also ensures the efficacy and safety of the product. Thus, this initial stage serves to ensure that the product not only meets functional needs but also user preferences.

The Process of Visualizing Ideas into product prototypes, Idea visualization is an important step in realizing concepts into real products. In this context, several prototypes were proposed, such as herbal powders whose bitter taste has been removed, instant sachet drinks, and special biscuits for breastfeeding mothers. Each prototype was tested with critical questions such as, "Do breastfeeding mothers prefer snacks?" or "Do breastfeeding mothers prefer drink-shaped products?" The answer to this question helps validate and refine the best prototype. However, in practice, prototyping that is less in line with market preferences often results in low acceptance. According to (T. Brown, 2020), the prototype stage is not only about creating an initial version of the product but also integrating user feedback to ensure the final product meets the user's needs. For illustration, if breastfeeding mothers prefer practical products such as sachet drinks, then a drink-based prototype will be more acceptable than other forms.

Testing and Product Acceptance by the Market, The prototypes that have been made are further tested on the target market segment, which is millennial breastfeeding mothers. These tests include testing the taste, ease of use, and perception of product benefits. Products such as herbal drinks, sachets, and specialty biscuits tend to get a positive response due to their practicality. Millennial breastfeeding mothers often prioritize products that can be consumed quickly without compromising their nutritional value, as revealed by recent research showing that millennial breastfeeding mothers' preferences focus more on convenience and immediate benefits (W. Jones, 2022). In addition, in another study by (Huang et al., 2020), it was found that product packaging and marketing play a big role in attracting the attention of millennial breastfeeding mothers. Attractive, information, and environmentally friendly packaging can increase user interest in new products.

Innovation to Increase Product Competitiveness, To ensure that herbal products for breastfeeding mothers have high competitiveness, innovation must continue to be carried out. Adding flavor variants, increasing nutritional content, and education-based promotions are the main strategies. For illustration, providing clear information about the

benefits of certain herbs in improving breast milk quality can be an added attraction. The literature by (Y. Li et al., 2022) reveals that products that provide added value through consumer education are more likely to succeed in a competitive market. The DT approach in the development of herbal products for breastfeeding mothers emphasizes the importance of understanding user needs, making relevant prototypes, and thoroughly testing the product before launching it to the market. With the right measures, the product can meet the preferences of millennial breastfeeding mothers and compete effectively in the market. This process shows that innovation supported by research and user engagement can create products that are not only practical but also in demand by the targeted market segment.

Figure 7.9. regarding the option of visualizing ideas in the form of public policy. Road crossing facilities, such as pedestrian bridges, are an important solution in overcoming the problem of traffic accidents involving pedestrians. However, even though these facilities are available, challenges remain, especially in the behavior of people who tend to be undisciplined and reluctant to use the facilities. To answer this problem, a public policy-based approach through structural intervention, education, and law enforcement is very important.

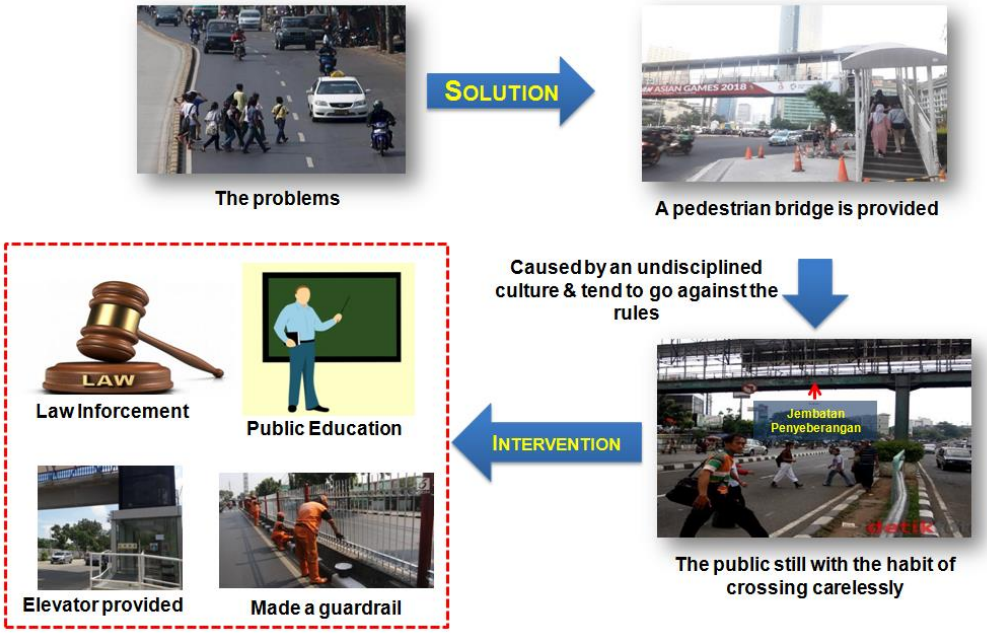

Figure 7.9. The choice of visualization of ideas in the form of public policy.

Problem Identification: Culture of Undiscipline, The main problem faced is the behavior of people who often cross the road carelessly, even

though facilities such as pedestrian bridges have been provided. This is due to a culture that tends to ignore rules and lack awareness of the importance of safety. A study by (Zhao et al., 2022) highlights that pedestrian behavior that disobeys traffic rules is often related to social, cultural, and public factors and a lack of public education about safety.

Structural Solution: Provide Facilities and Infrastructure, The first solution implemented is the construction of crossing facilities, such as pedestrian bridges, elevators, and guardrails to force pedestrians to cross where they should. This facility aims to improve pedestrian comfort and safety, while reducing traffic accidents. However, the success of this solution depends not only on the provide infrastructure, but also on how the facility is used. According to research by (D. Li et al., 2023), the design of user-friendly and accessible infrastructure significantly increases the likelihood of its use. For illustration, bridges with elevators are more appealing to the elderly or people with disabilities than manual stairs. Behavioral Interventions: Law Enforcement and Public Education, The provide facilities alone is not enough to change people's habits. Therefore, more interventions are needed in the form of law enforcement and public education. Law enforcement, such as sanctioning violators, aims to create a deterrent effect. On the other hand, public education helps to raise awareness of the importance of obeying traffic rules. Research by (Nguyen Truong Sa & & Nguyen Thi Diem Thi, 2022) shows that safety campaigns involving social media and local communities are effective in changing people's perceptions of traffic rules. The campaign can include educational videos, posters, and collaborations with schools to convey messages to the younger generation.

Challenges in Policy Implementation, although various solutions have been implemented, challenges remain. One of them is the community's resistance to behavior change, especially among those who are used to breaking the rules. In addition, the lack of continuous oversight can make policies not work effectively. According to a study by (T. L. Chen et al., 2020), policy sustainability is highly dependent on the active participation of various parties, including the government, society, and the private sector. Success of integrated approach, Successful implementation of public policies in encouraging the use of road crossing facilities requires an integrated approach. This includes a combination of adequate infrastructure provision, consistent law enforcement, and ongoing education campaigns. For illustration, in some major cities, the implementation of guardrails and CCTV surveillance has proven effective in reducing the number of violations by pedestrians.

Furthermore, collaboration among the government and local communities can accelerate the adoption of new habits. A study by (P. Kumar et al., 2021) shows that community-based programs, such as safety training in residential environments, have a significant impact on increasing public awareness. The problem of undisciplined community behavior in using road crossing facilities is a complex challenge and requires multifaceted solutions. The provide infrastructure alone is not enough; Law enforcement, public education, and continuous monitoring are also important elements in ensuring policy success. With an integrated approach, it is hoped that people's behavior can change toward a more disciplined and safe culture.

7.2. Business Canvas Model

The business model explains the reasons for how to create value for the corporation, customers, and society. In discussions related to business models, the focus will be on the BMC. BMC is a business model that explains the reasons for how an organization creates, delivers, and captures value. This canvas divides the business model into nine main components, then separated again into the right (creative side) and left (logical side) components. The nine components are customer segment, value proposition, channel, customer relationship, revenue stream, key resources, key activities, key partnerships, cost structure (figure 7.10).

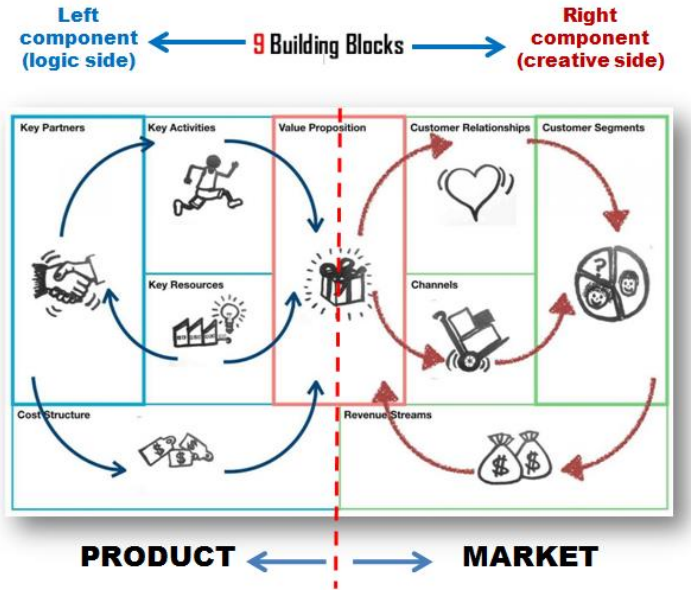

Figure 7.10. BMC *(Source: Global Leadership Center).*

1. Customer segments: customer segments are the elements that define the group of individuals or organizations served by a corporation. In business,

understanding the needs, preferences, and characteristics of customer segments is fundamental. For illustration, in the technology industry, customer segments can range from individual technology users, large corporations, to government agencies. A recent study confirms that personalizing products based on customer segment needs increases customer loyalty and experience (Qing et al., 2020).

2. Value proposition: a value proposition is a key promise that a corporation bids to customers to meet their needs or solve a specific problem. A strong value proposition provides a reason why customers should choose that product or service over competitors. For illustration, streaming platforms like Netflix bid convenience, rich content, and an ad-free experience, which is its main value proposition. Research by (Zhang, Chu, et al., 2023) shows that innovative value propositions contribute to long-term competitive advantage.

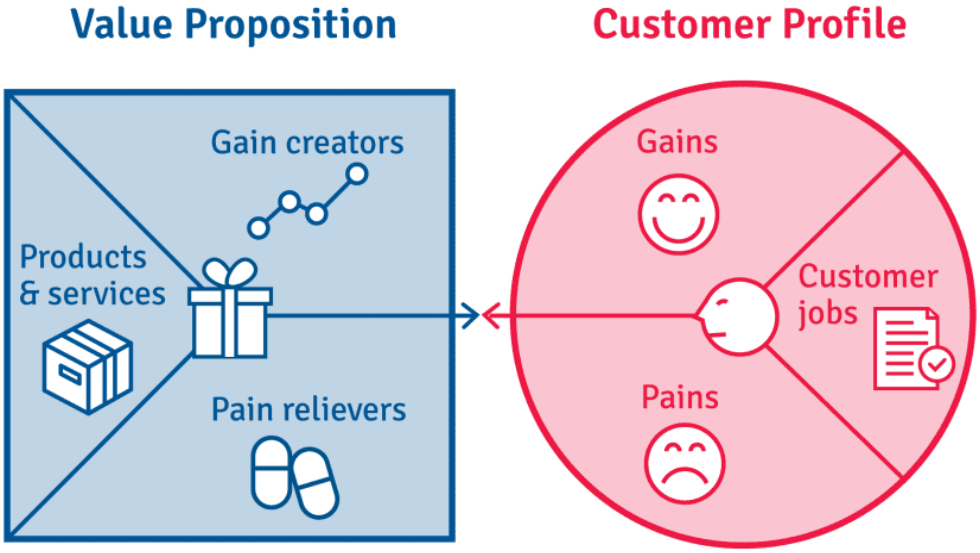

Figure 7.11. *Value Proposition Canvas* (Source: Lusiani A., 2022).

In the ever-evolving business world, a deep understanding of the customer is key to creating relevant and competitive value (Figure 7.11). One of the most widely used strategic tools to help organizations understand customer needs in detail is the Value Proposition Canvas. This model was developed by Alexander Osterwalder as part of the BMC framework. The value proposition canvas aims to bridge the gap among what a corporation bids (value proposition) and customer needs (customer profile). With a structured visual approach, this model provides clear insights into how the product or service can benefit customers.

The value proposition canvas opponent is divided into two main parts, namely the value proposition and the customer profile. These two parts are interconnected to ensure that the product or service bided is truly

by the customer's needs, wants, and concerns. Value Proposition: This section describes how a product or service can create value for customers. The value proposition consists of three main elements:

- Products and services: this element includes all the goods and services bided by the corporation. For illustration, a tech corporation like Apple bids innovative hardware like the iPhone as well as digital services like iCloud.
- Pain relievers: the product or service must be able to reduce the obstacles or problems experienced by the customer. For illustration, online transportation applications such as Gojek provide solutions for customers who have difficulty finding fast and efficient transportation.
- Gain creators: this element refers to how a product or service creates more benefits for customers, such as increasing productivity or providing a better experience. For illustration, streaming services like Spotify create profits by providing instant access to millions of songs without ads.

Research shows that a relevant and unique value proposition increases customer attraction to a particular product or service (Qing et al., 2020). Customer profile: a customer profile describes the needs, wants, and problems faced by customers. This part consists of three elements:

- Customer jobs: this element identifies what the customer wants to achieve, whether functionally, socially, or emotionally. For illustration, customers use e-learning services to improve their professional skills.
- Pains: this section covers the obstacles, challenges, or frustrations that customers face in getting their work done. For illustration, inconvenience in the compensation process can be a major problem for ecommerce customers.
- Gains: profits are the positive outcomes that customers expect from using a product or service, such as time savings or increased convenience.

Studies show that understanding customer needs holistically allows companies to create more targeted and effective solutions (X. Wang et al., 2023). The value proposition canvas is widely used in various industries to develop a more customer-focused business strategy. Here are some important implementations of this model:

- Improving product innovation, by understanding customer problems and desires, companies can design products or services that are more

innovative and by market needs. For illustration, startups often use the value proposition canvas to validate product ideas before launch.

- Better market segmentation, customer profiles help companies identify the most relevant market segments to target. With this data, companies can craft more personalized marketing campaigns. A study showed that personalization increased conversion rates (Z. tang Li et al., 2023).
- Optimization of the development process, value proposition canvas allows development teams to focus on the elements that have the greatest impact on customers, reducing the time and cost spent on irrelevant features.
- Improving customer experience, by identifying bottlenecks and expected benefits, companies can create a more enjoyable experience for customers.

In the digital age, customer needs and preferences are changing rapidly. The Value Proposition Canvas is becoming increasingly relevant to help companies stay adaptive to market dynamics. Data analytics and AI technologies allow companies to gather more in-depth information about customers, thereby improving accuracy in the application of these models. A study by (Z. tang Li et al., 2023) confirms that companies that use the Value Proposition Canvas along with digital technology are superior in creating value compared to their competitors. The Value Proposition Canvas is a very useful tool for companies to align products or services with customer needs. By systematically mapping out the value proposition and customer profile, companies can create solutions that are relevant, innovative, and competitive. In the era of global competition, a deep understanding of customers through this approach has become one of the main factors for business success.

3. Channels: channels are a way for companies to reach customers to provide a value proposition. These channels include physical, digital, or a mix of both. The use of digital technologies such as ecommerce has become one of the main channels in many industries, especially after the COVID-19 pandemic (X. Wang et al., 2023).
4. Customer relationships, this opponent focuses on how companies interact with customers to build loyalty and trust. These relationships can be in the form of personal services, communities, or automation. An illustration of an implementation is an artificial intelligence-based chatbot that helps customers quickly and efficiently.

5. Revenue streams: revenue streams are a way for a corporation to make money from its customer segments. Revenue models can vary, including direct sales, subscriptions, or freemium models. The use of subscription models, such as those implemented by many SaaS platforms, has been shown to provide more stable revenue (Meyer & Boch Waldorff, 2022).
6. Key resources: key resources include assets that are essential for running a business, such as human, technological, intellectual, or physical resources. For illustration, for tech companies like Google, their main resources are innovative software and customer data.
7. Key activities: key activities include core tasks or processes that must be performed to realize a value proposition. In a manufacturing corporation, the main activities include the production of goods, distribution, and quality management.
8. Key partnerships: key partnerships are strategic alliances with other parties that help a corporation achieve its goals. These partnerships can include suppliers, technology partners, or distribution networks.
9. Cost structure: the cost structure refers to all the costs and expenses incurred to run a business model. Efficient management of the cost structure is essential to maintain profit margins.
10. Left and Right Approaches to the BMC The BMC also divides these nine components into two sides, the left side (logical) and the right side (creative). The left side focuses on operational efficiencies, such as key resources, key activities, and cost structures. The right side focuses on creative aspects, such as customer segments, value propositions, customer relationships, and channels. This division helps organizations to maintain a balance among innovation and efficiency.
11. Relevance of BMC in the Digital Age, In the digital age, BMC has become a highly relevant tool for aligning corporate strategies with the changing dynamic business environment. Digital technologies, such as AI and data analytics, enable companies to better understand customer needs and optimize their operations.

The BMC is a very effective tool for describing and managing business models holistically. With its nine key components, it helps companies create, deliver, and capture value efficiently and innovatively. In an increasingly competitive and technology-based era, the use of the BMC is one of the keys to long-term success. Business models are created to make it easier and help the owners of companies or organizations and their professionals to craft business ideas on an abstract level and then test them on a real level. After

that, a business strategy was developed to make the corporation strategically different from its competitors.

By using the BMC, financial analysis projections can then be carried out, namely: 1). Revenue Stream, namely main income and other income; 2). Cost Structure, namely production costs, marketing costs, development and research costs, administrative costs and taxes. With the BMC, we will not only focus on the marketing or product part of the business we are running, but the BMC will pay attention to all the elements that exist and build the business. This way, it will be very easy for business owners to determine what business strategies to implement in the future. The BMC will provide guidance for everything that supports the formation of new strategies that allow it to be implemented in a particular business. The strategy to be implemented is not only about marketing strategies, which are generally always a priority for business owners. All the elements that build it will also have a new strategy.

The business model has the goal of assisting a corporation or startup in designing a business plan and establishing and validating the key points of the business line, ranging from activities, resources, customer relationships, revenue and costs and expenses.

The BMC can increase focus and clarity on what the entrepreneur's business wants to achieve. In addition, the BMC can be a medium to identify the strengths and weaknesses of a business model, find new ideas, and develop a business for the long-term. The BMC is useful in identifying products, target markets, and the budget needed. This is done so that our business can get a lot of profits in the future.

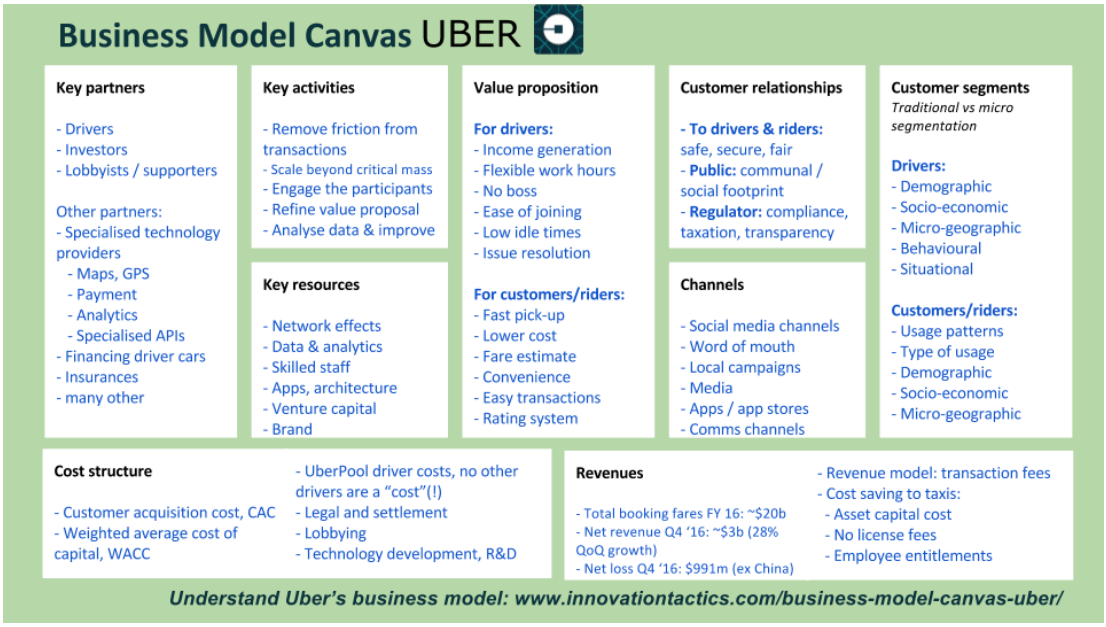

Figure 7.12. UBER BMC

The BMC can help provide a brief overview of the business model and without unnecessary details compared to a traditional business plan. The visual nature of the BMC makes it easy for anyone to refer to and understand. Illustrations of BMC can be seen in Figure 7.12 (BMC of UBER), Figure 7.13 (BMC of Airbnb), and Figure 45 (BMC of Kopi Kenangan).

Uber's BMC: Innovation in the transportation industry, Uber is one of the companies that has revolutionized the transportation industry through an innovative approach that integrates technology, data, and user needs. With a simple but sophisticated business model, Uber has managed to create an ecosystem that connects drivers with customers efficiently. In understanding how Uber creates, delivers, and captures value, the BMC becomes a very useful tool. This model helps analyze nine key elements of Uber's business, including the value proposition, customer relationships, and cost structure.

1. Uber's value proposition is designed to meet the needs of two key groups of customers, drivers and passengers. For Drivers: Uber bids the opportunity to generate revenue with high flexibility. Without having a boss or a fixed schedule, drivers can work according to their own time. In addition, the easy onboarding process, low idle time, and troubleshooting support are significant pluses. For Passengers: Passengers get fast, convenient, and transparent transportation services. Other advantages include competitive rates, clear cost estimates, and a rating system to ensure quality of service. Uber also allows cashless compensation s, which provides an easier transaction experience. According to research by (Xiong et al., 2020), a technology-based value proposition that prioritizes convenience and efficiency is one of the main success factors for platform-based companies like Uber.
2. Customer segment: Uber serves various customer segments that are divided based on: passengers, this segment includes demographic, behavioral, and geographic location factors, such as passengers who need fast transportation in urban areas. Drivers, individuals who seek flexibility in generating revenue are Uber's top targets. The micro-segmentation approach allows Uber to tailor its services to specific market needs, such as biding UberPool in areas with high demand levels.
3. Customer relationships: Uber builds customer relationships through two main ways: public interaction, social media, local campaigns, and direct communication with customers help Uber maintain good relationships and increase loyalty. Regulatory compliance, as part of its relationship with governments, Uber ensures transparency, taxes, and compliance with transportation regulations. Uber's commitment to maintaining these

relationships allows the corporation to remain relevant in a highly competitive global market (G. Wang et al., 2024).

4. Channels, the main channels that uber uses include: Mobile app as the main point of interaction among drivers and passengers. Social Media and Local advertising, used to promote services, attract new drivers, and build brand awareness.
5. Key Activities, Uber's core activities include: reducing transaction friction through automated compensation technology. Scaling a business across critical boundaries, such as expanding services in a new city. Analyze data to improve efficiency and user experience.
6. Key resources, the resources that are the main pillars of Uber include: network effect, the more users and drivers are connected, the greater the value of the platform for all parties. Technology and data, Uber leverages algorithms to efficiently match drivers with passengers. Venture capital as a technology corporation, Uber relies on external funding to support its global expansion.
7. A key partner, Uber has partnerships with a variety of parties, including: Technology providers such as digital maps and custom APIs. Compensation service providers. Investors, to support product development and expansion.
8. Fee structure, Uber's fee structure includes: Customer Acquisition Cost (CAC). R&D of new technologies. Lobbying activities to support local regulations.
9. Revenue sources, Uber's revenue model is based on transaction fees paid by passengers to drivers. Uber takes a percentage of each trip as a commission. In addition, Uber is also adopting an more fee model for premium services such as Uber Black.

By understanding the elements of the BMC, it is clear that Uber's success is based on technology integration, operational flexibility, and a deep understanding of customer needs. This approach allowed Uber not only to survive, but also to dominate the global transportation market.

Airbnb has been one of the most successful illustrations of platform-based business models in the sharing economy. Through an innovative approach to connecting hosts and guests, Airbnb not only creates economic value but also redefines the way people perceive travel and accommodation. Using the BMC framework, this essay will explain in detail the key elements of Airbnb's business model, namely key partners, key activities, resources, value proposition, customer relationships, customer segments, distribution channels, cost structure, and revenue sources.

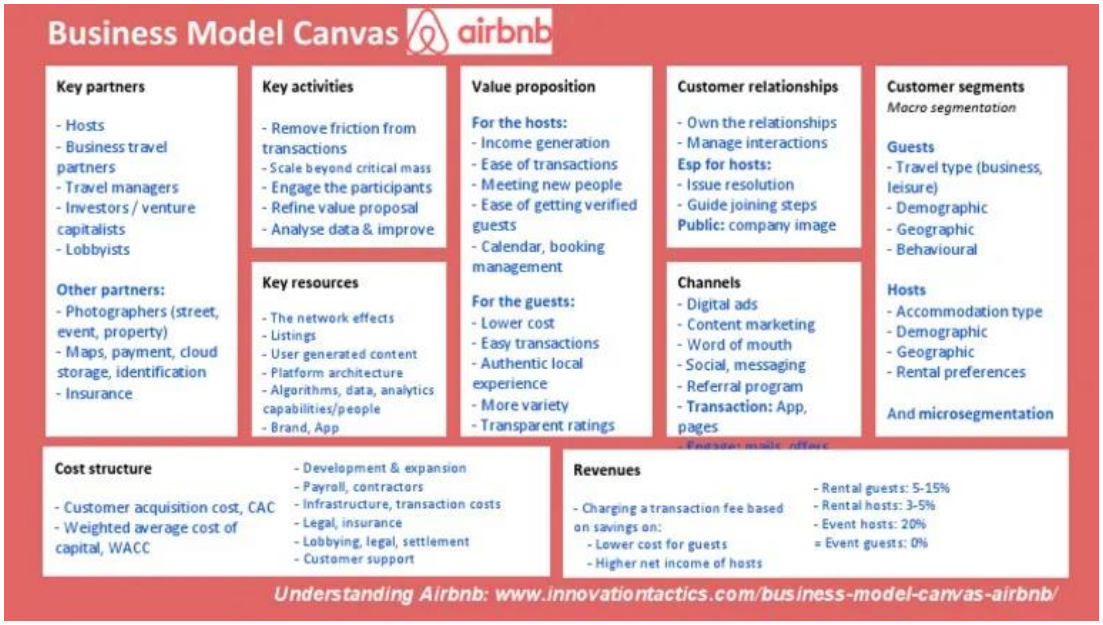

Figure 7.13. Airbnb BMC (source: Raynaldo Jodistiro, 2019).

Key Partners: Airbnb's main partners include hosts, business travel partners, travel managers, investors, and third parties such as photographers and insurance providers. These partners are instrumental in ensuring the smooth operation of the platform and creating a consistent user experience. According to the research of (J. Lee et al., 2015), strategic partnerships in technology-based platforms play a central role in strengthening the network effect, namely the more users on the platform, the greater the value of the platform to other users. In the context of Airbnb, the host as the main partner acts as the provider of the asset (building) that is the core of the service.

1. Key Activities, Airbnb focuses on removing transaction barriers, scaling the system to manage large demand, and increasing user engagement through technology. One notable innovation is the use of data-driven algorithms to improve the customer experience. According to relevant research, algorithm optimization is a key factor for the success of platform companies to create personalized experiences for users (Frenken & Schor, 2019). This activity supports Airbnb in providing a seamless experience for users, from finding accommodations to processing compensation s.
2. Key Resources: Airbnb's main resources include network effects, user-generated content, as well as platform architecture and analytics data. The network effect is a significant asset as the value of the platform increases as the number of users increases.
3. Value Proposition: Airbnb bids unique value for both hosts and guests. For hosts, Airbnb is a tool to generate more revenue, meet new people, and simplify the building management process through digital tools.

Meanwhile, for guests, the main value lies in the lower cost compared to traditional hotels, the authenticity of the local experience, and the variety of accommodation options. A study by (Zervas et al., 2021) shows that this value proposition has changed consumer preferences significantly, making Airbnb a serious competitor to the traditional hospitality industry.

4. Customer Relationships: Airbnb prioritizes managing customer relationships through data-driven and technology-driven approaches, such as efficient feedback management and problem solving.
5. Distribution Channels (Channels): Airbnb uses various channels to reach customers, ranging from digital advertising, social media, to mobile applications. These channels allow Airbnb to reach diverse customer segments, both geographically and demographically. Previous research has shown that digital channels play a vital role in the platform's success due to its ability to reach users globally at a low cost.
6. Customer Segments: Airbnb caters to two main segments, host and guest, with further segmentation based on travel preferences (business, leisure), demographics, and geographic location. In a study by (Choi & Choi, 2023; Lu & Kandampully, 2016), effective segmentation allows platforms like Airbnb to bid experiences that suit the specific needs of customers.
7. Cost Structure: Airbnb's fee structure includes customer acquisition costs, technology development, and customer relationship management. Airbnb also faces costs related to legality and dispute resolution, especially in highly regulated markets. Related research shows that these costs are generally fixed after the initial stages of platform development, allowing companies to achieve economies of scale (Frenken & Schor, 2019).
8. Revenue Streams: Airbnb generates revenue through transaction fees charged to hosts and guests, as well as more services such as local experiences.

Airbnb's business model describes how platform companies can create value for various stakeholders through innovation and the use of technology. By leveraging network effects, data-driven algorithms, and the right segmentation approach, Airbnb has managed to become a leader in the sharing economy.

Amazon is one of the largest technology companies in the world that has revolutionized the ecommerce sector through a technology- and customer-driven approach (figure 7.14). Using the BMC framework, this essay will discuss key elements of Amazon's business strategy, including key partners, core activities, resources, value proposition, distribution channels,

customer relationships, customer segments, cost structure, and revenue sources.

Figure 7.14. Amazon BMC (source: DigitalBizModel, 2023).

1. Key Partners: Amazon's key partners include suppliers, transportation partners (including Flex drivers), Amazon product manufacturers, marketplace sellers, and technology partners for infrastructure. This cooperation allows Amazon to create an integrated ecosystem, where all partners benefit from the large scale of Amazon's operations.
2. Key Activities: Amazon focuses on continuous improvement, increasing demand, and supply-side participation. Research shows that ecommerce companies like Amazon use a data-driven approach to analyze consumer trends and behaviors, thereby continuously improving efficiency and customer experience.
3. Key Resources, The fulfillment network is an important asset for Amazon, supported by a strong brand, retail technology infrastructure, and subscription services. According to recent research, Amazon's advantage lies in the combination of technology and logistics to ensure fast delivery and a superior customer experience.
4. Value Proposition: For consumers, Amazon bids low prices, fast shipping, and a wide selection of products. Meanwhile, for sellers, Amazon provides access to millions of buyers through the marketplace as well as efficient logistics and delivery services. Research shows that this value proposition has created a competitive advantage for Amazon that is difficult for other platforms to compete with.
5. Customer Relationships: Amazon prioritizes customer relationships based on convenience, low prices, and a secure buying experience.

Personalization technologies such as product recommendations play a crucial role in increasing customer loyalty.

6. Distribution Channels: Amazon uses a variety of channels, including websites, mobile apps, delivery networks, and online support. These channels allow Amazon to reach different customer segments in an efficient and effective way.
7. Customer Segments: Amazon customer segments encompass a wide range of demographic and geographic groups, from individual consumers to businesses. Amazon also leverages micro-segmentation to bid personalized experiences based on customer preferences.
8. Cost Structure: Amazon's cost structure is dominated by selling costs (58%), fulfillment, and technology. Huge investments in logistics and technology have allowed Amazon to maintain its operational excellence.
9. Revenue Streams: Amazon earns revenue from a variety of sources, including online sales, subscriptions, AWS services, and marketplace sales. This diversification makes Amazon one of the companies with the largest revenue in the world.

Amazon's business model shows how technology-driven strategies, logistics, and customer onboarding can create tremendous value for consumers, sellers, and partners. By leveraging technology and logistics resources, Amazon continues to lead the global ecommerce market.

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KATSINOV'S FRAMEWORK

**"Innovation is key.
Only those with the agility to change with
the market and innovate quickly will survive."**

- Robert T. Kiyosaki

Chapter 8
URGENCY AND BENEFITS OF KATSINOV

Hartanto Kurniawan, Cahyono Nugroho

Innovation has become the main pillar in building the competitiveness of organizations and countries, especially in the midst of an era of technological disruption that dominates almost all sectors of life. Not only creating new ideas, innovation also includes the ability to manage these ideas strategically to produce a real impact, both for the organization and the wider community. Now, technological changes and very rapid market needs make companies have to be able to adapt in a more systematic and efficient way. Without these capabilities, companies risk falling behind in increasingly intensifying global competition. In the era of digital transformation, the need for innovation is even more urgent. The life cycle of products that used to last for years is now getting shorter. For illustration, the life cycle of a personal computer, which in the previous decade was around five years, currently only lasts about three years. This phenomenon shows that organizations must be able to produce innovations faster and more effectively without sacrificing product quality. In this regard, innovation is no longer just a tool for survival, but has become a key strategy for achieving sustainability and competitiveness. However, the success of innovation depends not only on how sophisticated the technology is developed, but also on the readiness of the organization to manage the innovation throughout its life cycle. From the conceptualization stage of the idea to its implementation in the market, every step requires careful planning for innovation to achieve sustainability. One of the tools that has emerged to support this need is the Innovation Readiness Level (KATSINOV).

8.1. Basic Concepts of KATSINOV

Innovation is one of the most important elements in building organizational competitiveness, especially in the modern era which is colored by the dynamics of technological changes and increasingly complex market needs. As a process that involves the creation and implementation of new ideas, innovation requires systematic management to be able to create added value for both the organization and the wider community. One of the approaches that has developed to support the management of this innovation is the Innovation Readiness Level (KATSINOV). As a generic model, KATSINOV is designed to help organizations map their innovation position throughout its

lifecycle, from the conceptualization stage to the commercialization stage. This approach provides strategic guidance for organizations to evaluate innovation readiness thoroughly, covering aspects of technology, markets, organizations, manufacturing, investment, and risk (Fithri et al., 2021). As a development of the Technology Readiness Level (TRL) concept, KATSINOV offers a wider scope by including non-technical aspects that are essential in ensuring the success of innovation in the market. The TRL concept, which focuses on measuring technological readiness, is often considered inadequate to provide a comprehensive picture of innovation readiness, especially in aspects such as market feasibility and investment risk. Therefore, KATSINOV has become a very relevant tool in the midst of increasingly fierce global competition. In this context, organizations are not only vital to produce advanced technologies, but also ensure that the innovations are market-acceptable and have sustainable competitiveness (Lokuge & Sedera, 2020). The shorter innovation lifecycle is a major challenge for many organizations. In the electronics industry, for illustration, the life cycle of products such as personal computers has shrunk from five years to less than three years. This drives the need for a faster and more efficient approach to managing innovation. KATSINOV, as a measure of innovation readiness, helps organizations not only map the position of innovation, but also identify specific needs at each phase of their life cycle. With these tools, organizations can take strategic steps to ensure the sustainability of innovation without sacrificing product quality (Corallo et al., 2022). In addition, KATSINOV has been instrumental in helping organizations overcome major challenges that often occur in the innovation journey, such as the "valleys of death". These three phases include the scientific feasibility test stage (Devil's River), the technical feasibility test (Death Valley), and the economic feasibility test (Darwin Sea). At each of these phases, organizations are faced with a significant risk of failure. For illustration, products that fail to pass the technical test in the second phase will not be able to proceed to the market development phase. With a systematic approach, KATSINOV provides guidance that can help organizations anticipate and manage these risks (Santoso et al., 2022).

The implementation of KATSINOV provides various strategic benefits for organizations. First, it helps organizations evaluate innovation readiness holistically, not only from technical aspects but also from non-technical aspects such as markets and investment risks. This evaluation allows organizations to identify potential obstacles early on, so mitigation measures can be better designed. Second, KATSINOV improves the efficiency of the innovation process by providing a clear picture of the needs at each phase of the innovation life cycle. Third, it helps organizations make strategic decisions,

such as determining whether an innovation is worth continuing, adjusting, or discontinuing. In the technology sector, for illustration, KATSINOV has helped organizations manage digital product development in a more integrated manner through a data-driven approach. By mapping out the feasibility of technology and market opportunities, organizations can accelerate product launch times without sacrificing quality. In the pharmaceutical sector, KATSINOV has been used to evaluate vaccine development readiness, including analysis of investment risks and market needs before product launch (Markard, 2020).

The relevance of KATSINOV is getting higher in the era of digital transformation, where innovation is a fundamental need to survive in global competition. Organizations are not only vital to create new technologies, but also ensure that they can be applied effectively in the market. Taking into account elements such as strategic partnerships and investments, KATSINOV provides practical guidance for organizations to make the most of market opportunities. In the energy sector, for illustration, the tool has been used to manage the transition to renewable energy technologies, such as the development of more efficient and cost-effective solar panels. With the holistic approach offered by KATSINOV, organizations can be more confident in facing the challenges of innovation in the global market. This tool not only helps identify potential failures, but also provides strategic guidance to ensure the sustainability of innovation. As a result, KATSINOV not only increases the competitiveness of the organization but also makes a positive contribution to the development of the national economy. KATSINOV is a strategic tool designed to help organizations manage innovation more effectively and holistically. With a focus on a wide range of aspects, from technology to investment risk, this tool provides practical guidance for organizations to face the challenges of the innovation lifecycle. In an era full of technological transformation, the implementation of KATSINOV is an important step to ensure that innovation is not only relevant but also capable of making a sustainable impact in the global market.

The innovation life cycle in the modern era has undergone significant changes, especially with the accelerating development of technology and the needs of the dynamic market. If previously products in the electronics and automotive industries could last up to five years before being replaced by new innovations, now the life cycle has shrunk to about three years. This phenomenon is a real reflection of the intensifying competitive pressure and the need for organizations to innovate faster without sacrificing product quality and relevance. In this context, the Innovation Readiness Level (KATSINOV) comes as a systematic framework designed to help organizations

face these challenges. By mapping innovation positions, identifying risks, and designing strategic moves, KATSINOV enables organizations to manage innovation in a more structured manner to ensure success in the global market (Sachithra Lokuge, 2020).

KATSINOV offers a holistic approach to ensure innovation can survive in the midst of an increasingly short life cycle. The tool integrates various important aspects such as technology, markets, organizations, partnerships, manufacturing, investment, and risk. This approach provides comprehensive guidance for organizations to manage innovation not only at the technology development stage, but also at other critical phases such as marketability testing and product commercialization (Fithri et al., 2021). For illustration, in the automotive industry, the apply KATSINOV can be used to accelerate the development of electric vehicles that are more energy-efficient and environmentally friendly. In the early stages, the tool helps map the feasibility of the technology and the risks associated with such innovations. Furthermore, KATSINOV also supports the process of technical validation and market analysis to ensure that the products produced are by consumer needs and have high competitiveness potential in the global market (Markard, 2020).

With the innovation life cycle getting shorter, accelerating the innovation process is a major challenge for organizations. In this case, KATSINOV serves as an evaluation tool that helps organizations identify opportunities and challenges at each phase of the innovation lifecycle. This tool allows organizations to reduce the risk of failure by detecting problems early, both in technology and market. For illustration, in the early stages of product development, KATSINOV can be used to evaluate the feasibility of the technology using the concept of TRL. However, KATSINOV's advantage lies in its ability to go further by evaluating non-technical aspects such as market feasibility and investment risk (Corallo et al., 2022; Denysiuk et al., 2023). As an evaluation tool, KATSINOV also helps organizations to overcome three major challenges in the innovation life cycle known as valleys of death. These stages include the Devil's River, which tests the scientific feasibility of innovation; Valley of Death, which tests the technical feasibility of the prototype; and the Darwin Sea, which tests the economic feasibility of a product before it enters the market. In each of these stages, organizations are faced with the risk of failure that can affect the sustainability of innovation. Using KATSINOV, organizations can map these risks and design appropriate mitigation strategies (Calderon-Tellez et al., 2024; Santoso et al., 2022).

Innovation is a key element in maintaining competitiveness in the midst of rapid technological and market changes. However, the success of an innovation is not only determined by the sophistication of the technology, but

by how ready the innovation is to be implemented and commercialized. One of the approaches that provides a comprehensive framework in innovation management is the Innovation Readiness Level (KATSINOV). In contrast with the TRL which focuses only on technological aspects, KATSINOV involves an evaluation of seven main aspects, technology, market, organization, partnerships, manufacturing, investment, and risk. This approach provides a more holistic guide to ensure innovation success from multiple perspectives (CucculeIli & Peruzzi, 2020; Markard, 2020)

KATSINOV's approach, which includes seven key aspects, creates a framework that can help organizations identify their innovation positions at different stages of their life cycle.

1. Technology aspect: this aspect focuses on the readiness of the technology used in innovation, including technical feasibility, stability, and scalability. In the pharmaceutical industry, for illustration, KATSINOV is used to assess the readiness of vaccine technology before entering the stage of further clinical trials. By evaluating these aspects, organizations can ensure that the technology used has a strong scientific basis and is ready to be developed (Calderon-Tellez et al., 2024; Corallo et al., 2022).
2. Market aspects: assessment of market potential, consumer needs, and competitive trends is the main focus of this aspect. In the pharmaceutical industry, this assessment can help determine whether the vaccine being developed has a significant market and whether potential demand can support investment in product development.
3. Organizational aspects: the organization's internal readiness to support the development and implementation of innovations is essential. Factors such as human resource capabilities, organizational infrastructure, and internal processes need to be evaluated to ensure innovation can run effectively. For illustration, in technology companies, the readiness of the research and development team to face technical challenges is one of the determining factors for the success of innovation.
4. Partnership aspects: in many cases, collaboration with external parties such as research institutions, governments, or business partners can increase the success of innovation. Strategic partnerships allow organizations to share risks, resources, and knowledge. In the renewable energy industry, for illustration, partnerships with government agencies are often key in developing more efficient solar panel or wind turbine technologies (Santoso et al., 2022).
5. Manufacturing aspect: an organization's ability to efficiently produce innovations at scale is also an important element. In the pharmaceutical

industry, this aspect involves the evaluation of production facilities, manufacturing processes, and compliance with regulatory standards.

6. Investment aspect: KATSINOV helps organizations evaluate the economic feasibility of the developed innovations. This aspect includes an analysis of funding needs, potential profits, and investment risks. In this context, organizations can ensure that the allocation of their financial resources is in line with the potential for innovation success.
7. Risk aspect: every innovation has risks, whether related to technology, market, or regulation. KATSINOV enables organizations to identify these risks early and design appropriate mitigation strategies. For illustration, in the development of electric vehicle technology, technical risks such as battery life and emission regulations are important factors that must be evaluated.

One illustration of the apply KATSINOV's holistic approach is in vaccine development. The vaccine development process requires large investments and careful risk management. KATSINOV allows pharmaceutical organizations to evaluate the technological readiness of vaccines, assess market feasibility, and ensure that the organization's infrastructure supports production and distribution processes. In addition, partnerships with governments or health institutions are an important element to accelerate the clinical hearing process and product distribution to the wider community. By using this approach, the risk of failure can be minimized, and products can reach the global market faster (Sachithra Lokuge, 2020). KATSINOV's approach provides many advantages for organizations, including a more thorough evaluation and the ability to identify risks at an early stage. By integrating various aspects, organizations can make more informed and strategic decisions. However, the main challenge in the implementation of KATSINOV is the need for comprehensive and accurate data from the various aspects being evaluated. In addition, the success of the implementation of KATSINOV also depends heavily on the organization's ability to integrate the results of the evaluation into their decision-making process. KATSINOV is a strategic tool designed to help organizations manage innovation more effectively and holistically. Covering seven key aspects, this approach provides a comprehensive guide for organizations to face the challenges of innovation in the modern era. In the pharmaceutical, technology, and energy industries, KATSINOV has proven to be a relevant framework for ensuring that innovations are not only technically feasible but also have economic and sustainability potential in the global market. In this context, KATSINOV is not

only an evaluation tool but also a strategic guide to support the success of future innovations.

8.2. The Importance of KATSINOV in Innovation Management

Innovation is one of the main pillars in creating sustainable competitiveness in the midst of rapid technological developments and increasingly complex market needs. In a business world full of uncertainty, innovation is not only an option, but an absolute necessity to survive and thrive. However, despite being a vital element, innovation management is not an easy process. Innovation is often faced with various challenges, both from the technical, market, organizational, and economic sides. Therefore, a systematic approach that can help companies manage innovation effectively and efficiently is essential. One of the approaches that is relevant and urgently needed in this context is the KATSINOV. KATSINOV offers a more holistic and comprehensive approach to managing innovation compared to other methods that only focus on technical aspects such as TRL. Taking into account seven key aspects, namely technology, market, organization, partnerships, manufacturing, investment, and risk, KATSINOV provides a comprehensive overview of innovation readiness at every stage of its life cycle. This approach is especially important given the shorter product life cycles and accelerating technological changes. With KATSINOV, companies can not only evaluate the feasibility of the technology, but also prepare better strategic measures related to the risks and opportunities that arise in the innovation process (Fithri et al., 2021).

The apply KATSINOV is very relevant in the midst of changing global market dynamics. The speed of market changes, increasingly specific consumer demands, and the emergence of disruptive technologies make companies have to innovate quickly and responsively. In many cases, fail adapt to these changes can be fatal for companies, even large companies. For illustration, in the electronics industry, changing technological trends such as the shift to 5G technology or artificial intelligence (AI) have significantly changed the competitive map. In the face of these challenges, KATSINOV provides a clear structure to help companies assess the readiness of their products to compete in the market. With in-depth market evaluation, companies can understand the position of their innovative products in the market and design more effective marketing and distribution strategies. This allows companies to not only survive, but also thrive in a highly competitive market (Sachithra Lokuge, 2020). Further, a better understanding of the market potential allows companies to identify more specific segments and not only rely on technological innovation alone, but also create products that truly

meet consumer needs. This is especially important, especially in sectors that rely heavily on consumer adoption, such as the healthcare, automotive, and renewable energy industries. For illustration, in the development of electric vehicle technology, a mature market evaluation will lead companies to determine appropriate prices, develop supporting infrastructure, and appropriate communication strategies to build consumer trust in the new product (Audretsch et al., 2021; Cucculelli & Peruzzi, 2020; Markard, 2020).

Innovation always carries risks, and managing these risks is one of the important aspects that must be considered in every step of innovation development. In this context, KATSINOV offers a more structured guide in identifying and mitigating existing risks. The risks that companies face in the innovation process are not only limited to technical aspects, but also include market, regulatory, and even financial aspects. By integrating these aspects into the innovation evaluation process, KATSINOV allows companies to take more informed steps and minimize potential losses that can occur as a result of innovation failure. For illustration, in the development of new technologies in the pharmaceutical sector, innovations that not only fail technically but also fail to meet regulatory requirements can lead to significant financial losses. Therefore, by using KATSINOV, pharmaceutical companies can conduct a more comprehensive evaluation of the readiness of their products to meet regulatory standards, as well as the readiness of the market to receive such products. This is also important in investment, where the financial risks associated with the development of innovative products can be minimized by evaluating the market potential and profitability of the product (Santoso et al., 2022).

One of the main factors in the success of innovation is the ability to establish partnerships and collaborations with other parties, be it research institutions, suppliers, business partners, or governments. In many cases, successful innovations are the result of complementary cross-sector collaborations. KATSINOV emphasized the importance of partnerships in facilitating the development of innovations. By evaluating the partnership aspects of the innovation process, KATSINOV enables companies to build a network that supports every stage of innovation, from initial research to commercialization. In the renewable energy sector, for illustration, the development of new energy technologies often requires support from various parties, ranging from raw material providers, research institutions, to government agencies that can provide incentives or supportive regulations. By using KATSINOV to evaluate the readiness of partnerships, companies can design more efficient and productive collaboration strategies. This will accelerate the development process and increase the chances of innovation

success in the global market (Barbieri & Santos, 2020; Coralllo et al., 2022; Subramoniam et al., 2021).

One aspect that is often overlooked in the innovation process is production readiness. After successfully developing a new technology or product, the next challenge is how to produce it on a large scale efficiently and with consistent quality. KATSINOV allows companies to evaluate the readiness of their manufacturing processes. With a more in-depth assessment of manufacturing readiness, companies can identify potential bottlenecks that can occur during the production process and design more effective solutions. For illustration, in the development of electric vehicle technology, the main challenge is not only the development of efficient battery technology, but also how to produce such vehicles in large quantities at a competitive cost. KATSINOV helps companies to conduct production readiness evaluations at an early stage, so that they can prepare manufacturing capacity and optimize the supply chain to ensure the smooth production of such innovative products (Calvosa, 2020; Sachithra Lokuge, 2020). The urgency of implementing KATSINOV in innovation management is very clear, especially in the midst of global market dynamics that are full of uncertainty and rapid changes. By providing a more holistic approach through the evaluation of seven key aspects, KATSINOV enables organizations to not only evaluate the feasibility of the technology, but also prepare their products for success in the market. Better risk management, strategic partnerships, and mature production readiness are some of the key elements that make KATSINOV a highly relevant tool for companies looking to ensure the long-term success of their innovations. As a systematic and comprehensive solution, KATSINOV provides much-needed guidance in optimizing the innovation process from the research stage to commercialization.

8.3. Benefits of KATSINOV Application

Effective and efficient innovation is one of the main keys for companies to be able to survive and thrive in a highly competitive global market. However, in the process of developing and implementing innovations, there are various challenges that must be faced, ranging from technical problems, markets, to investment risks. For this reason, the apply tools that can measure the readiness of innovation as a whole is very important. One of the most effective tools in innovation management is the Innovation Readiness Level (KATSINOV), which helps companies to better assess and manage their innovations. KATSINOV provides various significant benefits, including in evaluating innovation readiness, reducing the risk of failure, and making more informed strategic decisions. The systematic approach provided by KATSINOV allows

organizations to carry out innovation planning more carefully and effectively, ensuring that each product or technology developed has a greater chance of succeeding in the market.

1. Innovation readiness evaluation, one of the key benefits of the implementation of KATSINOV is its ability to evaluate the readiness of innovations in each phase of its life cycle. The innovation process usually consists of various stages, ranging from concept, research and development, market trials, to commercialization. Each of these stages has different challenges and risks, and an evaluation of innovation readiness is essential to ensure that the product or technology can pass each phase successfully. With KATSINOV, companies can conduct a comprehensive evaluation of seven key aspects that affect innovation readiness, namely technology, market, organization, partnerships, manufacturing, investment, and risk. For illustration, in the development of a new product, the corporation must evaluate whether the technology used is mature enough and ready for large scale production, whether the market is ready to accept the product, and whether the existing organizational infrastructure and partnerships can support the product launch. With thorough evaluation at every stage of the life cycle, KATSINOV helps organizations to ensure that their innovative products are not only technically feasible, but also market-ready and can meet consumer needs. This is especially important, especially in sectors that rely heavily on consumer adoption, such as the electronics industry, pharmaceuticals, and renewable energy (Fithri et al., 2021). The apply KATSINOV in the innovation readiness evaluation process can also help companies in estimating the time needed to develop products until they are ready to be launched to the market. A more in-depth evaluation of the readiness of technology, markets and production processes allows companies to accelerate time to market, which in turn can improve their competitiveness in a highly dynamic global market.
2. Failure risk reduction, the apply KATSINOV also plays a big role in reducing the risk of innovation failure. As is known, innovation always brings uncertainty and risk, be it from a technical, market, or regulatory perspective. Fail manage these risks can result in large financial losses, especially if the product fails to meet market expectations or cannot be produced efficiently. Therefore, it is important for companies to have tools that can identify and manage these risks early on. Using KATSINOV, management can conduct an in-depth analysis of risks associated with innovation, both in technical and market aspects. For illustration, in the development of electric vehicles, technical risks that may arise include

battery life, energy efficiency, and system integration issues. Market risks, on the other hand, include consumers' readiness to adopt new technologies, competitive prices with fossil fuel vehicles, as well as adequate battery charging infrastructure. KATSINOV helps companies to identify and map these risks at every stage of development, so that management can take appropriate mitigation measures to reduce potential failures. In this context, the analysis conducted by KATSINOV allows companies to reduce existing uncertainties and make more informed decisions in managing the innovation process (Corallo et al., 2022; Tverytnykova et al., 2021; Zhang et al., 2022). In addition, the reduction of the risk of failure through KATSINOV also has an impact on the efficiency of resource use. In many cases, companies tend to allocate their resources to innovation projects that may not have the potential to succeed. Using KATSINOV, companies can evaluate whether the innovation project has considerable potential to continue or needs to be stopped early, so that limited resources can be allocated more efficiently to more promising projects.

3. More informed strategic decision-making, KATSINOV provides invaluable data for management in making strategic decisions related to innovation. In innovation management, the right decisions at every stage are crucial to ensure the success of the product in the market. KATSINOV provides the necessary information to evaluate the readiness of an innovation at every phase of its life cycle, from the research and development phase to the launch of the product to the market. By using KATSINOV, management can make more informed decisions regarding the continuation or discontinuation of an innovation. The data obtained from KATSINOV's measurements can be used to determine whether the product being developed is feasible to proceed to the next phase or whether it is time to stop the innovation project. For illustration, if an innovation fails at the marketability stage or has not yet demonstrated enough potential to compete, management may decide to stop the project and focus on other, more promising innovations. Conversely, if innovation shows high readiness in all aspects, management can plan strategic steps to accelerate the launch of products to market. In this regard, KATSINOV supports faster and more targeted decision-making, which is crucial in a competitive and fast-changing market (Sachithra Lokuge, 2020). On the other hand, more informed decision-making can also increase effectiveness in planning investments. In innovation management, decisions about resource allocation are critical. Using the data obtained through KATSINOV, management can identify innovation projects that

have high potential to gain profits and contribute to the corporation's growth, so that they can allocate resources more optimally.

The apply KATSINOV in innovation management brings many significant benefits, including in evaluating innovation readiness, reducing the risk of failure, and making more appropriate strategic decisions. By using KATSINOV, companies can comprehensively evaluate their innovations, from technological readiness to market readiness. Additionally, by identifying and managing risks early on, KATSINOV helps companies reduce the likelihood of failure and maximize opportunities for success. The more holistic and systematic approach offered by KATSINOV allows companies to make more informed decisions, improve the effectiveness of resource use, and accelerate product time to market. In an increasingly competitive and uncertain business world, KATSINOV is a very important tool to ensure that innovation is market-acceptable, sustainable, and provides maximum profits.

8.4. Implementation of KATSINOV in the Real World

KATSINOV can be applied in a wide range of industries, from technology to manufacturing. For illustration, in the automotive industry, this tool can be used to develop electric vehicles that are more efficient and highly competitive. In the pharmaceutical sector, KATSINOV helps map drug development from laboratory research to distribution to the global market. Taking into account the elements of investment and partnerships, the implementation of KATSINOV becomes more strategic in ensuring the success of innovation in a competitive market. KATSINOV is a strategic tool that not only helps organizations understand their innovation positions, but also reduces risks and promotes sustainability in the face of market dynamics. With a systematic approach, KATSINOV offers practical guidance in navigating the challenges of the innovation lifecycle, ensuring innovative products are market-acceptable, and creating a long-term impact for organizations. Tao, et al. (2008) stated that when research began, the need for a managerial approach increased to support the innovation process. Thus, the role of innovation management is very important in the context of managing innovation in an organization through the stages of the innovation cycle. The management of this innovation includes how aspects of technology, market, organization, partners and risks can be managed optimally so that innovation products can be solutions and used by the community, as well as create sustainable competitiveness for the corporation.

Taking into account the above explanation, a measuring tool is needed that can describe the development of innovation and implement innovation

throughout the life cycle more effectively. One of the preferred measures is the Innovation Readiness Level (IRL). With the KATSNOV measuring tool, the perspective of the innovation life cycle is not only seen from the technological aspect, but also other aspects, such as markets, organizations, partnerships, manufacturing, investment, and risk.

The apply the KATSINOV measurement tool is one of the systematic approaches designed to help organizations understand and manage their innovation lifecycle more effectively. In an era of rapid technological change and increasingly fierce market competition, the use of measuring instruments such as KATSINOV has become very important to ensure that any innovation developed is not only technically feasible but also has the potential to succeed in the market. The implementation of KATSINOV is based on several strategic reasons and key objectives that make it one of the important approaches in the management of innovation in various industrial sectors.

1. Anticipation of a shorter innovation life cycle, one of the main reasons for the implementation of KATSINOV is to help organizations anticipate the acceleration of the innovation life cycle. In recent decades, the life cycle of products in various industries has experienced significant shrinkage. For illustration, the life cycle of personal computers, which used to reach five years, is now only about three years. This phenomenon reflects the ever-evolving market dynamics, where new technologies are rapidly replacing old ones. By using KATSINOV, organizations can accelerate the innovation process to keep up with dynamic market trends. KATSINOV provides guidance in designing product development strategies that are more responsive to change, ensuring that the resulting technology remains relevant to consumer needs. This approach allows organizations to shorten the time vital from the conceptualization stage to commercialization, giving them a significant competitive advantage in the global market (Fithri et al., 2021; Waliulu et al., 2020).
2. Facing fierce competition, the implementation of KATSINOV also aims to help organizations face increasingly fierce competition, especially in fast-moving industries such as personal computers, digital cameras, automotive, and smartphones. In these industries, success is often determined by a corporation's ability to produce products that are more innovative, efficient, and relevant to consumer needs. KATSINOV allows organizations to map their position compared to competitors and determine the necessary strategic measures to increase their competitiveness. For illustration, in the automotive industry, KATSINOV can be used to evaluate the technological readiness of electric vehicles before they are launched to the market. By understanding the level of

technological readiness, organizations can design more effective marketing and distribution strategies to win competition with similar products in the market (Corallo et al., 2022).

3. Describing the development of innovation, KATSINOV is not only used to evaluate the readiness of innovations, but also to describe the development of innovations over time. This tool provides a framework that allows organizations to monitor the progress of their innovations at every stage of their lifecycle. This information is critical to identifying areas that need improvement and to ensure that innovations remain on the right track to commercialization. For illustration, in the development of renewable energy technologies such as solar panels, KATSINOV can be used to evaluate progress from the research stage to prototype testing. With continuous monitoring, organizations can identify technical obstacles that may arise and take the necessary mitigation steps to address them. This approach not only improves the efficiency of the innovation process but also helps organizations to ensure that the innovations developed have a significant impact on the market (Markard, 2020).
4. Determining the status or position of readiness in the innovation life cycle, one of the main objectives of KATSINOV is to help organizations determine the status or position of readiness of their innovations in their life cycle. This information is essential for designing more effective development strategies and to ensure that innovation can move smoothly from one stage to the next. For illustration, in vaccine development, KATSINOV can be used to evaluate the readiness of the technology at the initial clinical hearing stage and determine the necessary steps to accelerate the transition to the mass production stage. By understanding the status of innovation readiness, organizations can plan resources and time more efficiently, thereby increasing the chances of product success in the global market (Raditya Faisal Waliulu et al., 2020; Santoso et al., 2022).
5. Reducing the risk of failure in implementing Innovation, Innovation always involves risks, be it technical, market, or financial risks. KATSINOV provides a framework that allows organizations to identify and manage these risks early on. With a data-driven approach, KATSINOV helps organizations to take appropriate mitigation measures and reduce the chances of failure in implementing innovations. For illustration, in the pharmaceutical industry, the risk of failure often arises at the stage of clinical trials, where the product may not meet efficacy or safety standards. By using KATSINOV, pharmaceutical companies can comprehensively evaluate these risks and devise strategies to address potential emerging barriers (Nur Rahmawati and & Amalia Suzianti, 2023; Sachithra Lokuge, 2020).

6. Evaluating the progress of the implementation of innovation programs, KATSINOV also serves as a tool to evaluate the progress of the implementation of innovation programs or activities. Using the indicators specified in KATSINOV, organizations can monitor their achievement against the targets that have been set. This information is essential to ensure that the innovation program stays on track and to identify areas that need more attention. For illustration, in the development of AI technologies, KATSINOV can be used to evaluate whether the development of algorithms and models has reached a certain level of readiness before being implemented in real applications. With continuous monitoring, organizations can identify technical or organizational constraints that may be hindering progress and take the necessary steps to address them (Fithri et al., 2021; Nur Rahmawati and & Amalia Suzianti, 2023).
7. Encouraging innovation implementation through systematic planning, one of the main advantages of KATSINOV is its ability to encourage the implementation of innovation through systematic planning. KATSINOV provides a framework that allows organizations to design an innovation implementation strategy that covers all important aspects, from idea creation, drafting concepts, to producing products that are competitive in the market. With more structured planning, organizations can ensure that every step in the innovation process is carried out with maximum efficiency and effectiveness.

The implementation of KATSINOV offers a variety of strategic benefits that help organizations to manage their innovations more effectively and efficiently. With a more systematic and holistic approach, KATSINOV enables organizations to anticipate market dynamics, reduce risks, and increase the chances of innovation success. In the ever-changing business world, KATSINOV is a very important tool to ensure that innovation can meet market needs and make a significant contribution to the growth of the organization.

KATSINOV's position regarding TRL is to be able to be continued and complete (Figure 8.1.). Sustainable means that the measurement of KATSINOV requires a certain level of TRL status condition as a prerequisite that must be met so an innovative product to be ready to enter the market and survive and be sustainable. Meanwhile, complete means that the KATSINOV assessment includes, in addition to technological aspects, also aspects of the market, organization, partnerships, manufacturing, investment and risks.

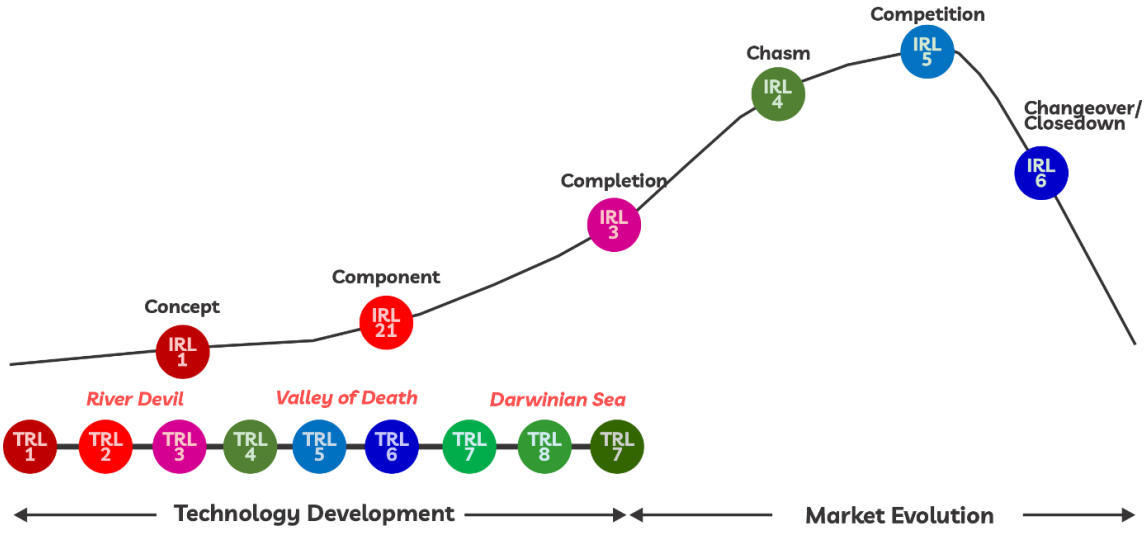

Figure 8.1. The relationship among TRL and KATSINOV.

The innovation process, especially in organizations engaged in technology and manufacturing, is often faced with various critical challenges that can hinder its success. The challenge is known as the "three valleys of death" which describes the crucial stages in the innovation journey, namely the Devil's River, the Valley of Death, and the Darwin Sea. These three phases test various aspects of innovation feasibility, ranging from scientific, technical, to economic feasibility. Failure in any of these phases can result in the cease innovation before it reaches the market. Therefore, strategic approaches such as the IRL (KATSINOV) have become very relevant to help organizations get through these critical phases and ensure the success of innovation in the global market (Redata et al., 2021; Santoso et al., 2022; Waliulu et al., 2020).

1. First phase: Devil's River

   The first phase, called the Devil's River, tests the scientific feasibility of an innovation idea. At this stage, the main focus is to prove that the proposed idea has a strong scientific basis and is worthy of further development. In this context, organizations need to conduct in-depth research and experiments to evaluate the potential of the proposed technology. Failure at this stage usually occurs due to a lack of supporting data or inadequate research results. For illustration, in the biotechnology industry, vaccine development requires rigorous scientific validation before entering the clinical hearing stage. KATSINOV, with its comprehensive approach, helps organizations identify gaps in scientific feasibility and provides a framework to address those challenges (Markard, 2020).

2. Phase two: Valley of Death

   After passing the stage of scientific feasibility, innovation entered a second phase known as the Valley of Death. In this phase, the technological

prototypes developed are tested from a technical perspective to ensure that the innovation can function according to the expected purpose. This phase is often a major challenge because it involves testing and validating the technology in an environment that is close to real conditions. Technical failures at this stage, such as system failures, performance instability, or inconsistent results, may result in the ceease product development. In the electronics industry, for illustration, battery life testing or hardware reliability is often the determinant of success in this phase. KATSINOV supports organizations by providing evaluation tools that cover technical aspects, so that the risk of failure can be minimized before the technology is launched to the market (Corallo et al., 2022).

3. Phase three: Darwin Sea

   The final stage is the Darwin Sea, where innovations are tested in economic feasibility and readiness to compete in the market. At this stage, the main focus is to ensure that the innovations developed are not only technically feasible but also have significant economic value. Market feasibility evaluation, cost analysis, and commercialization strategy are important elements in this phase. Failure at this stage usually occurs due to a lack of effective marketing strategies, high production costs, or lack of market acceptance of new products. In the pharmaceutical industry, for illustration, products that cannot meet market needs or compete with existing alternatives are often stalled at this stage. With its holistic approach, KATSINOV enables organizations to map opportunities and challenges in the market and design appropriate strategies to overcome economic headwinds (Sachithra Lokuge, 2020; Waliulu et al., 2020).

KATSINOV is designed to help organizations get through these three critical phases by providing an evaluation framework that covers seven key aspects:,technology, market, organization, partnerships, manufacturing, investment, and risk. With this approach, KATSINOV not only helps identify risks but also provides strategic guidance for overcoming them. For illustration, in the development of renewable energy technologies, such as wind turbines or solar panels, KATSINOV can be used to evaluate the feasibility of the technology, market readiness, and partnership strategies with governments or investors. This allows organizations to reduce risk and accelerate the product development process (Fithri et al., 2021; Redata et al., 2021). The pharmaceutical industry is one sector where the challenge of the three valleys of death is very relevant. In vaccine development, for illustration, the Devil's River phase involves scientific validation to ensure that vaccine formulas have the potential to fight certain diseases. After that, the Valley of Death phase

tested the stability and efficacy of the vaccine in clinical trials. Finally, the Darwin Sea phase determines whether the vaccine can be mass-produced at a competitive cost and accepted by the market. By using KATSINOV, pharmaceutical companies can integrate various aspects of this evaluation to ensure the success of products in the global market (Redata et al., 2021; Santoso et al., 2022).

The challenge of the three valleys of death in innovation requires organizations to adopt a more systematic and holistic approach. KATSINOV, with its framework that covers seven key aspects, has become a highly relevant tool to help organizations get through these critical phases. By mapping risks, evaluating feasibility, and devising mitigation strategies, KATSINOV not only increases the chances of innovation success but also ensures that the resulting products have significant added value in the global market. In an era of increasingly fierce competition, KATSINOV is a strategic solution for organizations that want to ensure the sustainability and competitiveness of their innovations. KATSINOV as a generic innovation readiness model can be applied in managing the innovation process or innovation management in industries/institutions that can provide information to the management of entities (companies/ institutions) about the position of their innovations and the key elements that are taken into account related to innovation, so that they can know the development of innovation and help implement innovation in its life cycle more effectively.

The KATSINOV is a strategic approach that provides comprehensive insight into the position of the innovation lifecycle of a product, process, management, or other entity. By utilizing the results of these measurements, companies or institutions can make more informed decisions regarding the strategic steps that need to be taken to manage innovation. In a business ecosystem full of challenges and rapid changes, the results of KATSINOV's measurements are not only relevant in evaluating the success of innovations, but also an important basis in determining the future direction of the corporation. The three main dimensions that this measurement results focus on include the introduction of innovations in the market, market maturity, and strategic decisions regarding the corporation's future.

1. Introduction of innovation in the market

   One of the main benefits of KATSINOV's measurement results is its ability to provide information on the readiness of innovative products when they are first introduced to the market. At this stage, companies are faced with the great challenge of ensuring that their innovative products can meet the needs or demands of customers. This is especially important because the initial market is often the main measure of a product's success

in creating a significant impact in the broader market. The innovation recognition process focuses not only on the technical quality of the product, but also on the corporation's ability to understand customer preferences and design effective marketing strategies. For illustration, in the consumer technology industry, the launch of a new smartphone is often accompanied by the challenge of convincing the market that the product provides added value compared to an existing product. Using the results of KATSINOV's measurements, companies can map the needs of the initial market and evaluate whether their innovative products have enough appeal to attract the attention of customers in the early segments of the market (Fithri et al., 2021; Nur Rahmawati and & Amalia Suzianti, 2023; Redata et al., 2021). Further, the results of the KATSINOV measurement allow organizations to identify potential challenges that may arise at the stage of market introduction, such as customer resistance to new technologies or difficulties in building market awareness. With these insights, companies can design more effective mitigation strategies, such as customer education, marketing campaigns that focus on product benefits, or the development of more flexible business models to drive the adoption of innovative products.

2. Market maturity generated by innovation

The next stage that is the focus of the results of KATSINOV's measurement is the market maturity phase. At this stage, the balance among demand and supply begins to be reached, and market growth tends to slow down. This stage is often a critical point for companies because they need to maintain market share while facing pressure from competitors who may bid more innovative products or services. The results of KATSINOV's measurements provide important information about market dynamics at this stage, including product penetration rates, customer responses, and user satisfaction levels. This data allows companies to evaluate whether the innovations they have introduced are still relevant and whether there are still opportunities for further growth. In this context, strategies to maintain innovation are critical, such as updating product features, improving customer service, or diversifying products to reach new market segments. For illustration, in the automotive industry, electric vehicles (EVs) have entered the market maturity stage in some regions with stable demand and the presence of many new players. The results of KATSINOV's measurements help companies to understand the extent to which their products are still competitive in this mature market. With clearer data, companies can plan strategies such as developing more efficient battery technology or expanding the network of charging stations

to increase the added value of their products in the eyes of customers (Markard, 2020).

3. Decisions regarding the corporation's future

   Another strategic benefit of KATSINOV's measurement results is its ability to support long-term decision-making regarding the corporation's future. At some stage in the innovation lifecycle, companies are faced with an important choice, namely whether to continue investing in existing innovations, switch to new technologies, or stop outdated innovations. These decisions are often very complex because they involve considering a variety of factors, including market potential, profit levels, and risks associated with the development of new technologies. The results of KATSINOV's measurements provide the necessary insights to support this decision-making process. For illustration, if measurements show that a particular innovation has reached a saturation point in the market and no longer has significant growth opportunities, companies may decide to stop production and redirect their resources to other, more promising innovations. Conversely, if the measurement shows that the innovation has the potential to grow further with more investment, the corporation can devise a strategy to extend the lifecycle of that product through technological updates or market expansion. As a real illustration, in the digital camera industry, many companies are deciding to switch from conventional cameras to mirrorless technology due to changing market demands. These decisions are often based on data obtained from evaluation tools such as KATSINOV, which shows that conventional camera technology is no longer able to compete in a market that is increasingly dominated by lighter and more advanced technologies (Raditya Faisal Waliulu et al., 2020; Santoso et al., 2022). In addition, the results of KATSINOV's measurements can also be used to design a smoother transition strategy to new technologies, so that companies can maintain their competitive advantage while reducing the risks associated with major changes in the product portfolio.

The results of KATSINOV's measurements provide very important benefits in supporting strategic decision-making related to the innovation lifecycle. With the information gained from these measurements, companies can manage the process of introducing innovations in the market, understand the dynamics of market maturity, and make more informed decisions regarding the future of their innovations. In a business ecosystem full of challenges, KATSINOV is a very relevant tool to ensure that innovations are not only technically feasible but also capable of providing sustainable added value

to the corporation and its customers. With a more systematic and data-driven approach, KATSINOV enables companies to remain competitive and adaptive in the face of rapid and dynamic market changes.

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Chapter 9
KATSINOV FRAMEWORK

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Innovation is at the heart of technological and economic transformation in the modern era. To systematically manage and evaluate the innovation process, a structured framework is needed. One comprehensive model is the KATSINOV framework, which consists of two main phases, six levels, seven aspects, and a set of indicators to measure innovation progress.

Table 9.1. KATSINOV framework

Aspect \ KATSINOV	KATSINOV 1	KATSINOV 2	KATSINOV 3	KATSINOV 4	KATSINOV 5	KATSINOV 6
TECHNOLOGY						
MARKET						
ORGANIZATION						
PARTNERSHIP						
MANUFACTURE						
INVESTMENT						
RISK						

The framework integrates the innovation lifecycle with innovation management, allowing developers to navigate challenges from the concept stage to the product changeover or closure stage. In this essay, we will explain KATSINOV through four sub-topics, the phase of technological development, the phase of market evolution, the seven main aspects, and the practical implications of the key indicators used.

9.1. Technology Development Phase

The technological development phase in the KATSINOV framework includes three initial levels that serve as an important foundation in the innovation process: KATSINOV 1 (concept), KATSINOV 2 (component), and KATSINOV 3 (completion). These three phases provide a strategic framework

to manage the development of technology in stages, from the exploration of ideas to the prototype stage that is ready to be tested in the market. A deep understanding of each phase allows the corporation or organization to minimize risks while maximizing the potential for innovation success.

In the KATSINOV 1 stage, development begins with strategic thinking based on innovation frameworks such as S-curve and Business Model Canvas. This strategic thinking is crucial to ensure that the resulting innovations have market relevance and sustainable growth potential. The S-curve, for illustration, is used to understand the technology lifecycle and determine the right time to start or change the innovation approach. Meanwhile, the Business Model Canvas helps in identifying key elements that support innovation, such as customer segments, value propositions, and distribution channels. A study by (Brown, 2020) emphasizes the importance of strategic thinking in the early stages of innovation, which not only advises the exploration of new ideas but also ensures alignment with market needs.

At this level, the main focus is the exploration of new ideas that can result in innovative products, services, processes, or business models. Design thinking is a very important tool to encourage creativity and innovation. By leveraging this approach, the development team can deeply understand user needs, formulate problems holistically, and create relevant and effective solutions. Design thinking also helps in building the relationship among the corporation's strategy and the resulting innovations, thus ensuring that every step taken has a significant impact on business sustainability.

Furthermore, at the level of KATSINOV 2, the focus shifted to the development of technological components. The new knowledge generated at the KATSINOV 1 stage is integrated to create prototypes or initial components. This stage involves the identification and validation of the core technology as well as the initial testing of the concepts that have been formulated. Legality, certification, and protection of Intellectual Property Rights (IPR) are important steps that cannot be ignored. IPR protection provides the necessary legal security for innovation, which in turn advises further investment from stakeholders. A study by (Smith et al., 2023) shows that IPR protection in the early stages of technology development has a very important role in attracting strategic partners and investors.

At this stage, the integration of technological components is carried out taking into account technical feasibility and market needs. Laboratory testing and simulation are an important part of ensuring that the resulting innovations meet the quality and performance standards that have been set. Additionally, collaboration with external partners, such as research institutions or technology companies, can provide access to more resources

and necessary expertise. According to a study by (Armstrong & Johnson, 2019; W. H. A. Johnson et al., 2023), strategic collaboration at this stage can accelerate the technology development process and increase the chances of success.

The KATSINOV 3 level marks the completion of the prototype, where beta testing is carried out to ensure that the product or technology has met all the requirements for functionality, compatibility and sustainability. At this stage, the main focus is on product validation through iterative testing involving early adopters. This testing process not only helps in identifying and fixing product weaknesses, but also provides valuable insights into user needs and preferences. According to (W. Zhang, 2024; Y. Zhang, 2023), success at this stage largely depends on the developer's ability to respond to feedback quickly and effectively.

In addition to technical testing, this stage also involves the certification process and testing against relevant standards. Certification provides assurance to consumers that the products produced have met quality and safety requirements. In a global context, certification is also an important tool to enter the international market. A study by (Derkach & Tsygankova, 2021; Dewanti et al., 2023; Moirangthem & Nag, 2020) highlights that certification by international standards can increase product competitiveness in the global market and open up export opportunities. The prototypes that have been validated at this stage form the basis for further development, both on a production scale and in design refinement. This stage is also a moment to identify the broader market potential and plan an expansion strategy. Thus, the KATSINOV 3 stage is not only the terminate of the technological development phase but also the beginning of a broader commercialization phase.

The three initial phases in the KATSINOV framework provide a solid foundation for the successful development of the technology. With a systematic and data-driven approach, organizations can effectively manage the innovation process, from idea exploration to prototype validation. The framework also allows organizations to mitigate risks and maximize opportunities through knowledge integration, strategic collaboration, and the use of user feedback. With the support of the latest literature and best practices, KATSINOV has become an invaluable tool for organizations looking to lead in the era of technological innovation.

9.2. Market Evolution Phase

The KATSINOV framework not only serves to measure innovation readiness but also helps organizations understand market dynamics at every stage of the innovation life cycle. In the evolution stage of the market, this

framework includes three critical levels: KATSINOV 4 (Abyss), KATSINOV 5 (Competition), and KATSINOV 6 (Switching/Closing). These three levels reflect the innovation journey from testing market needs to strategic decision-making related to the continuation or discontinuation of innovation. By understanding this process, organizations can manage their resources more effectively to achieve success in a competitive market. KATSINOV 4: Overcoming the Gap of Market Needs, At the KATSINOV 4 level, innovations are tested against real market needs. This stage is often a tipping point because innovations that cannot answer the specific needs of consumers tend to fail to move on to the next stage. The process at this level involves intensive dialogue between developers and customers to ensure that innovative products are well received. According to the literature presented by (Markard, 2020), one of the main causes of innovation failure at this stage is a lack of understanding of the specific needs of consumers. This shows the importance of in-depth market data collection, customer surveys, as well as product testing in a real-world environment. For example, in the healthcare technology industry, medical device developers often use prototypes to get direct feedback from end users, such as doctors and patients. By listening to their specific needs, developers can make adjustments that ensure that the product is not only relevant but also has a significant impact. This approach also helps identify early barriers that may be hindering market acceptance, so developers can design more suitable solutions before moving on to the next level (S. Santoso et al., 2022).

KATSINOV 5: Building Competitiveness in the Market, The KATSINOV 5 level marks the phase in which innovation faces real market competition. At this stage, the main focus is on building brands, increasing market share, and ensuring that innovations can compete effectively. To achieve success at this level, organizations must develop effective marketing strategies, provide optimal customer support, and constantly monitor competitive dynamics in the market. One of the key elements at this level is brand strengthening. Developers must ensure that their innovative products can create a positive perception in the minds of consumers. Strategies such as creative marketing campaigns, the use of social media, and direct engagement with customers can help strengthen a product's presence in the market. In this context, consistent investment in research and development (R&D) also plays an important role. According to research by (S. Santoso et al., 2022), successful innovation in the market is often supported by continuous R&D, which allows organizations to continuously update and improve their products according to changing consumer needs. In addition, at this stage, developers must pay attention to the dynamics of the competitive market. By analyzing the strengths and weaknesses of competitors, organizations can devise strategies

to differentiate their products from similar products in the market. For example, in the smartphone industry, developers often use market data to evaluate the features that consumers are most interested in and tailor their products to stay competitive. With this approach, organizations can maintain the relevance of their products in a highly dynamic market (Markard, 2020).

KATSINOV 6: Transition or Closure Stage, KATSINOV Level 6 is the phase in which organizations must make strategic decisions regarding the future of their innovation. At this stage, decisions are made based on a thorough analysis of user feedback and product profitability. Organizations can choose to continue innovation through a changeover strategy, which is integrating updates and new features to extend the product lifecycle, or choose a closedown strategy, which is to stop outdated innovations and allocate resources to other, more promising projects. According to research by Wang et al. (2023), making the right decisions at this stage is essential to reduce the risk of long-term losses. If a product no longer meets market needs or fails to generate adequate profits, the organization may choose to discontinue the product and focus on developing new, more relevant technologies. Conversely, if the analysis shows that the product has the potential to continue to grow, the organization can invest in technology updates or enter new markets to extend the product lifecycle. For example, in the digital camera industry, many companies are deciding to switch from conventional camera technology to mirrorless technology due to changing consumer preferences. These decisions are often based on market data that shows that conventional camera technology is no longer competitive. With the right transition strategy, organizations can maintain their position in the market while reducing the risks associated with technological changes (S. Santoso et al., 2022). The market evolution stages in the KATSINOV framework—which include KATSINOV 4 (Abyss), KATSINOV 5 (Competition), and KATSINOV 6 (Switching/Closing)—provide strategic guidance for organizations to manage their innovations more effectively. From testing market needs to making strategic decisions regarding the continuation of innovation, each stage offers insights that are essential to ensure that innovation can create a positive impact in the market. By understanding and implementing these principles, organizations can increase their chances of innovation success, better manage risk, and make optimal use of their resources to achieve a competitive advantage in the global market.

9.3. Seven Key Aspects in KATSINOV

The KATSINOV framework covers seven main aspects, technology, markets, organization, partnerships, manufacturing, investment, and risk. Each

aspect has an important role in supporting the innovation cycle, from planning to implementation. With a holistic approach, the framework provides a comprehensive strategic guide for innovation management in various industry sectors. Technology as a Key Pillar, The technological aspect of the KATSINOV framework focuses on the development, testing, and certification of innovations. This process begins with the exploration of new technologies relevant to market needs and continues to prototype testing. This stage ensures that the technology developed is not only innovative but also practical. For illustration, research by (Chen et al., 2023) shows that systematic testing of technology can accelerate the process of technology adoption in the market. In addition, certification is an important element in ensuring that innovative products meet applicable regulatory standards. This certification not only increases the credibility of the product but also provides quality assurance to consumers.

Strategic market approach, the market is a crucial element in the innovation cycle. Within the framework of KATSINOV, the market aspect includes analysis of consumer needs, development of marketing strategies, and collect feedback from customers. This process allows companies to deeply understand market trends and customer needs. A study by (Matzembacher & Meira, 2019) confirms that a deep understanding of consumer needs can increase the chances of product success in the market. Thus, the development of a targeted marketing strategy can maximize market penetration and increase product adoption. Customer feedback, on the other hand, provides important insights that can be used for future product improvements. The role of organizations in supporting innovation, organizations play an important role in supporting the implementation of innovation. A good internal structure, an innovative organizational culture, and adequate human resource capacity are the key elements that support the success of innovation. In this context, KATSINOV emphasized the importance of developing an organizational culture that advises creativity and collaboration. According to research by (Brown, 2020), organizations with a strong culture of innovation are more likely to succeed in managing innovation projects. In addition, training and development of human resources are a key factor in increasing the capacity of organizations to face challenges related to innovation.

Partnerships as drivers of innovation, partnerships within the framework of KATSINOV include collaboration with external partners such as suppliers, research institutes, or other stakeholders. This collaboration can accelerate the innovation process by providing access to more resources and new knowledge. A study by (Johnston & Cushing, 2020; Johnstone, 2022) shows

that effective partnerships can improve the efficiency of the innovation process and expand market coverage. In this context, it is important to choose a partner who has a vision and goals that align with the organization. In addition, good partnership management is necessary to ensure the success of the collaboration. Efficiency in manufacturing: manufacturing is an important aspect in ensuring that innovative products can be produced efficiently and meet the set quality standards. In the KATSINOV framework, the manufacturing process begins with the identification of production needs and ends with the implementation of Good Manufacturing Practice (GMP). This process includes prototype testing, production system development, and quality control. A study by (J. Lee, 2023; S. M. Lee & Lee, 2021) shows that the consistent implementation of GMP can improve production efficiency and ensure product quality. In addition, innovation in manufacturing technology is also needed to face changing market needs and increase product competitiveness.

The Importance of Investment in Innovation, Investment acts as a supporting pillar that provides the funds needed for each stage of the innovation life cycle. Within the framework of KATSINOV, investment includes the development of business models, market analysis, and financial planning. According to (Jin et al., 2023), targeted and data-driven investment can increase the chances of innovation success. In addition, the identification of Key Performance Indicators (KPIs) is important to monitor the success of investments. With this approach, organizations can ensure that allocated resources are used effectively and efficiently. Proactive risk management, The risk aspect, which is often overlooked, is an important element in the KATSINOV framework. Risks can come from a variety of sources, including market uncertainty, regulatory changes, or technical failures. Within this framework, risk management is carried out proactively through risk identification, analysis, and mitigation. The literature by (Jin et al., 2023) highlights the importance of a systematic risk management approach to ensure the success of innovation. By effectively monitoring and managing risks, organizations can minimize any negative impacts that may arise and ensure the sustainability of innovation projects. The KATSINOV framework provides comprehensive guidance for innovation management, from technology development to risk management. With a holistic approach, this framework can help organizations face complex challenges in the innovation cycle. Through the integration of technology, market, organization, partnerships, manufacturing, investment, and risk aspects, KATSINOV creates a solid foundation for successful innovation in various industrial sectors. Recent literature supports the relevance and

importance of this approach in the context of modern dynamic and competitive business.

Table 9.2. KATSINOV framework Technology

	TECHNOLOGY DEVELOPMENT			MARKET EVOLUTION		
	KATSINOV 1	**KATSINOV 2**	**KATSINOV 3**	**KATSINOV 4**	**KATSINOV 5**	**KATSINOV 6**
TECHNOLOGY	– basic scientific principles observed and reported; – technological feasibility confirmed; – for radical innovation: ▪ ensure innovation is radical; ▪ identified uniqueness; ▪ identify progressive technical targets.	– individual components tested; – demonstration of prototypes; – intellectual Property (IP) protection.	– actual system demonstrated; – external test completed; – protection of IP; – technology/product is documented; – launch of innovation results; – compliant with regulations.	– skills are formed; – general use of products/ technology to a wide market; – after-sales support; – identify key benefits from testing; – provide support and encouragement for market adoption of the technology.	– lower research and development (R&D) activity; – performed technological maintenance; – technology services provided; – identify opportunities to develop new technologies.	– Identified sustainable innovation. – Learn from experience to innovate again (as incremental innovation) or leave it to develop more advanced technology (as breakthrough innovation). – Developing new innovations or managing the business or seeking an exit strategy.

The KATSINOV framework is a systematic approach to technological innovation that integrates two main phases, technological development and market evolution. Each phase includes six levels, from the initial stage of conceptualization to the decide continue or discontinue the innovation. In this essay, Table 9.2 related to the technological dimension within the framework of KATSINOV will be explained, which covers progress from basic scientific principles to sustainable innovation management. Each level offers specific guidelines and indicators to ensure innovation runs effectively and in a targeted manner.

KATSINOV 1: Basic Scientific Principles

The initial stage of KATSINOV 1 focused on the observation and reporting of the basic scientific principles that form the basis of technology. The feasibility of the technology must be confirmed to ensure initial feasibility. For radical innovation, it is important to identify the uniqueness of the innovation, ensure that the innovation is truly radical, and set clear progressive technical targets. This stage is an important foundation that determines the next direction of development. The literature supports the importance of this early stage in ensuring the continuity of science-based innovation, as discussed in an article by (Piqriani et al., 2023; Skordoulis et al., 2020), which highlights that early observations are often the main direction in technological innovation.

KATSINOV 2: Testing of Individual Components

At this level, the focus is on testing individual components and demonstrating prototypes. IPR protection has also been started to ensure that innovation has a clear legal value. These tests aim to validate the basic functionality of the technology on a limited scale. An article by (Chesbrough, 2019) mentions that the initial demonstration of the prototype can increase investor confidence and accelerate the next stage of development.

KATSINOV 3: Demonstration of the Actual System

In KATSINOV 3, innovation entered the demonstration phase of the system as a whole. External tests are carried out to ensure that the technology can meet a wider range of needs. Documentation of the technology or product is a priority to record all relevant technical aspects. IPR protection is continued to provide a guarantee of legality for the innovations produced. This stage also prepares for the launch of the innovation to the market by ensuring regulatory compliance. According to a study by (Sepasgozar & Davis, 2019), external demonstrations can accelerate the adoption of the technology in the market as it provides tangible evidence to stakeholders.

KATSINOV 4: Market Development

KATSINOV 4 is the phase in which the technology or product begins to be widely applied in the market. At this stage, after-sales support becomes an

important element to ensure the sustainability of technology adoption. The main benefits of the previous tests are identified and added to the market. In addition, the push for market adoption is also carried out through various marketing strategies. An article by (V. S. Kumar, 2018) shows that effective after-sales support can increase customer loyalty and ensure the success of the technology in the market.

KATSINOV 5: Low R&D Activity

At this rate, R&D activity begins to decline. The focus shifts to technology maintenance and the provide technology services to users. Opportunities to develop new technologies are also identified as part of continuous innovation endeavors. This stage aims to maintain the relevance of the technology in the long-term. A study by (Huo et al., 2023) emphasizes the importance of technology maintenance to prevent quality degradation and ensure sustainability.

KATSINOV 6: Sustainable Innovation or Exit Strategy

This final stage includes the identification of sustainable innovations that can be carried out based on the experience that has been gained. Companies can choose to develop new innovations as a form of incremental innovation or take strategic steps, such as exiting the market. This choice is based on an evaluation of the benefits and potential of the technology. According to a study by (Connolly et al., 2023), continuous experience-based innovation has a greater chance of succeeding in the market than completely new innovation.

The KATSINOV framework provides structured guidance in managing technological innovations, from initial observation to sustainable innovation management. With this approach, developers can ensure that every stage of innovation runs efficiently and directionally. The current literature supports the relevance of each stage of KATSINOV, showing that this framework can be applied to different types of technological innovations. With a deep understanding, KATSINOV has become a very valuable tool in driving the success of innovation in the modern era.

Tabel 9.3. KATSINOV framework Market

	TECHNOLOGY DEVELOPMENT			MARKET EVOLUTION		
	KATSINOV 1	**KATSINOV 2**	**KATSINOV 3**	**KATSINOV 4**	**KATSINOV 5**	**KATSINOV 6**
MARKET	– work with leading customers; – customer needs and demands are observed; – for radical innovation, market location initiation.	– terminate customers identified; – a detailed market rollout plan has been issued; – intellectual Capital.	– customer specific needs and requirements are known; – segment, size and market share have been predicted; – prices and product launches have been released; – information management.	– market positioning; – the business model is determined; – marketing emphasizes getting to know its customers well; – competitors are well identified; – using partnerships to enter the market.	– product differentiation; – providing services and solutions; – periodic reviews are carried out; – refinement of the business model; – using partnerships to compete.	– market decline has been confirmed; – market research for approval of re-innovation (as incremental innovation) or leaving it for the development of more advanced technology (as breakthrough innovation); – review market demand; – identify opportunities for market growth or new market expansion.

The KATSINOV framework is a systematic approach in managing the innovation life cycle, especially in the market aspect. Table 9.3 illustrates the development of the market that coincides with the development of technology through the six stages of KATSINOV. Each stage provides strategic guidance to analyze customer needs, business models, market competition, and re-innovation strategies. By integrating technological and market approaches, KATSINOV enables innovative developers to achieve commercial success effectively. In this essay, each stage of the market within the framework of KATSINOV will be discussed in-depth, linking it to the current literature.

KATSINOV Stage 1: Market Initiation

The first stage in the framework of KATSINOV emphasizes on the initial understanding of customer needs and demands. In this stage, innovation developers work with leading customers to identify specific needs. The discovery of market locations is also a focus for radical innovation. This process requires intensive collaboration with key stakeholders to gain initial insight into market trends. According to recent studies, understanding customer needs at an early stage is essential to determine the direction of innovation that suits market demand (Chesbrough, 2019).

KATSINOV Stage 2: Market Planning

In the second stage, the terminate customer is identified and a detailed plan for the market launch is formulated. This stage involves applying the concept of "Intellectual Capital" to ensure a marketing strategy backed by strong intellectual assets. Research shows that careful market planning can increase the competitiveness of innovative products (Teece et al., 2022). With this approach, developers can prepare for an effective launch by understanding the market structure and opportunities.

KATSINOV Stage 3: Launch and Market Segmentation

This stage includes identifying the customer's specific needs, predicting the market size, and launching the product. Information regarding market segmentation, pricing, and product launches is essential to determine market position. Efficient information management allows developers to respond to customer needs more appropriately. The literature shows that effective market segmentation helps increase the market share of new innovations (Kotler dan Keller, 2016).

KATSINOV Stage 4: Market Position

In the fourth stage, determining the business model is the top priority. Marketing strategies are focused on getting to know customers better, while competitor identification is an important step. Strategic partnerships are used to help market penetration. Research supports that partnerships can

accelerate the adoption of innovations, particularly in the early stages of market entry (Ahvari et al., 2023). Thus, understanding the market position allows developers to strengthen the competitiveness of the product.

KATSINOV Stage 5: Market Competition

The fifth stage involves product differentiation, service delivery, and solutions that suit customer needs. In addition, periodic reviews are conducted to improve the business model. Partnership strategies are not only to enter the market but also to survive the competition. Recent literature mentions that periodic refinement of business models helps companies maintain market relevance and face competitive challenges (Zott & Amit, 2009).

KATSINOV Stage 6: Market Decline and Re-innovation

The final stage marks a market decline that requires a thorough review of market demand to determine whether new innovations are needed or old technologies need to be eliminated. This process identifies opportunities for new market growth or expansion into other segments. According to studies, proper management of the product lifecycle at this stage allows companies to take advantage of further innovation opportunities (Christensen, 2023; M. W. Johnson et al., 2008).

The KATSINOV framework provides a comprehensive guide to managing the evolvethe market as technology develops. Each stage provides a strategic approach to ensure the success of innovation in the market. By understanding customer needs, designing go-to-market strategies, and re-innovating, developers can optimize the product lifecycle. Recent literature further underscores the relevance of this framework in supporting the sustainability of innovation in dynamic markets.

Tabel 9.4. KATSINOV framework Organization

	TECHNOLOGY DEVELOPMENT			MARKET EVOLUTION		
	KATSINOV 1	**KATSINOV 2**	**KATSINOV 3**	**KATSINOV 4**	**KATSINOV 5**	**KATSINOV 6**
ORGANIZATION	– eligible strategy confirmed; – define project scope and tasks; – confirm vital resources and services; – informal, loose structure (especially R&D team); – for radical innovation: ▪ defining a meaningful radical innovation strategy; ▪ free channels of communication.	– issue analysis and business plans; – involve key individuals; – approval of project requirements and list of project partners; – approval of responsibilities and approval of time limits.	– formalize the organization (business structure with staff and collaborators); – identify some more staff needed.	– Determine the form (*e.g.*, dynamic network). – Develop partnerships with independent organizations. – Identification of product introduction opportunities to new partners and markets.	– increase effectiveness and collaboration; – make the necessary restructuring; – identification of opportunities to improve technology meeting with market needs; – review of technical and commercial processes to improve prices and profits.	– Restart the Invention Readiness Level (IRL) process or concentrate on commercial activity or exit strategy

The KATSINOV framework, as outlined in Table 9.4, highlights the organizational approach used in the technology development cycle and market evolution. This Table divides the organization's approach into six stages (KATSINOV 1 to KATSINOV 6), which reflects the process that starts from the initial strategy to the decide continue the innovation or take the final step. Each stage within this framework has a focus and measures designed to support the achievement of innovation goals, both in technology and market. This essay will explain each stage in detail about the current literature to provide in-depth insights.

KATSINOV 1: Initial Strategy and Informal Structure

The first stage in the KATSINOV framework is the process of formulating a feasible strategy to ensure that the innovation project has a clear direction. At this stage, the project scope and key tasks are defined. The resources needed to support development are also confirmed. The organizational structure in this stage is usually informal, especially in the R&D team, which allows for flexibility in communication and collaboration.

In the action of radical innovation, this strategy is more focused on a deeper definition of a meaningful innovation approach. Open and uninhibited communication is the main key to creating a creative and adaptive work environment. Research by (Ertl et al., 2021) in the Journal of Business Research shows that free communication in organizations in the early stages advises cross-functional collaboration and generates better innovative ideas. Therefore, it is important for organizations to create flexible structures that support the early exploration of innovation.

KATSINOV 2: Formal Analysis and Planning

Once the initial strategy is in place, the next step is to conduct an in-depth analysis and draw up a business plan. At this stage, key individuals who have a great influence on the project are identified and engaged. Approval of the project needs, a list of potential partners, key responsibilities, and project deadlines are also given at this stage.

As the process becomes more formal, organizations are starting to involve more relevant stakeholders. The literature shows that the involvement of key individuals in strategic decision-making can improve the effectiveness of business plan implementation (Chesbrough, 2019). In addition, alignment among the needs of the project and the selected partner is an important foundation for the success of innovation in the next stages.

KATSINOV 3: Formalization of the Organizational Structure

In the third stage, the organization began to be formalized. A business structure that includes core staff and collaborators is established to support the development of the project in a more organized manner. Identification of

more staff needs is also carried out to ensure that the organization has adequate human resources to carry out the project.

This formalization creates the stability necessary to manage the increasing complexity. In this context, the literature emphasizes the importance of adaptive organizational design. For illustration, research by (Pisano, 2019) in the Strategic Management Journal shows that a flexible but organized organizational structure supports better management of innovation projects, especially in the face of dynamic market challenges.

KATSINOV 4: Partnership Development and Market Opportunities

The fourth stage focuses on developing partnerships with independent organizations. More dynamic forms of organization are beginning to take shape, such as collaborative networks that allow rapid adaptation to market needs. In addition, opportunities to introduce products to new partners and new markets are identified at this stage.

Strategic partnerships built in this stage are often key to entering a wider market. According to research by Hagedoorn and Zobel (2020), cross-organizational partnerships allow companies to leverage external resources, such as technical expertise and market access, ultimately accelerating technology adoption. Therefore, building a mutually beneficial relationship is a critical step in this stage.

KATSINOV 5: Effective Restructuring and Collaboration

In the fifth stage, the organization's focus shifts to improving effectiveness and collaboration. The necessary restructuring is in place to ensure that the organization remains relevant to the evolving needs of technology and markets. Technical and commercial processes are also reviewed to improve cost efficiency and profit margins.

This stage reflects the importance of managing the process strategically. The literature shows that organizations that actively review and optimize their processes are able to maintain a sustainable competitive advantage (Grant, 2016). The restructuring process is also a moment for organizations to re-evaluate the alignment among the technologies they develop and the changing needs of the market.

KATSINOV 6: Final Decision and Future Strategy

The final stage in the KATSINOV framework is the decision-making process to continue the innovation cycle or focus on commercial activities or exit strategies. At this stage, organizations have the option to restart the IRL process or concentrate their endeavors on commercial management. Another alternative is to evaluate exit strategies that can involve selling assets or licensing technology to third parties.

Decisions at this stage are often based on a thorough evaluation of the sustainability of the innovation. According to (Christensen, 2023) in Harvard Business Review, wise strategic decision-making at the terminate of the innovation cycle can open up opportunities for the development of new innovations or strengthen market positions through the optimization of existing technologies.

The organizational framework in the KATSINOV framework offers a systematic approach to managing innovation projects from the initial stage to the final decision. By highlighting aspects such as initial flexibility, formal planning, partnership development, and restructuring, the framework provides a holistic guide to support technology development and market evolution. Each stage in this framework is supported by the current literature, which confirms the importance of a structured and adaptive approach to innovation management.

Tabel 9.5. KATSINOV framework Partnership

	TECHNOLOGY DEVELOPMENT			MARKET EVOLUTION		
	KATSINOV 1	**KATSINOV 2**	**KATSINOV 3**	**KATSINOV 4**	**KATSINOV 5**	**KATSINOV 6**
PARTNERSHIP	– Potential partners identified.	– partner selection; – calibration is done.	– A formal partnership is established.	– collaboration in dynamic networks; – management that is already underway.		– partnership terminated; – search for academic partners.

Partnership is one of the fundamental elements in the development of technology and the evolvethe market discussed in the KATSINOV framework. Table 9.5 in this framework describes the strategic stages in building, managing, and ending partnerships during the process of technology development to market evolution. This article will elaborate on these elements in-depth, with the addition of up-to-date literature to provide relevant academic and professional context.

KATSINOV Stage 1: Identify Potential Partners

The first stage in the partnership is the identification of potential partners that align with the vision, mission, and strategic objectives of the innovation being developed. Potential partners can be academic organizations, research institutions, technology companies, or even governments. At this stage, the corporation or development team must be able to recognize actors who have alignment in the field of technology being worked on. According to (Ortega et al., 2022), a successful initial partnership depends on the suitability of competencies among partners as well as transparency of communication during the initial exploration process. Identification of potential partners can also be facilitated through mapping the innovation ecosystem to connect actors with similar interests. This stage is very crucial in determining the direction of collaboration that has the potential to be sustainable.

KATSINOV Stage 2: Partner Selection and Calibration

In the second stage, the selection of partners is carried out based on the results of previous identification. Calibration is necessary to ensure that each party has the same understanding of the goals of the partnership. In this process, both technology developers and partners need to define their respective roles and responsibilities to create effective synergies. Literature such as the study from (Nudurupati et al., 2024) emphasizes that calibration in technology partnerships requires a data-driven approach to mapping the technical capabilities and resource commitments of each partner. In addition, formal contracts or memoranda of understanding (MoU) are often drafted at this stage to clarify the legal and commercial aspects of the partnership.

KATSINOV Stage 3: Formation of a Formal Partnership

Once the calibration is complete, the next stage is the formation of a formal partnership. Within the framework of KATSINOV, this stage involves the drafting of a formal contract among partners that covers technical, commercial and legal aspects. This formal partnership creates a working foundation that allows collaboration to run in a structured manner. A study by (Chunling et al., 2021) shows that formal partnerships based on trust and clear agreements result in faster and more effective technological innovation. In

addition, risk management is also a major focus at this stage, especially in projects with a high level of uncertainty.

KATSINOV Stage 4: Collaboration in Dynamic Networks

In the fourth stage, collaboration develops into a dynamic network. This includes managing ongoing partnerships to ensure that shared goals are achieved. Partnerships in a dynamic network allow for flexibility and adaptability in the face of market or technological changes. According to (Bauer et al., 2022), collaboration in dynamic networks strengthens an organization's ability to deal with complex challenges, such as regulatory changes or technological disruption. At this stage, the role of coordination is very important to maintain the sustainability and effectiveness of collaboration.

KATSINOV Stage 5: Termination of Partnership

The fifth stage in the partnership is the formal termination of cooperation. This process is carried out after the initial goal is achieved or if the partnership is no longer relevant to the organization's strategy. In addition, at this stage, technology developers also commence to look for new partners to explore the next innovation opportunity. A study by (Chunling et al., 2021) highlights the importance of evaluating the performance of partnerships before termination. This evaluation includes an analysis of the impact of collaboration on technology development and commercial benefits. With good evaluation, organizations can learn from experience to improve partnership strategies in the future.

KATSINOV Stage 6: Finding an Academic Partner

The final stage in the framework of the KATSINOV partnership is the search for academic partners to support further research or develop new innovations. Academics often have access to cutting-edge knowledge and research resources that can accelerate the innovation process. A study by (V. S. Kumar, 2018) shows that collaboration with academic partners provides a significant competitive advantage, especially in creating science-based innovations. The partnership also helps organizations to maintain the relevance of their technology amid rapidly changing market dynamics.

The KATSINOV framework in partnership provides a comprehensive strategic guide in building, managing, and concluding collaborations. From the identification of potential partners to the search for academic partners, each stage has a unique role in supporting the development of technology and the evolvethe market. By understanding and applying these principles, organizations can create more effective and sustainable partnerships to support technological innovation.

Table 9.6. KATSINOV framework Risk

	TECHNOLOGY DEVELOPMENT			MARKET EVOLUTION		
	KATSINOV 1	**KATSINOV 2**	**KATSINOV 3**	**KATSINOV 4**	**KATSINOV 5**	**KATSINOV 6**
RISK	– Technological risks are considered	– Technological risks are assessed (alternative solutions are considered). – Organizational risks are taken into account (initiation of investment plans and starting investments).	– Technology risks assessed. – Organizational risks are taken into account (estimated profit for the large investment incurred).	– Organizational risk is reviewed periodically (especially financial indicators)	– Organizational risk is reviewed periodically (especially financial indicators)	– consider two options; – plans to move (changeover) or stop (closedown).

The KATSINOV framework identifies risk as a key element in the development of technology and the evolve the market. In Table 9.6, risks are grouped into six stages of development, each with a focus on technology and organizational risk assessment. This approach is designed to ensure that the organization can manage and mitigate the challenges that arise during the development of the technology and its journey to market.

KATSINOV Stage 1: Technology Risks in Early Development

In the early stages (KATSINOV 1), the risks associated with technology became the main focus. Organizations consider the technical risks that may arise from basic research or initial experiments. This step includes identifying potential technical obstacles, such as fail achieve basic scientific principles or an inability to validate the feasibility of the technology.

In the literature, early identification of technological risks is recognized as an important step in innovation. For illustration, a study by (Emrouznejad et al., 2023) states that technology risk mitigation at an early stage requires a systematic approach, including early validation of scientific principles and the use of analytical tools to evaluate the likelihood of failure. By doing this, organizations can avoid large losses due to unsuccessful investments.

KATSINOV Stage 2: Technology and Organizational Risk Assessment

In KATSINOV 2, organizations began to assess technological risks in more detail, including considering alternative solutions if technical failures. In addition, organizational risks are also starting to be considered, especially in about investment planning. This stage emphasizes the importance of initial investment management to ensure that available funds are used effectively.

According to research by (Q. Zhang, 2022), investment planning in the early stages of technology development plays an important role in reducing organizational risks. They emphasized the importance of a strategic approach in resource allocation to support technology development, as well as identifying opportunities for partnerships to share risks.

KATSINOV Stage 3: Risk Assessment at Large Scale

At this stage, organizations conduct more in-depth technology risk assessments, including testing at scale. Organizational risk is also taken into account, especially about the estimated return on the large investment that has been spent. This stage reflects the organization's commitment to continue developing technology despite financial risks.

A study by (Egeberg et al., 2022) shows that an organization's risk assessment at this stage is crucial to maximizing investment returns. They recommend using financial models to project potential profits and identify areas that require greater attention in risk management.

KATSINOV Stage 4: Periodic Review of Organizational Risks

In KATSINOV 4, the organization's risks commence to be reviewed periodically, focusing on financial indicators. This review is designed to ensure that the large investments that have been made are delivering the expected results. Additionally, periodic risk evaluations allow organizations to identify potential problems before they become crises.

In the literature, the importance of periodic risk reviews is affirmed by Li et al. (2020), who highlight that organizations that routinely evaluate financial risk have a greater chance of achieving long-term success. They recommend the use of risk modeling tools to support strategic decisions (Chernyshova et al., 2022).

KATSINOV Stage 5: Advanced Review and Collaboration

At this stage, the organization continues to review risks periodically with a focus on financial and organizational indicators. These evaluations help organizations to decide whether to continue, change direction, or stop a particular project. These decisions are often based on an in-depth analysis of the performance of the technology and the sustainability of the market.

According to research by (Meyer & Boch Waldorff, 2022), the ability of organizations to adjust strategies based on the results of risk reviews plays an important role in the success of innovation. They suggest that organizations consider two main options, continue the project as an incremental innovation or stop it to make room for the development of more advanced technologies.

KATSINOV Stage 6: Planning for the Future

The final stage in this framework involves making strategic decisions based on the results of previous risk evaluations. Organizations can choose to continue the project, stop it, or start the development of new technology. This step requires a deep understanding of the market and technology to ensure that resources are used optimally.

The literature shows that decision-making at the final stage should be supported by robust data and in-depth analysis. For illustration, a study by (Anderson et al., 2022) emphasizes the importance of an evidence-based approach in making strategic decisions in the final stages of innovation.

The KATSINOV framework provides clear guidance for managing risks in technological development and market evolution. By following the steps outlined in Table 9.5, organizations can ensure that they have a systematic approach to identifying, evaluating, and mitigating risks. Literacy in risk management is becoming increasingly important in a dynamic and competitive business environment. Organizations that can integrate risk assessment into their strategies have a greater chance of achieving long-term success.

Tabel 9.7. KATSINOV framework Manufacture

	TECHNOLOGY DEVELOPMENT			MARKET EVOLUTION		
	KATSINOV 1	**KATSINOV 2**	**KATSINOV 3**	**KATSINOV 4**	**KATSINOV 5**	**KATSINOV 6**
MANUFACTURE	– Identified the implications (consequences or direct consequences of the findings of a scientific research) basic manufacturing. – Identified manufacturing concept. – There is a manufacturing proof of concept through analytics or laboratory experimentation.	– Identification of technology and critical components is complete. – Materials, tools and prototype testing tools, as well as personnel expertise have demonstrated the readiness of the sub system/system in a relevant production environment.	– the system design is mostly stable and proven in test and evaluation; – proven manufacturing processes and procedures on pilot scale; – carry out production at a low rate.	– Shows production at full rate and execution. – Start implementing GMP. – Start implementing standard quality assurance (SNI). – There are demands from society for the quality, security and safety of the products used.	– Implement GMP intensively. – There is a need for input (both internal and external) to management for performance improvement. – Implement quality assurance according to standards (SNI) intensively. – There is a guarantee for the quality, security and safety of products used by the public.	– There is a need for production innovation or the development of new production technologies

The manufacturing dimension in the KATSINOV framework serves as a systematic guide for integrating production processes in the stages of technological development and market evolution. Table 9.7 illustrates the development of manufacturing from the initial stage to the final stage, covering concept identification to innovation in production technology. The following explanation outlines each stage in more depth.

KATSINOV Stage 1: Identification of Basic Concepts and Manufacturing Implications

In the early stages, manufacturing begins with the identification of the basic implications of relevant scientific research findings. Manufacturing concepts are formulated based on laboratory analysis or initial experiments to prove the basic concepts. This stage is exploratory, focusing on the apply scientific principles into the prototypes that underlie the manufacturing process. The literature shows that at this stage, it is important to adopt a data-driven analytical approach to ensure the validity of the initial concept ((Lin et al., 2020).

KATSINOV Stage 2: Identification of Critical Technologies and Components

In the second stage, the focus shifts to the completion of the identification of critical technologies and components that will be used in manufacturing. The readiness of the production environment is tested through materials, tools, and prototype testing. Personnel with special expertise are involved to ensure that the sub system or system as a whole is ready for use in the relevant context. According to a study by (V. Kumar et al., 2021), the involvement of experts from this stage can improve the accuracy of predicting manufacturing success.

KATSINOV Stage 3: Design Stability and Small-Scale Production

In the third stage, the system design achieves stability, which is tested through in-depth evaluation and testing. Proven manufacturing processes and procedures are implemented on a pilot scale. Production is carried out at a low rate to validate the reliability of the system before full production. This stage is important to minimize technical risks and ensure that the procedures implemented are repeatable. Research from (Wang et al., 2024) emphasizes that design stability and thorough evaluation tests at this stage play an important role in reducing future development costs.

KATSINOV Stage 4: Full-Scale Production and Standard Implementation

The fourth stage is marked by the implementation of full production and the implementation of standards such as GMP and Indonesian National Standards (SNI). Requests from the public regarding product quality, security, and safety are starting to become a major concern. The implementation of these standards not only increases consumer confidence but also ensures

compliance with applicable regulations. A study by (J. Lee et al., 2023) shows that the effective implementation of GMP can improve operational efficiency and overall product quality.

KATSINOV Stage 5: Improving Manufacturing Performance

At this stage, GMP and SNI are implemented intensively. Input from various parties, both internal and external, is used to improve manufacturing performance. Product quality assurance, security, and safety are top priorities. This process involves continuous evaluation of production procedures to meet high standards. According to research by (Singh et al., 2020), an iterative approach to improving product quality can provide a competitive advantage in the global market.

KATSINOV Stage 6: Production Innovation

The final stage in the manufacturing dimension emphasizes the importance of innovation in the production or development of new manufacturing technologies. As market needs change, innovation in the production process becomes the main strategy to maintain competitiveness. In this context, the use of advanced technologies such as automation and predictive analytics can provide greater efficiency. Research by (Brown, 2020) highlights that production innovation can improve a corporation's adaptability to changes in market dynamics. The manufacturing dimension in the KATSINOV framework provides a holistic approach to managing and developing the production process from the conceptual stage to advanced innovation. Each stage is designed to ensure the efficiency, quality, and sustainability of the manufacturing process. By integrating international standards, input from stakeholders, and technological innovation, the corporation can achieve a sustainable competitive advantage. The current literature supports this approach as an effective strategy to deal with manufacturing challenges in the modern era.

Tabel 9.8. KATSINOV framework Investment

	TECHNOLOGY DEVELOPMENT			MARKET EVOLUTION		
	KATSINOV 1	**KATSINOV 2**	**KATSINOV 3**	**KATSINOV 4**	**KATSINOV 5**	**KATSINOV 6**
INVESTMENT	– There is a business model concept for the idea developed. – There are customer, market and competitor analysis results from the idea developed. – There is evidence that the idea developed has provided a solution for the customer.	– successfully define the terminate state of a technology product by considering all target persons, vertical markets, and/or geography; – validation of the business is carried out; – identification and validation of KPIs that indicate business success.	– Identified market potential; – Identified the acceptability of the product/service in the market	– identified the need for market expansion; – there is an increase in production capacity.	– identified the need for market expansion; – there is an increase in production capacity.	– Follow-up product/service innovations are identified based on current and future market needs and demands

Investment is one of the crucial elements in the development of technology and the evolvethe market, which is described in detail in the KATSINOV framework. Table 9.8 describes the stages of investment from KATSINOV 1 to KATSINOV 6, covering the entire cycle from conceptualization to market diversification and product innovation. The following is an in-depth description of these stages.

KATSINOV 1: Conceptualization of the Business Model

In the early stages of technological development (KATSINOV 1), the main focus was on the conceptualization of the business model. This stage involves identifying the potential of the idea developed through the analysis of customers, markets, and competitors. This is done to ensure that the idea can provide a real solution to customer needs. Literature studies show that this process requires a systematic approach to reduce the uncertainty that usually accompanies the initial development of an innovation (Teece et al., 2022). The validation of the business concept at this stage is not only the basis for further investment but also determines the potential success of the technology in the market.

KATSINOV 2: Business Validation and Definition of Terminate Result

In the second stage, KATSINOV 2, the underlying business of the technology began to be thoroughly validated. This step involves defining the final status of the technology product by considering the vertical target market, the targeted personnel, and the relevant geography. In addition, KPIs are beginning to be identified and validated as a benchmark of business success. Business validation aims to create a solid framework so that further investments can be made with minimal risk. As explained by (Christensen, 2023), this process helps companies in ensuring that the technology produced can compete in an increasingly competitive market.

KATSINOV 3: Identifying Market Potential

The KATSINOV 3 stage includes the identification of market potential as well as the level of acceptance of products or services in that market. At this stage, it is important to study market demand patterns as well as market segmentation in detail. Research by (Sawhney et al., 2017) emphasizes the importance of market segmentation analysis to support investment sustainability, especially in assessing the suitability among the products developed and consumer needs. Identification of market potential also plays a strategic role in determining investment focuses that can generate optimal economic value.

KATSINOV 4: Expand Production and Market Capacity

The fourth stage, KATSINOV 4, marks a strategic step toward market expansion and increased production capacity. The main focus at this stage is to identify the needs of market expand improve the corporation's competitiveness. In this stage, the corporation began to see new opportunities in the domestic and international markets. A study conducted by (Manotti et al., 2021) highlights that increasing production capacity must be supported by a market demand-oriented investment strategy to maintain operational efficiency.

KATSINOV 5: Production Optimization and Market Diversification

At the KATSINOV 5 stage, the main focus is on optimizing the production process to reach full capacity. In addition, investment is directed to support market diversification to expand the scope of existing products or services. In a recent study, (Shafique et al., 2023) emphasized that market diversification not only increases a corporation's revenue but also strengthens its competitive position by utilizing existing resources efficiently.

KATSINOV 6: Advanced Innovation Based on Market Needs

The final stage, KATSINOV 6, is the culmination of the evolveinvestment where the focus is directed at further innovation. These innovations are based on current and future market needs and demands. At this stage, the corporation is expected to be able to create new products or services that are not only relevant but also visionary. Research by (Pisano, 2019) states that the success of iterative innovation is highly dependent on the corporation's ability to respond to dynamic changes in market needs.

The KATSINOV framework on the investment dimension provides comprehensive guidance in managing financial and strategic resources from the conceptualization stage to advanced innovation. Through this approach, companies can ensure that every stage of investment is carried out in a measurable manner and supports the achievement of long-term goals. Relevant literature, such as those put forward by (Christensen, 2023; Teece et al., 2022), underscore the importance of business validation, market analysis, and continuous innovation to support successful investment in technology development. As such, this framework is not only relevant in the context of technology but can also be applied to various industry sectors.

The KATSINOV framework provides a holistic approach to managing and evaluating innovations, from the early stages of technology development to market evolution. By integrating seven key aspects and 124 key indicators, the framework offers a comprehensive tool for innovation developers. Thus,

the implementation of KATSINOV not only increases the efficiency of the innovation process but also maximizes the chances of success in the market.

Graphically, the relationship among the innovation life cycle which is the six levels of KATSINOV and Innovation Management which is seven key aspects where there are several main activities that are indicators of the progress of the technological innovation process are shown in Figure 9.1.

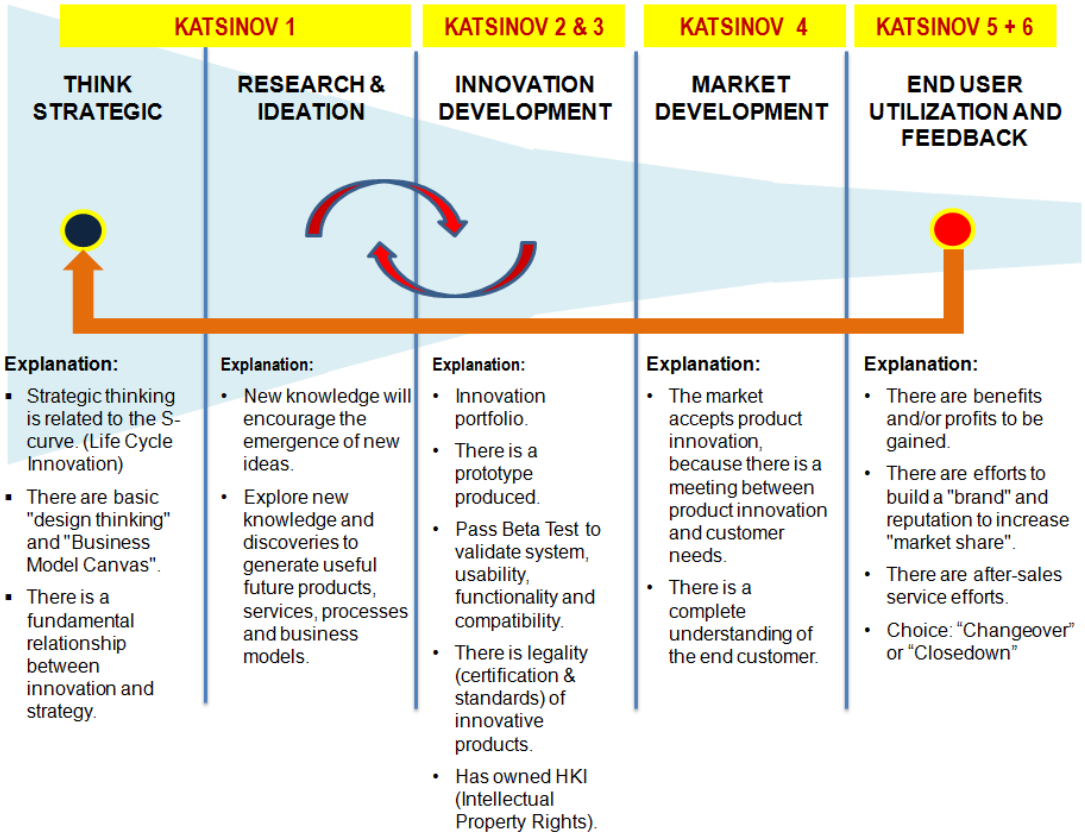

Figure 9.1. Innovation life cycle.

The KATSINOV framework is a strategic approach to managing innovation from the initial idea to implementation and evaluation of user feedback. This model consists of six stages in order: Think Strategic, Research & Ideation, Innovation Development, Market Development, to Terminate User Use and Feedback. Each stage has an important focus and interconnected elements to ensure the success of the innovation. Here is a professional breakdown of each stage in this framework:

Stage 1: Think Strategic

This stage is related to strategic planning which includes design thinking and innovation based business models. This process begins with an understanding of the S-curve in the innovation lifecycle, which helps organizations to identify

phases of technological development and potential transitions from old technologies to new technologies.

At this stage, the fundamental relationship among innovation and strategy is emphasized. The focus is on creating a solid foundation to support the next steps of innovation. The literature shows that a strong strategy-based approach, as discussed by (García-Sánchez et al., 2021), can help organizations build competitiveness through broader exploration of market opportunities.

Stage 2: Research & Ideation

In the second stage, emphasis is placed on the exploration of new ideas and the development of relevant knowledge. This new knowledge is used to produce innovative products, services, processes, or business models. With this approach, organizations can identify innovation opportunities that are relevant to the needs of the market or the latest technology.

This phase is also an important stage to encourage creativity within the team. Literature such as (Chesbrough, 2019) on open innovation emphasizes the importance of cross-functional collaboration and the use of external knowledge to encourage the birth of new ideas. This is in line with the strategy in KATSINOV 2, where organizations prepare innovations based on knowledge and in-depth exploration.

Stage 3: Innovation Development

The innovation development stage includes an innovation portfolio, where product prototypes commence to be developed and tested. Beta tests are conducted to evaluate the functionality, usability, and compatibility of the system. In addition, this stage also includes legality aspects such as certification and standards for innovative products as well as the submission of IPR.

This process is crucial to ensure the feasibility of the technology before it enters the market. Research by (Heidenreich, 2023) highlights the importance of rigorous testing and product validation during the development stage to minimize the risk of failure in the market. Thus, this phase becomes the core of the readiness of the technology to be adopted in the wider market.

Stage 4: Market Development

Once the technology or product innovation is proven to be feasible, the focus shifts to market development. This stage ensures that innovation is accepted by the market through a deep understanding of customer needs and alignment among the innovation product and the market needs. At this stage, the organization also conducts intensive communication with customers to create a comprehensive understanding of the product.

The literature shows that the success of this stage is highly dependent on the organization's ability to identify the right market segments and effective marketing strategies. According to (Shepherd & Gruber, 2021), customer involvement in the early stages of market development can increase the adoption rate of new products, thereby accelerating market penetration.

Stages 5 and 6: Terminate User Use and Feedback

The final stage in the KATSINOV framework includes use by terminate users and feedback collection. The focus is on building brand reputation and increasing market share through after-sales service. At this stage, the organization can choose to continue further innovation (changeover) or stop innovation that is no longer relevant (closedown).

In the literature, as discussed by (Köhler & Haferkamp, 2019), feedback from terminate users is a crucial component in the innovation cycle because it helps organizations improve product quality and proactively respond to market needs. With good after-sales service, organizations can strengthen customer loyalty and create a sustainable competitive advantage.

The KATSINOV framework provides a systematic approach to managing innovation, from strategic planning to implementation in the market and evaluation through user feedback. Each stage in this framework is designed to ensure that innovation not only meets the needs of technology, but is also aligned with the needs of the market and customers. Through a structured, data-driven approach, organizations can minimize risk and maximize opportunities for innovation success in the global market.

9.4. Practical Implications and Key Indicators

The Innovation Readiness Level Framework (KATSINOV) is designed to provide comprehensive guidance in managing the innovation lifecycle. One of the key advantages of this framework is the existence of 124 key indicators that cover various important aspects of the innovation process. These indicators are designed to help organizations systematically evaluate the progress of their innovations, provide insights into how successful the innovations have been, and identify areas that need further attention. With this approach, KATSINOV becomes a tool that not only drives the efficiency of the innovation process, but also increases transparency and accountability in innovation management (Jones et al., 2020).

1. The Role of Indicators in the Evaluation of the Innovation Process

   The indicators in the KATSINOV framework cover a wide range of activities that are essential for ensuring the success of innovations. These activities include prototype completion, market testing, product

certification, and risk analysis. Each indicator provides a specific picture of a specific aspect of the innovation process, allowing organizations to conduct more measurable and data-driven evaluations. For illustration, in the early stages of innovation development, indicators such as the Technology Readiness Level (TRL) are used to evaluate whether the technology developed is mature enough to move on to the next stage. TRL provides a clear framework for identifying the extent to which a technology has evolved, from basic research to practical applications. By using TRL, companies can ensure that the technology they develop has a strong scientific and technical basis before proceeding to the production stage (Markard, 2020). In addition, on the market aspect, indicators such as customer satisfaction surveys and market share analysis provide information on the extent to which innovative products are accepted by consumers. Customer satisfaction surveys, for illustration, help organizations understand user perceptions of their products, identify product strengths and weaknesses, and develop strategies to improve user experience. Meanwhile, market share analysis provides insight into the competitive position of innovative products in the market, helping organizations design more effective marketing strategies.

2. Indicators on Partnership and Organizational Aspects

   Partnerships are one of the essential elements of successful innovation, especially in an increasingly complex and interconnected business world. The indicators in the KATSINOV framework include an evaluation of the number of successful collaborations carried out by the organization and their impact on the innovation process. This collaboration can be in the form of partnerships with research institutions, universities, governments, or other companies that have relevant competencies or resources to support the development of innovations. For illustration, in the renewable energy industry, collaboration among technology companies and research institutions is often the key to success in developing technologies such as solar panels or wind turbines that are more efficient. The partnership indicators in KATSINOV allow organizations to evaluate the effectiveness of this collaboration, including its impact on the acceleration of innovation processes and product quality improvement. As such, organizations can leverage their partnership networks more strategically to support innovation success (Corallo et al., 2022). In the organizational aspect, indicators include an evaluation of the organization's internal readiness to support innovation, such as human resource capabilities, organizational structure, and innovation culture. This indicator provides insight into the extent to which organizations have

prepared themselves to manage the challenges associated with the innovation process. For illustration, in the development of electric vehicle technology, the readiness of the R&D team is one of the determining factors for success. With well-defined indicators, organizations can identify training or competency development needs to improve their team's ability to support innovation.

3. Risk and Regulatory Compliance Indicators

   Risk analysis is an important component in any innovation process, and the indicators in KATSINOV provide guidance for evaluating risks that may arise at each stage of the innovation life cycle. These indicators include the identification of technical, market, and regulatory risks, as well as the planning of appropriate mitigation strategies. For illustration, in the pharmaceutical industry, risks associated with clinical trials and regulation are often a major obstacle to the development of new drugs. By using the KATSINOV indicator, organizations can evaluate these potential risks early on and devise strategies to address them. In addition, regulatory compliance indicators provide guidance to ensure that innovative products comply with applicable standards and regulations in the target market. This compliance is essential, especially in highly regulated industries such as pharmaceuticals, healthcare technology, and automotive. For illustration, in the development of autonomous vehicle technology, regulatory compliance indicators help companies to ensure that their technology meets the safety and ethical requirements set by governments and relevant authorities (B. Santoso et al., 2020).

4. Benefits of Transparency and Accountability

   The use of well-defined indicators in the KATSINOV framework not only helps to increase the efficiency of the innovation process, but also provides benefits in transparency and accountability. With clear indicators, organizations can monitor and report on the progress of their innovations to stakeholders, including investors, business partners, and governments. This creates greater confidence in the organization's ability to manage their innovations effectively and responsibly. According to the research of (Wong et al., 2023), transparency and accountability in innovation management are becoming increasingly important in the modern era, where organizations are vital to demonstrate how they use existing resources to create added value. With the KATSINOV indicator, organizations can provide more structured and data-driven reports, which not only show their achievements but also identify challenges that need to be overcome to achieve success.

The KATSINOV framework with its 124 key indicators is a very useful tool for evaluating innovation progress and supporting more informed decision-making. With indicators that cover a variety of important aspects such as technology, markets, partnerships, and risks, KATSINOV provides comprehensive insights into the extent to which innovations have been successful and which areas need further attention. In addition to improving the efficiency and effectiveness of the innovation process, the use of the KATSINOV indicator also creates greater transparency and accountability in innovation management. With a more systematic and data-driven approach, KATSINOV helps organizations to stay competitive and adaptive in facing challenges and opportunities in a dynamic global market.

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Chapter 10
KATSINOV PHASE

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In a rapidly evolving world, technology has become a key driver in creating social, economic, and cultural change. One of the most recognizable figures in understanding this dynamic is Joseph Schumpeter. In his seminal work in 1942, Schumpeter identified three main stages in the process of penetrating new technologies into the market, invention, innovation, and diffusion. This stage not only explains the journey of a technology from idea to its implementation, but also how it affects and is influenced by market structure, consumer behavior, and the overall industry ecosystem. The discovery stage is the initial phase in which new ideas or potential technologies are first identified and developed. In this phase, research and development (R&D) plays a central role in creating a technological foundation that can be further processed. The innovation stage, as the next step, involves the practical apply the idea or technology into a product or service that has commercial value. Innovation is often influenced by factors such as market needs, resource availability, and innovative business strategies. Finally, the diffusion stage marks the spread of the technology to a wider market, where new technologies are massively adopted by consumers or organizations.

This model introduced by Schumpeter became the basis for many modern concepts, including the KATSINOV phase (study, adaptation, technology, strategy, implementation, normalization, and validation), which emphasizes the importance of a holistic approach in the development and apply technology. The KATSINOV phase encompasses the broader dimensions of the innovation process, not only limited to the technological aspects themselves, but also involves market dynamics, regulation, and sustainability. Understanding this cycle provides deep insights into how technology evolves from an idea to an integral part of everyday life. As such, this concept has become a valuable tool for academics, practitioners, and policymakers in designing effective innovation strategies to face challenges and opportunities in the ever-changing era of technology.

10.1. Basic Concepts of KATSINOV

The concept of KATSINOV covers the main stages in the technological journey from the laboratory to the market (figure 48). This process consists of two main phases, the technology development phase (KATSINOV 1 to KATSINOV 3) and the Market Evolution Phase (KATSINOV 4 to KATSINOV 6)

(Raditya Faisal Waliulu et al., 2020; Waliulu et al., 2020). This phase is designed to help the implementation of innovation strategies through appropriate transition responses, such as the timing of technology transfer to industry and the transformation from a research institute to a business organization (Wang et al., 2024). These stages include important decisions such as licensing, marketing, and innovation protection.

In the era of globalization and rapid digital transformation, technology and innovation play a key role in supporting economic growth and industrial progress. One of the concepts that underlies the process of technological transformation from the laboratory to being able to be implemented in the market is the KATSINOV model. This model covers the important stages in technological development and market evolution, which are divided into two main phases, the Technological Development Phase (KATSINOV 1 to KATSINOV 3) and the Market Evolution Phase (KATSINOV 4 to KATSINOV 6). With a systematic approach, this concept helps to simplify technology implementation strategies through proper transition processes, such as the time of technology transfer to industry and the transformation from a research institution to a business organization (Wang et al., 2024). The first phase in KATSINOV is technology development, which involves R&D activities in the laboratory. At this stage, the initial idea or invention is developed into a prototype through various scientific approaches and experiments. Researchers and engineers work together to ensure that the resulting technology can meet technical standards, performance, and market needs. These activities include technology feasibility analysis, preparation of technical specifications, and calculation of production costs. Research at this stage requires significant resource support, both in the form of funding, laboratory equipment, and collaboration among research institutions and industry (H. Chesbrough, 2012).

The next stage is the testing or validation phase of the technology. This process involves testing prototypes to ensure that the technology developed conforms to the technical specifications and established performance standards. These tests include laboratory trials, field tests, and evaluations of the technology's performance under real-world operational conditions. Validation also includes the preparation of user manuals, risk assessments, and certifications needed for the technology to be accepted by interested parties, such as certification bodies, regulators, and potential users (Scharowski et al., 2023). Success in this phase is very important because it is the basis for decision-making in proceeding to the production and commercialization stages.

The production phase marks the technological transition from laboratory-scale to mass production. At this stage, companies or industries commence to massively produce technology with the aim of meeting market demand. These activities include patent registration to protect intellectual building rights, production licensing, and meeting market needs through effective marketing strategies. The protection of intellectual building rights (IPR) is crucial to maintain the economic value of technology and prevent the practice of duplication or unauthorized imitation. In addition, product pricing, branding, and spare parts supply are also integral parts of a production strategy that aims to maximize technology adoption in the market (Teece et al., 2022). The final phase in KATSINOV is the market entry phase, in which mass-produced technologies are introduced to the terminate consumer. This stage involves marketing, distribution, and after-sales service strategies that aim to ensure that the technology can be widely and sustainably adopted. Effective marketing plays a crucial role in building market awareness, attracting consumer interest, and creating stable demand. In addition, interaction with the market also allows companies to gain valuable feedback, which can be used to make further improvements and development of the technology. At this stage, collaboration among industry, regulators, and users is key to success in supporting the overall commercialization of the technology (Pisano, 2019; Pisano & Teece, 2007).

In general, the success of the process of innovation and commercialization of technology is determined by the synergy among R&D, technology validation, mass production, and effective marketing strategies. This process is not an easy journey, but rather a long and steep road that requires commitment, resources, and collaboration across sectors. Technology transfer and commercialization involve science, law, and business, where each stage requires sound decision-making to ensure that technology can provide added value to society and industry.

According to the latest literature, the four main stages in the process of technology transfer and commercialization are invention disclosure, intellectual building rights protection, marketing, and licensing (Bei & Rothaermel, 2022). Disclosure of the invention is the first step in this process, where researchers document the results of their findings for further analysis. IPR protection, such as patents, copyrights, and trademarks, is the next step to ensure that inventions are legally protected and can provide economic benefits to their owners. The marketing stage involves promoting the technology to potential investors, industry partners, and terminate users, while licensing includes the administrative process of obtaining approval from the relevant regulators.

In the context of globalization, technology transfer and commercialization not only focus on the local market, but also take into account the potential for expansion into international markets. Cross-border collaboration, licensing agreements, and foreign investment are effective strategies in expanding the adoption of technology to the global market. Thus, the apply the KATSINOV concept and systematic commercialization strategy can support the acceleration of technology adoption, improve industrial competitiveness, and promote sustainable economic growth in the modern technological era.

By understanding the stages of KATSINOV, researchers, practitioners, and stakeholders can optimize the process of innovation and commercialization of technology to achieve the desired results (figure 10.1.). This process not only creates economic value, but also advises sustainable innovation and has a positive impact on the development of society as a whole.

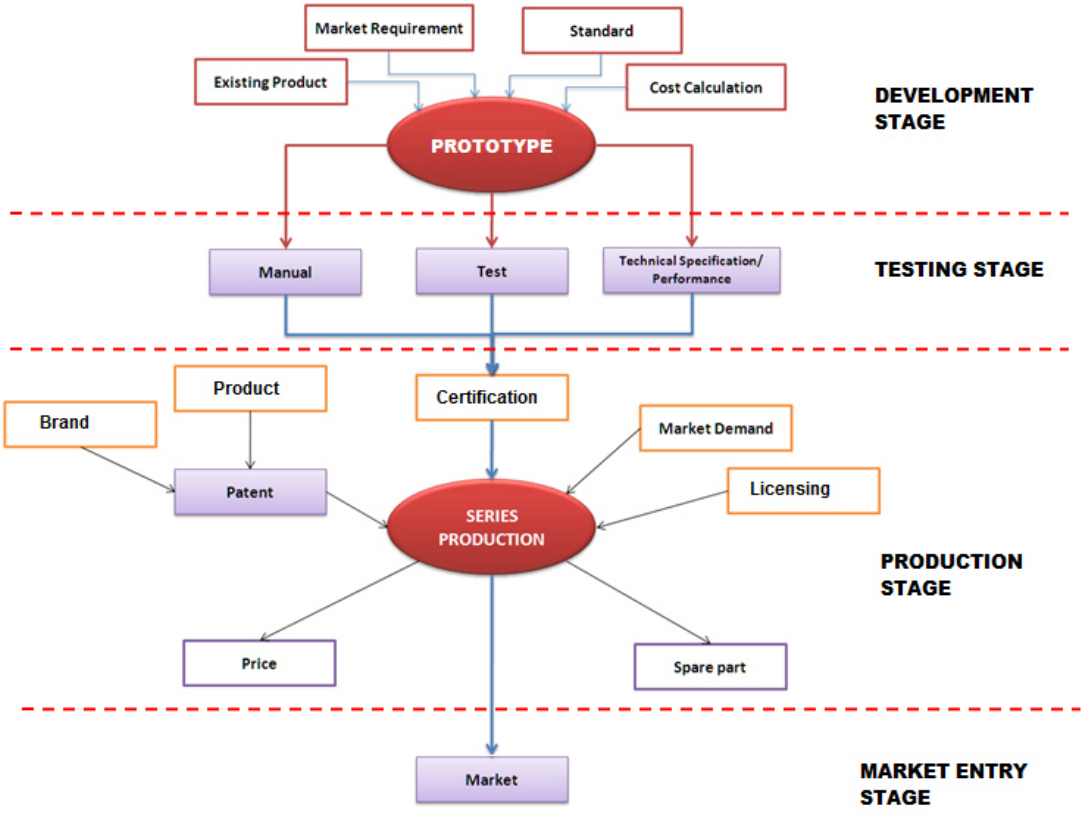

Figure 10.1. The stage of preparing technology for the market.

In the process of technological transformation from the laboratory research stage to the commercialization stage in the market, the existence of the Intermediation Institute plays a crucial role. This process includes complex stages, ranging from innovation development, testing, intellectual building rights (IPR) protection, to marketing and licensing. Intermediation institutions

such as the IPR Center, Innovation Center, Business Center, Technology Incubator, and Technology Transfer Office (TTO) are present as a bridge to ensure that the technology developed can be accepted by the industry and the market at large. Without the effective role of these institutions, innovation potential is often hampered by various constraints, such as limited funding, lack of market understanding, and administrative and legal barriers. The Intermediation Institute functions as the main facilitator in the process of technology transfer and commercialization of research results. According to a recent study published in Technological Forecasting and Social Change, technology intermediation plays an important role in improving the efficiency of technology transfer among research institutions and the industrial sector, especially in the context of a knowledge-based economy (Soh & Mara, 2017). They help identify industry needs, refine prototypes, and ensure technology readiness through validation and certification.

The IPR Center, for illustration, is responsible for legal protection of inventions so that they are not easily imitated by other parties before entering the market. This protection includes patents, trademarks, and copyrights, which aim to provide added value to innovation. With strong legal protections, researchers and industry are more confident to invest their resources in product development. On the other hand, the TTO plays the role of a liaison among universities or research institutions and commercial companies. Research by (Thomas & Awasthi, 2021) in the Journal of Technology Transfer revealed that TTO is effective in accelerating the transition of technology to the industrial sector through technology licensing mechanisms and strategic cooperation among stakeholders. The TTO also assists in the negotiation of licensing agreements and the evaluation of the potential of the technology market. The role of Intermediation Institutions can be outlined in several important stages during the process of technology commercialization:

1. Development of Invention and Validation of Technology, at this stage, institutions such as the Center for Innovation and Technology Incubator play a role in perfecting research results so that they are ready to enter the large-scale production stage. Business and technology incubators also provide support in the form of mentoring, seed funding, and access to industry networks. According to a study by (Zhang, 2022) in the journal Research Policy, technology incubators play a significant role in lowering the risk of fail technology based startups through integrated support.
2. IPR Protection and Legality, at the stage of IPR protection, the IPR Center helps ensure that the innovation has patents or other legal protections. This protection provides legal certainty for researchers and allows innovations to be rewarded according to the economic value they create.

3. Marketing and Market Needs Identification, Consultant agencies and Business Centers play a role in facilitating market analysis and technology marketing. They help innovators understand market needs, identify potential customers, and develop effective business strategies. Research by (Ek & Svensson, 2022) in the journal Innovation: Management, Policy & Practice confirms that the involvement of consulting institutions increases the competitiveness of new technologies in the market through a customer needs-based approach.
4. Licensing and commercialization of technology, this stage involves the licensing process and cooperation with the industry through a technology licensing mechanism. The licensing company became a strategic joint venturer in large-scale production and technology distribution. The Intermediary Agency ensures that the licensing contract made is fair and beneficial to both parties.

Challenges in the role of Intermediation Institutions, although the role of Intermediation Institutions is very important, there are some challenges that need to be overcome. These challenges include limited funding, lack of synergy among research institutions and industry, and lack of technological readiness to meet market standards. Research by (X. Li et al., 2023) in Science and Public Policy shows that strengthening collaboration among academia, industry, and government is the key to the success of a sustainable innovation ecosystem. In addition, government policies are needed that support the existence of the Intermediation Institution so that it can operate optimally. Clear regulations and financial incentives such as research grants and tax exemptions can accelerate the process of commercializing innovation.

In an effort to transform technology from laboratory research to the market, the role of Intermediation Institutions such as the IPR Center, Innovation Center, Technology Incubator, and TTO is very crucial. These institutions help ensure technology readiness, legal protection, and support marketing and licensing processes. Through structured support and strong collaboration, the potential for innovation can be realized into products with high economic value and can compete in the global market. Existing challenges must be overcome through synergy among researchers, industry, and the government, so that a sustainable innovation ecosystem can be achieved.

In the process of introducing new technologies to the market, there are often significant barriers to adoption among consumers in the initial market and consumers in the real market. This obstacle occurs due to the differences in the characteristics and ways of thinking of the two groups. The theory of

innovation diffusion, first popularized by Everett Rogers in 1964 and expanded on in his book "Diffusion of Innovations" (Dearing, 2021; P. Yu, 2022) in the 1983 revised edition, provides an in-depth understanding of the process of accepting innovation in society. According to Rogers, innovation diffusion is the process when an innovation is communicated through various communication channels within a certain period among members of a social system. This theory provides insight into technology adoption patterns as well as the factors that affect the acceleration or slowdown of technology adoption by the market.

In Innovation Diffusion Theory by Everett Rogers, Rogers divides the process of innovation diffusion into four main elements, the innovation itself, communication channels, time, and social systems. These elements are interrelated to determine the extent to which a technology can be adopted by society. Rogers also divides consumers into several categories based on their speed of adoption of new technologies, namely: Innovators, Early Adopters, Early Majority, Late Majority, and Laggards. Consumers in the early market, which is made up of Innovators and Early Adopters, have visionary characteristics. They tend to be enthusiastic about new technology, have better financial capabilities, and dare to take risks. Meanwhile, consumers in the real market, which fall into the Early Majority and Late Majority categories, are more pragmatic and conservative. They tend to judge a technology based on its reliability, practical benefits, as well as evidence of its success in previous markets. Recent research by (Dedehayir et al., 2017, 2019, 2021) the differences among these two groups pose a major challenge in bridging technology adoption in the initial market toward the wider market. This is known as the phenomenon of "gap" or chasm which is described in the concept of Geoffrey Moore in his book "Crossing the Chasm".

In expanding Rogers' theory, (A. Moore, 2014) explained that among the Early Adopters and Early Majority groups there is a significant gap or gap. Early Adopters are visionary and focus on the potential of new technologies, while the Early Majority are more pragmatic and only interested in technologies that have proven useful and reliable. The process of crossing this abyss is very important because technologies that fail to get adoption from the Early Majority have the potential to experience commercialization failure. A recent study by (Fang et al., 2023) shows that a marketing approach tailored to the characteristics of each consumer group can accelerate the transition from the initial market to the real market. This strategy includes increasing evidence of technology success through case studies, user testimonials, and an educational approach that focuses on practical benefits.

Rogers in Diffusion of Innovations also identifies five main factors that affect the adoption rate of an innovation, namely: Relative Advantage: The extent to which a new technology provides more advantages than the old one. Compatibility: The suitability of new technologies to the values, experience, and needs of potential users. Complexity: The level of difficulty in understanding and using new technologies. Trialability: The ease of the technology to test or try before adoption. Observability: The extent to which the benefits of the new technology can be seen by others. Research by (Talwar et al., 2023) found that relative advantage and observability are the two most dominant factors in driving technology adoption in the pragmatic market. Pragmatic consumers tend to adopt technology only if the benefits are clear and proven through concrete evidence.

To bridge the gap among visionary consumers in the initial market and pragmatic consumers in the real market, several strategies can be applied: Technology Value Demonstration: Provide case studies, user testimonials, and test results of the technology to prove its benefits. Simplification of Complexity: The design of the technology that is easier to use and more intuitive will accelerate adoption in real markets. Education and Training Programs: Increasing consumer understanding through educational programs on how to use and benefit technology. Segment-Based Marketing Strategy: Identifying the specific needs of each consumer group and tailoring marketing strategies. Research by (Rana, 2022) in the journal Information Systems Frontiers states that an educational approach that focuses on the use of technology in daily life has proven to be effective in increasing adoption among the pragmatic majority. Differences in characteristics among visionary consumers in the early market and pragmatic consumers in the real market are often a major obstacle to the adoption of new technologies. The diffusion theory of innovation presented by Everett Rogers provides a clear framework for understanding this process. The chasm phenomenon described by Geoffrey Moore further emphasizes the importance of special strategies to bridge these differences. By implementing evidence-based strategies, technology simplification, and proper education, barriers to technology adoption can be overcome. Thus, the new technology will not only be accepted by the initial market but can also achieve success in the real market.

The process of communicating new technology to the market or known as technological diffusion is an important step in ensuring that innovation can be accepted by society and industry. Technology diffusion aims to introduce, replace, or update technologies that are already in the market. However, the development of technology and modern social systems has made this process more complex and no longer linear. The transformation from technological

diffusion to innovation networks occurs in response to the increasing level of interaction among various actors in the system. This allows the creation of a fit among technological innovations and user needs, while increasing added value in their application. According to Everett Rogers in his theory of Diffusion of Innovations (Fèvres, 2012; Robinson, 2009), the process of diffusion is an effort to spread innovation through various communication channels within a certain period among members of a social system. In this classic model, technology diffusion is generally described as a linear flow, where the technology is developed, produced, and then adopted by the user. This pattern involves four main elements, innovation, communication channels, time, and social systems. However, with the development of digital technology and the complexity of the global economic system, this Diffusion Pattern has evolved to become more interactive and connected. Recent research shows that the diffusion of modern technology is more dynamic and networked. According to (Secundo et al., 2020) in the journal Technological Forecasting and Social Change, innovation networks allow for higher interaction among technology developers, governments, users, and other parties in the technology adoption process. This creates an environment that is more adaptive and responsive to changing market needs.

The diffusion of technology that was initially linear has now transformed into a network of innovations as a result of increased interaction among actors in the system. In the innovation network, the diffusion process no longer involves just one-way communication from the technology developer to the market. Instead, technology and innovation are developed collaboratively through iterative and participatory processes. This means that innovation does not stand alone but is closely related to the ecosystem that supports it, from research, development, implementation, to adoption by users. A study by (Suominen, 2018) shows that in innovation networks, actors such as industry, research institutions, governments, and users have an equally important role in determining the success of technology diffusion. With this collaboration, innovation can more quickly adapt to market needs, thereby reducing barriers to adoption. The innovation network system also allows for direct feedback from users to technology developers. This process is known as co-creation, where users not only become recipients of the technology but also contribute to its development. This accelerates the diffusion of technology because the resulting technology becomes more relevant and by market needs.

In the transformation toward an innovation network, the pattern of technological diffusion has also developed. Different types of diffusion

patterns determine the mechanism or direction of the spread of technology and innovation. Some of the dominant technology diffusion patterns include:

1. S-Curve Diffusion Pattern, this pattern describes the rate of technology adoption that starts slowly, then experiences significant acceleration, and finally stabilizes when the technology has reached a level of saturation.
2. Hierarchical Diffusion Pattern, in this pattern, technology spreads from innovation centers such as research institutes or large technology companies to a wider group of users. This pattern occurs a lot in complex technologies that require specific infrastructure support, such as industry 4.0 technology and artificial intelligence (AI).
3. Networked Diffusion Pattern, this pattern describes diffusion that occurs through direct interaction among various actors in the innovation system. This pattern is characterized by a high level of collaboration, where technology is developed together through various research and innovation networks.

In an innovation network system, the main goal of the technological diffusion process is to create added value for all actors in the system. This added value can be in the form of increased efficiency, reduced production costs, increased competitiveness, and user empowerment. Successful technology diffusion also promotes economic growth and sustainable development through the apply environmentally friendly technologies and social innovation. Research by (W. Yu et al., 2023) in the *Asian Business and Management* shows that the apply environmentally friendly technology through an innovation network approach can improve industrial sustainability and create long-term added value. The transformation from technology diffusion to innovation networks reflects a significant shift in the way new technologies are developed, communicated, and adopted by the market. This process is no longer linear but rather more complex and networked, where the interaction among various actors plays a crucial role in determining the success of technological diffusion. Through networked diffusion patterns, innovations can more quickly adapt to user needs, thereby increasing the relevance and added value of the technology. Thus, an innovation network-based approach not only advises the acceleration of technology adoption but also supports sustainable and inclusive economic development.

10.2. Stages of Technology Development

In the world of technological innovation, product development and implementation require systematic stages that are measured with certain measuring tools. One of the evaluation methods used is KATSINOV—a

framework that divides the innovation process into three main milestones. Each milestone has an important role in technology validation, system testing, and market competition. These milestones aim to ensure innovation does not just stop in the laboratory but can be implemented in real terms in meeting market needs. The KATSINOV diagram as seen in Figure 49 provides a clear mapping of the stages of technological development from start to finish.

1. Milestone A: technology development and validation

   Milestone A is the initial stage in the KATSINOV framework, which focuses on the development and validation of technological components. In this phase, the main focus is on creating and refining alpha prototypes equivalent to Technology Readiness Level (TRL) 6. TRL 6 indicates that the technology has gone through the validation stage in a simulation or laboratory environment that is close to real conditions. At this stage, the aspects of Scientific Feasibility (SF) and Engineering Feasibility (EF) are the main determinants of the success of the prototype. Technology validation at milestone A includes a series of trials to ensure the basic functions of the system run optimally. One of the major challenges in this phase is ensuring the stability of the technology's performance under varying operational conditions. As mentioned by (Shin et al., 2022), technology validation requires an iterative approach to reduce the risk of uncertainty in the early development stages. Therefore, collaboration among researchers, engineers, and industry practitioners is indispensable to accelerate prototype development. In addition, in the context of technological innovation, technical readiness in the early stages is often faced with limited funding. Several recent studies suggest the apply collaborative funding or support from government agencies to encourage the sustainability of early-stage research (Mun et al., 2023).

2. Milestone B: Technology Completion and Transition Through the Darwinian Sea

   Milestone B marks the completion of the technology with tangible evidence that the system has functioned as expected through field testing. In this phase, the technology reaches TRL 7, which indicates the readiness of the system to be implemented in a real environment. Milestone B is also often called a challenging transition phase due to a phenomenon known as the Darwinian Sea. The Darwin Sea illustrates the struggle to turn scientific findings into innovations that have real economic value. At this point, many innovations fail to proceed to the mass production stage due to low market acceptance or difficulties in integrating the technology with existing systems. According to recent research from (Christensen, 2023), the biggest obstacle in this phase is the lack of business model clarity and

mature market analysis. Strategies that can be implemented to meet these challenges include:

- collaborative approach with industry: Engaging stakeholders from the early stages of development to ensure the technology is relevant to market needs;
- large-scale functional prototypes: Provide prototypes that are ready to be tested under real conditions to attract investors and business partners;
- comprehensive market research: Identify potential market segments and accurately estimate the scale of technology adoption.

3. Milestone C: Market Competition and the Phenomenon of Saturation

   Milestone C is the phase where technology enters the market through the Market Introduction (IP) and Full Rate Production (PKP) processes. Success at this stage depends on how well the innovation can overcome the market gap and face competitive competition. Products that successfully escape this abyss will enter a growth phase, where the adoption of technology by the market is increasingly widespread. However, every innovative product has a sustainability deadline, which is characterized by a situation of market saturation. This phenomenon occurs when the demand for products reaches the maximum point, so the business growth space becomes limited. For illustration, in a study conducted by (Alqarni et al., 2022), radical innovation is the main solution in dealing with market saturation. This emphasizes the importance of continuous innovation to maintain competitiveness. In this phase, the decide the Advanced Innovation Decision (KIL) is crucial. KIL leads to strategies to develop existing products or create new innovations that are more relevant to current market needs. An approach that is often suggested is the implementation of open innovation, where companies collaborate with external parties to create innovative solutions that are faster and more effective.

The KATSINOV framework provides a systematic approach to the development and implementation of technologies from the early stages to the stage of market competition. The milestones comprising phases A, B, and C chart the innovation journey, from technology validation to endeavors to maintain competitiveness in saturated market conditions. Each milestone has unique challenges that require specific strategies to overcome, such as addressing the Darwinian Sea through cross-sector collaboration and confronting market saturation with radical innovations. Recent studies have confirmed that the success of technological innovation depends on a holistic

approach involving research, technical validation, market readiness, and policy and funding support. By effectively implementing the KATSINOV framework, technology can be developed sustainably and have a significant positive impact on society.

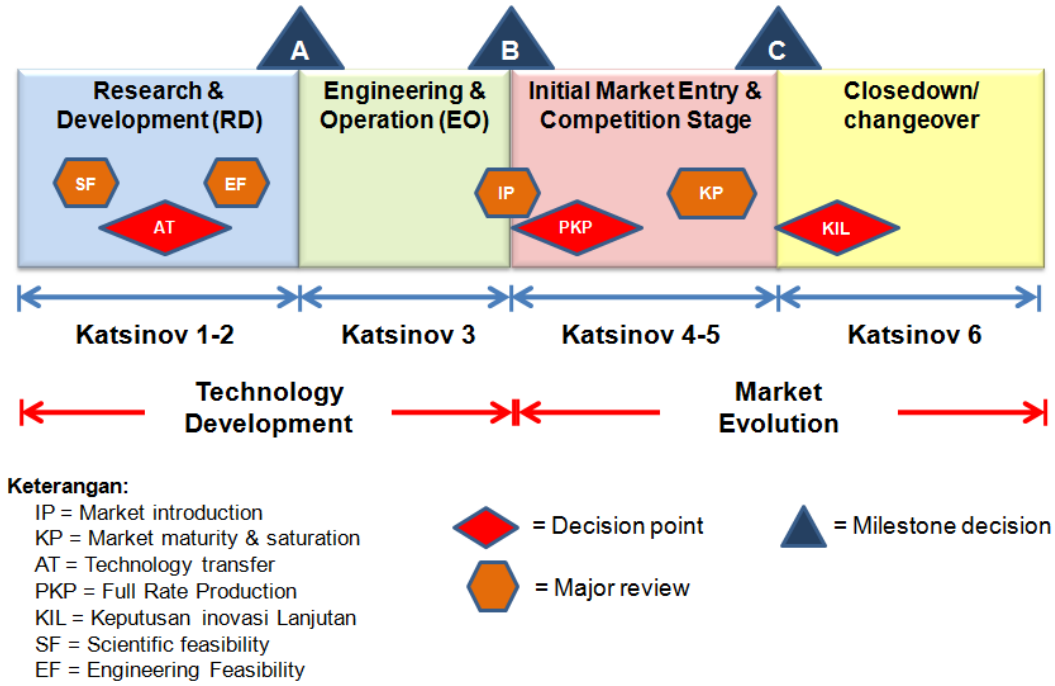

Figure 10.2. Phase diagram and milestones in KATSINOV.

Milestones A and B are the Technology Development Phases, while Milestone C is the Market Evolution Phase. KATSINOV requires several decision points (Figure 10.2), namely decision points for implementing technology transfer to industry, full-capacity production, and decisions on sustainable innovation.

10.3. Market Evolution Phase

Technological developments and innovations play an important role in facing competitive challenges in the modern industrial era. The diagram of technological readiness and innovation readiness (Figure 10.3.) illustrates the relationship among the stages of technology developed within the framework of the TRL and their implementation at the commercial level through the KATSINOV stage. Technology readiness (TRL) is a parameter that indicates the maturity of technology on a test scale from the basic stage to ready for business use. Meanwhile, the readiness to innovate through KATSINOV's milestones includes validation of commercial value, competitiveness in the market, and the corporation's ability to re-innovate or close products when

saturation occurs. In this phase, the apply the technology is not only tested on a technical scale but also in real market scenarios. Phenomena such as market chaos, commercial decline, and changeover or closedown require the right managerial strategy and business innovation. (Rogers, 2019) states that innovation can only survive if companies are able to respond to market dynamics through a flexible business model approach and continuous innovation.

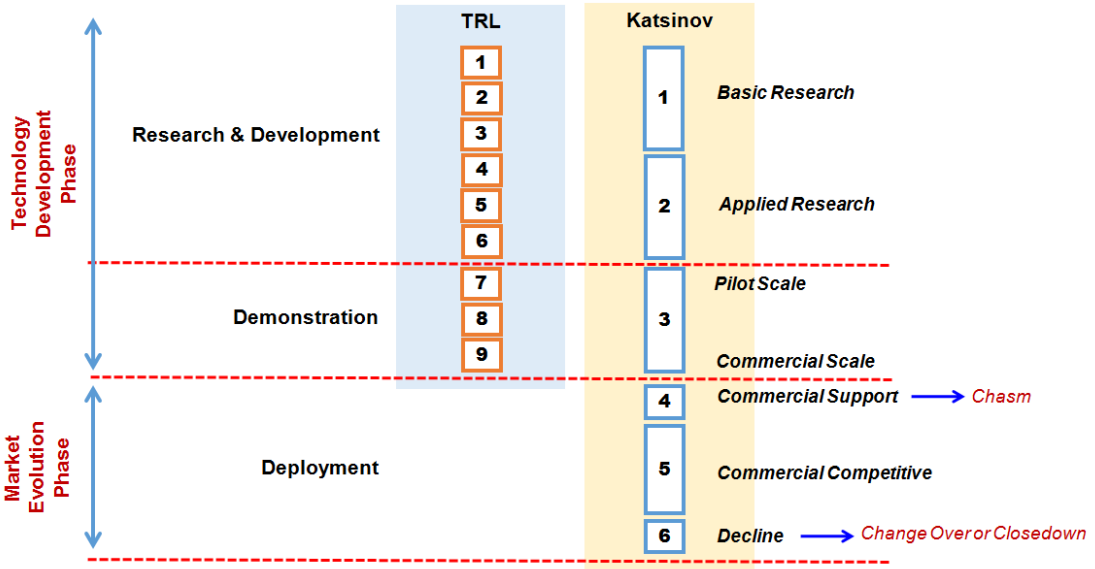

Figure 10.3. The relationship among technological readiness and innovation readiness.

The concept of TRL consists of nine levels that map technological development from basic research (TRL 1–3) to the implementation of technology at full operational scale (TRL 9). TRL helps validate technology readiness in laboratory testing, simulation, and real environments. On the other hand, KATSINOV's framework adds an innovation readiness perspective from the commercial aspect. KATSINOV divides innovation readiness into six milestones, namely: Basic Research: Development of basic ideas and principles of technology. Applied Research: Test concepts in a controlled environment. Pilot Scale: Small-scale testing to get close to real conditions. Commercial Support: Initial commercial support for market validation. Commercial Competitive: Implementation of technology in a competitive market. Decline: A stage of market decline, in which the technology faces the risk of becoming obsolescent and must be re-innovated or discontinued.

The integration of TRL and KATSINOV shows that technological readiness is only the starting point in the innovation process. Mature

technology must go through market validation and meet the competitive aspect. Challenges such as market chasm often arise in the transition from the demonstration phase (TRL 6–7) to the commercial implementation phase (TRL 8–9). A study conducted by (Christensen, 2023) shows that technological innovations often fail in this phase due to a lack of understanding of market needs and unpreparedness in mitigating business risks.

At the 4th and 5th Katsinov milestones, the technology began to be tested on a commercial scale with market support. However, a common challenge is the market chasm phenomenon, which is the gap among the adoption of technology by early adopters and wider acceptance by the market. (A. Moore, 2014) mentions that companies are often trapped in the market chasm due to the lack of a clear marketing strategy and the absence of validation of real customer needs. The phenomenon of market decline or decline occurs when technology reaches market saturation. At this point, innovation is no longer able to meet customer expectations or loose competition with other more sophisticated products. (Cucculelli & Peruzzi, 2020) states that technological innovations have a limited life cycle. Therefore, companies must implement a changeover or closedown strategy if they are unable to update the value of their products. A study from (Engez & Aarikka-Stenroos, 2022) emphasizes the importance of radical innovation in dealing with market saturation. Radical innovation can help companies reinvent new markets or disrupt existing technologies. For illustration, technology companies such as Tesla have succeeded in disrupting the automotive market by presenting electric vehicles as a solution to conventional technology.

To address the challenges of transitioning from technology readiness to innovation readiness, companies need to implement several key strategies:

1. Market validation From the Beginning, the market-driven innovation approach prioritizes understanding market needs before technology is further developed.
2. Collaboration with the Innovation Ecosystem, collaboration among companies, universities, and research institutions can accelerate technology development and expand market access. This approach is known as open innovation, where internal and external resources are used simultaneously to create innovative solutions.
3. Business model flexibility, an adaptive business model allows companies to re-innovate in the face of market saturation. A study from (H. W. Chesbrough, 2019) shows that companies that are able to change their business models tend to be more successful in maintaining competitiveness.

4. Sustainable and Radical Innovation, companies must continue to innovate continuously to improve existing technologies. In addition, radical innovation is needed to create new products that are able to disrupt the conventional market.

The relationship among technological readiness and innovation readiness provides a comprehensive understanding of the stages of technological development from basic research to commercial implementation. The TRL and Katsinov diagrams show that mature technologies do not always succeed in the market if they do not go through proper validation and adaptation. Challenges such as market chaos and market saturation require a continuous innovation strategy, business model flexibility, and an open innovation approach. By implementing this strategy, companies can bridge the technology and innovation gap and face increasingly competitive market dynamics. Recent studies show that the success of technology in the market is determined by the synergy among technical readiness and readiness for innovation that is aligned with the needs of the market and customers.

1. Phase 1: Technology Development, This phase focuses on technological readiness which includes two main stages, namely: R&D (TRL 1–7), at this stage, technology goes through a research process that involves: Basic Research (TRL 1–3), focuses on the development of ideas, theories, and basic principles of technology to understand the scientific phenomena behind innovation. Applied Research (TRL 4–6), testing of technology concepts on a laboratory and simulation scale to prove technical feasibility. Technology Demonstration (TRL 7), prototyping in a more realistic operational environment as a validation step toward a real application. Large-Scale Demonstration and Commercialization (TRL 7–9). In this phase, the technology is tested on a pilot scale and fully implemented for commercialization: Pilot Scale (TRL 7–8), the technology is tested in a real but limited environment, to see how it performs in a practical context. Commercial Scale (TRL 9), the technology is ready to be applied in a fully commercial production or environment. The success of this stage signifies the readiness of the technology to enter the market. Thus, the technology development phase ensures that the technology is technically mature before it is marketed. Without adequate technological readiness, innovation will be difficult to survive in the next phase.
2. Phase 2: Market Evolution, this phase emphasizes the apply technology in market dynamics, where technology is tested in a commercial and competitive environment: Commercial Support, technology begins to be

applied on a limited basis to gather support from early adopters. This stage is an important bridge to prove the value of technology. Commercial Competitive, technology enters a competitive market and faces direct competition with other technologies or products. In this phase, companies are vital to maintain competitive advantage through: Optimization of products and services in the form of adjusting marketing strategies according to customer needs. Continuous technological improvement in the form of market decline and re-innovation. Over time, technology will face market saturation or the emergence of more advanced replacement technologies. At this point, several strategies can be taken: Re-Innovation: Redeveloping technology with improvements or new features to create a competitive advantage. Opening New Markets: Exploring new market segments or expanding the scope of technology to global markets. Business Model Transformation: Adjusting business models to be more relevant to market dynamics. Reinvention in the Market: Disrupting the market through radical innovations that are able to recreate product value. Technology Shutdown: If technology is considered obsolete and unable to compete, then innovation needs to be stopped and replaced by new innovation objects. This phase of market evolution demands the flexibility of companies in responding to market changes, consumer behavior, and industry competition.

Ideally, the technology produced through R&D should have a real impact on society and support the national industrial structure. This can only be achieved if there is: Full Economy, in a state of balance among: Market Aspects: Validation of market needs, people's purchasing power, and readiness for technology adoption. Competitive Industry Behavior Aspects: Companies and industries must be able to compete through efficiency, continuous innovation, and adaptation to new technologies. Industrial Research and Implementation Connectivity, basic and applied research must be aligned with industry needs to ensure the technology can be effectively adopted. Collaboration among government, academia, and industry is crucial in this regard. Economic Infrastructure Development, infrastructure support such as research funding, incentive policies, and innovation ecosystems are key in advancing technological readiness toward market adoption. The two phases in the innovation process—technology development and market evolution—show that the success of a technology depends not only on technical readiness but also on the strategy of its implementation in the market. The integration of technological readiness and innovation readiness is the main

key to building a sustainable and highly competitive industry at the national and global levels.

10.4. Challenges in the Innovation Process

The innovation process is one of the key elements in supporting economic growth and competitiveness of a country or organization. However, the innovation journey is not something smooth and easy. In reality, innovation is faced with various challenges that include technical, economic, and social aspects. Factors such as market resistance, strict regulation, resource constraints, and innovation ecosystem imbalances are often major obstacles. Therefore, a strategic approach, proactive policy support, and collaboration among the public and private sectors are important prerequisites to ensure the success of innovation. The technical aspect is the initial challenge in the innovation development process. In the early stages of development, problems arise related to technological uncertainty and the inability to achieve optimal technological readiness. This is often due to limitations in R&D, the availability of experts, and inadequate supporting infrastructure. According to a study by (Kumar et al., 2021), the solution to this technical challenge is long-term investment in R&D and the improvement of the competencies of the human resources involved. Support in the form of the development of joint research centers and innovation laboratories can be a solution to minimize technical obstacles. In addition, technology testing through an iterative approach is essential to ensure that innovations can be implemented successfully. (Zhang, 2022) mentioned that technology prototypes need to go through several stages of testing to improve product quality and reduce the risk of failure in the market. Therefore, companies need to adopt a structured hearing and mistake approach and utilize simulation technology or AI in the technical validation process.

From an economic perspective, limited financial resources are often the main obstacle to the sustainability of innovation. The innovation process requires significant funding, especially in the early stages of development which have a high level of risk of failure. (Zotov & Abdikeev, 2021) explained that innovation funding from the public and private sectors is a key factor in determining the success of innovation. Governments have an important role to play in creating incentive schemes, such as research grants, innovation subsidies, and tax breaks for companies that invest in R&D. In addition, economic challenges are also related to market potential and return on investment (ROI). Market resistance to new products or services is often a challenge, especially if the product is considered to not meet the needs or added value expected by consumers. According to research by (Albats et al.,

2023), successful innovation requires an open innovation approach that involves customer engagement from the early development stage. With this approach, companies can ensure that innovative products have strong market relevance and are able to attract consumer interest.

From a social perspective, resistance to change often arises in society, especially if innovation is perceived as disrupting habits or causing social impacts that are not fully understood. This challenge often occurs in disruptive innovations, such as fintech technology, electric vehicles, or the apply AI-based technology. According to (Spandagos et al., 2022), public acceptance of innovation is highly dependent on effective communication and increased technological literacy among the public. In addition to social resistance, strict regulations are often an obstacle in accelerating the adoption of innovation. Regulation is necessary to ensure product safety and sustainability, but lengthy bureaucratic processes can hinder the speed of innovation development. The government needs to balance among community protection and support for innovation development. According to a study by (Russo & Pavone, 2021), flexible and evidence-based policies can accelerate the adoption of innovation while safeguarding the public interest.

Collaboration among the public and private sectors has a crucial role in facing innovation challenges. The public sector plays a role in providing supportive policies, financial incentives, and supporting infrastructure, while the private sector is responsible for technology implementation, R&D investment, and product distribution in the market. Collaborations can also involve research institutions, universities, and non-governmental organizations to enrich the innovation ecosystem. Platforms such as public-private partnerships (PPP) (Boiarko et al., 2021; Brogaard, 2021) are one of the mechanisms that have proven effective in overcoming resource limitations and encouraging sustainable technology development. The innovation process is faced with complex challenges, covering technical, economic, and social aspects. Market resistance, limited financial resources, and strict regulations require strategic and coordinated solutions. Proactive policy support, collaboration among the public and private sectors, and active stakeholder engagement can help overcome these barriers. With a holistic approach that involves all elements in the innovation ecosystem, innovation success will be easier to achieve and have a positive impact on economic growth and community welfare.

The process of technology diffusion in the modern era is becoming increasingly complex along with the high interaction among market players, technology, and innovation ecosystems. Technology diffusion is no longer just a linear process where innovation moves from researchers to terminate users,

but rather involves a dynamic network of innovations. This network allows for rapid adaptation to changing market needs, while facilitating the technology adoption process by various consumer segments, both visionary and pragmatic. In this context, strategic approaches such as KATSINOV play an important role in guiding the technological journey from the research phase to commercialization.

The diffusion of technology is increasingly influenced by changing market dynamics and increasingly fierce global competition. The interaction among technology developers, stakeholders, and consumers creates a complex innovation ecosystem, where the process of technology adoption depends not only on technical excellence but also on social, economic, and communication factors. According to (Rogers, 2019), technology diffusion requires a flexible approach because different market segments will have varying levels of technology readiness. Visionary consumers tend to be quicker to adopt new technologies, while pragmatic consumers need assurance of added value and reliability of technology before full adoption. In addition, the complexity of technology diffusion is also influenced by network phenomena or network effects, where the success of technology is largely determined by how widely the technology is adopted in the market ecosystem. (Emara & Zecheru, 2024) emphasize the importance of understanding these dynamics, especially for technologies that are related to industry standards or a specific digital ecosystem. As such, technology developers must be able to identify strategic markets to achieve optimal adoption scale through effective marketing approaches and targeted communication.

The success of technology diffusion is highly dependent on the communication strategies used to reach visionary and pragmatic consumers. Visionary consumers tend to be more open to technological innovations that provide new solutions, while pragmatic consumers require a more evidence-based approach and clear economic benefits. According to research conducted by (Soyadi, 2020), an effective communication approach must consider the emotional and functional needs of various consumer segments. Clear communication regarding the advantages of technology, success case studies, and testimonials from early adopters can increase market confidence and speed up the adoption process..

The KATSINOV concept offers a systematic approach to accelerating the technological journey from the research stage to commercialization. KATSINOV emphasized the importance of collaboration among various stakeholders, including researchers, industry, government, and intermediary institutions. According to research by (Bogers et al., 2022), collaborative approaches such as open innovation allow technology to evolve faster

through the use of shared resources and the active involvement of all parties in the innovation ecosystem. KATSINOV also highlighted the importance of understanding critical stages in the innovation process, such as technology validation, prototype testing, and commercialization strategies. According to (Shekapure et al., 2024), intermediary institutions such as technology incubators, research centers, and funding institutions play an important role in overcoming obstacles at this critical stage. Intermediary institutions serve as a liaison among researchers and the market, and provide financial, technical, and networking support to accelerate technology adoption. In the implementation of KATSINOV, it is also important to pay attention to the market readiness and production capacity of the developed technology. A study by (Jansen-Kosterink et al., 2022; Santos et al., 2023) shows that TRL and manufacturing readiness assessment are important steps in ensuring that technology can be successfully commercialized. With this approach, the resulting technology can be adopted more quickly and provide significant added value to the economy and society.

Effective technology diffusion not only accelerates technology adoption, but also creates added value in various aspects, such as increased productivity, cost efficiency, and industrial competitiveness. Well-adopted technologies can reduce the technology gap among developed and developing countries, as well as encourage digital inclusion. According to research from (C. Li et al., 2023), digital technologies such as the Internet of Things (IoT) and AI have great potential to create economic value through increased efficiency in industrial supply chains. With the apply the KATSINOV concept, the added value of technological innovation can be further maximized through the integration among technology, markets, and innovation ecosystems. Collaboration among parties is key to ensuring that the resulting technology can provide real solutions to global and local challenges, such as climate change, digital transformation, and improving people's welfare. Technological diffusion in the era of globalization faces complex challenges involving market dynamics, consumer segmentation, and technological readiness. In addressing this complexity, approaches like KATSINOV play a crucial role in guiding the innovation process from the research stage to commercialization. By leveraging effective communication strategies, multi-stakeholder collaboration, and the support of intermediary institutions, technology can be adopted more quickly and provide significant added value. The success of technological diffusion depends not only on technical excellence, but also on market readiness and its ability to provide relevant and sustainable solutions.

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Chapter 11
KATSINOV ASPECTS

Satmintareja, Suharto Ngudiwaluyo

In the modern era, the implementation of innovation is one of the keys to the success of organizations in facing global challenges. One of the important frameworks for analyzing and managing the implementation of innovations is the aspect of KATSINOV, which includes the components of technology, markets, organizations, partnerships, risks, manufacturing, and investment. These aspects are not only relevant to ensure the successful adoption of innovations, but also play a role in improving the competitiveness of organizations in various sectors.

The technological aspect refers to an organization's ability to develop, adopt, and integrate new technologies in its business processes. Technology not only drives operational efficiency but also becomes the foundation for creating innovative products and services. According to research by (Fathoni et al., 2020), the successful implementation of the Electronic-Based Government System (SPBE) in West Java shows that the development of a planned technology architecture can eliminate strategic gaps in organizational operations. The market is an important opponent that determines the acceptance of innovation by consumers. A deep understanding of market needs, preferences, and behaviors is key to creating added value through innovation. A study by (Ashari, 2020) shows that electronic application-based staffing service innovations increase user satisfaction by providing solutions that are relevant to market needs. An organization's readiness to adopt innovation is highly dependent on the work culture, structure, and capacity of human resources. Organizations with a culture that supports collaboration and learning tend to be more successful in implementing innovation.

Collaboration with strategic partners helps expand innovation capacity, both through knowledge exchange and risk sharing. A study by (Susilawati et al., 2021) shows that partnerships among farmers, governments, and community organizations have succeeded in increasing the adoption of agricultural technologies, such as soil fertility detection tools, which have a direct impact on productivity and efficiency. Innovation always involves a certain level of risk, be it financial, technical, or market risk. Effective risk management helps mitigate potential failures. Research by (Tanaamah et al., 2021) highlights that visionary leadership plays an important role in managing the risks of information technology governance implementation in the public sector, thereby increasing project success. Efficient and flexible manufacturing processes are a vital aspect in realizing product innovation.

Optimizing technology in the manufacturing process can lower costs and improve quality. Research related to the implementation of digitalization of STEM-based learning in Semarang shows how the efficiency of the process produces better results, with an increase in teachers' understanding of learning technology by 90% after training (Widiyatmoko et al., 2022).

The investment aspect includes the allocation of adequate financial resources to support research, development, and implementation of innovations. Targeted investment allows for accelerated technology adoption and mitigation of implementation barriers. In this context, a study by (Kandori, 2022) shows that investment in human resource training and development has a direct impact on organizational performance. The KATSINOV aspect provides a holistic guide to understanding and managing the implementation of innovation. By integrating technology, understanding the market, strengthening the organization, building strategic partnerships, managing risk, improving manufacturing, and allocating the right investments, organizations can maximize the potential for innovation to achieve long-term success. Each of these aspects is intertwined, and only through a comprehensive approach can innovation really have a significant impact.

11.1. Technology Aspects

In a rapidly evolving world, technology plays a critical role in producing impactful innovations. In an approach such as design thinking, technology is one of the three main elements along with human aspects and market needs. This aspect not only supports the innovation process but also determines the success of innovation adaptation in real life. This article outlines the role of technology in innovation, its life cycle, and how each stage in the cycle affects market growth and acceptance. Design thinking is an empathy-based approach that puts the user at the center of innovation. Technology here serves as a link among creative ideas and practical implementation. According to the research of (Aprianto et al., 2023), this method has been successfully applied to improve students' creative thinking skills through a technological innovation project-based learning model. With this approach, students are able to produce relevant and applicable technological solutions.

Technology, like any other innovation, has a life cycle that consists of stages of development, growth, maturity, and decline. In the early stages of development, the technology has not yet generated revenue because the focus is on research and prototyping. In the growth stage, technology begins to show its economic value as market acceptance increases. A study by (Fathoni et al., 2020) on the implementation of electronic-based government technology (SPBE) in West Java shows that the initial penetration of technology requires the integration of strategic planning to achieve maximum

efficiency. At the maturity stage, the technology reaches its peak point in adoption and revenue. However, the emergence of new technologies can accelerate the decline of old technologies. Innovations in the field of second-generation bioethanol, as outlined by (Ditia et al., 2021), show how the integration of the latest technologies can extend the life of technology by improving the efficiency of the production process.

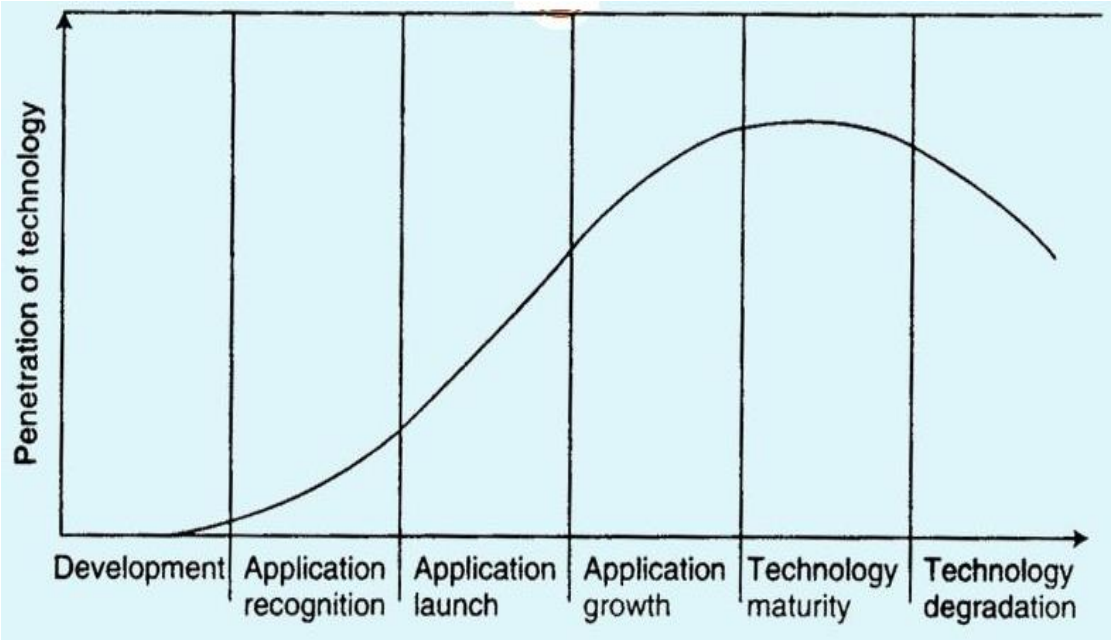

Figure 11.1. The life cycle of technology (Kingston, 2006).

In the context of the technology life cycle, market growth is a key indicator of successful adoption. Technologies designed with a good market approach tend to gain acceptance faster. (Zhangrinto, 2024) emphasizes that market orientation and technological capabilities are key factors in driving the performance of new product innovation in the smartphone industry. The apply technology in education, such as the digitization of flipbook-based learning media, also shows a significant increase in students' understanding of biological and physical concepts. A study by (Rizal et al., 2024) revealed that this technology is preferred by 85% of students because of its ease and effectiveness. Technology is a crucial element in generating sustainable innovation. Through the technology life cycle, from development to maturity, each phase provides opportunities for organizations to adapt and create added value. In an ever-evolving world, the success of innovation depends on the ability to integrate technology with market and human needs, as emphasized in the design thinking approach.

Technology, as one of the key drivers of innovation and change in various sectors, has a life cycle that describes how technology evolves, reaches

peak performance, and eventually declines or becomes obsolete. This cycle is often explained through an S-curve, where the performance parameters of the technology are plotted against time. This curve provides an in-depth understanding of the phases of technological development, from the initial design to the eventual replacement by newer and more sophisticated innovations. Figure 11.1. compiled by (Kingston, 2006) illustrates the life cycle of technology through six phases of growth that make up the process of technological evolution.

1. Technology Design Phase, in this early phase, technology is in the conceptual stage. This process involves research, experimentation, and initial design development. The performance of technology in this phase is still low because the main focus is on finding new solutions that can be implemented in the production process or market. A study from (Zhao et al., 2022) emphasizes that innovative and research-based design processes can be a solid foundation for sustainable technological growth. Factors such as creativity, needs analysis, and technical capabilities are crucial in ensuring that technology design can provide added value.
2. Technology Application Phase, once the technology design is formed, the next phase is the apply technology. At this stage, the technology begins to be tested in practical scenarios to determine its feasibility. This process often involves limited trials and the introduction of the technology to a small market segment. A study by (Lin et al., 2022) found that successful technology adoption in this phase depends on a deep understanding of the user's needs as well as their ability to address specific problems.
3. Implementation Development Phase, this phase is characterized by an increase in technology implementation on a larger scale. Technology is beginning to show an increase in market penetration and production efficiency. At this stage, investment in infrastructure and human resource development is a key factor. A study from (Rad et al., 2019) highlights the importance of collaboration among industry and academia in accelerating the implementation of technology at this stage.
4. Technology Maturity Phase, in this phase, technology has reached the peak of its performance. The growth of the market is starting to slow down, and the technology is widely used in various sectors. This phase reflects the stability of technology that has gone through various challenges and refinements. However, technology at this stage is starting to show limitations due to pressure from newer innovations. A study by (Lee & Park, 2021) shows that technological maturity is often a critical point where companies must start planning for further innovation to prevent obsolescence.

5. Technology Transfer Phase, this phase marks an effort to distribute technology to a broader market or sector, either through licensing, collaboration, or knowledge transfer. Technology transfer is often the solution to maximize the benefits of mature technology. According to (Li et al., 2022), effective technology transfer requires policy support, legal frameworks, and adequate resources.
6. Technology Obsolescence PhaseIn this final phase, technology begins to be considered obsolete as new innovations that are more efficient and relevant emerge. The decline in the performance of this technology can be caused by technical limitations or higher maintenance costs compared to replacement technologies. A study by (Rahman & Akbar, 2021) emphasizes that the cycle of technological obsolescence advises companies to continue investing in research and development to maintain competitiveness.

The S-curve describes the journey of the technology's performance over time. In the initial phase, the improvement of technological performance was slow due to various technical obstacles and innovation challenges. However, along with technological developments, performance growth begins to increase exponentially until it reaches the optimal point in the maturity phase. In this phase, the technology begins to stabilize, but its growth slows down due to capacity limitations or the emergence of new technologies. The S-curve also provides insight into the transition points at which technologies must be adapted or replaced to maintain competitiveness. In the context of the industry, companies that are able to identify technology phases appropriately will have a strategic advantage in planning innovation and investment. The technology lifecycle is an important concept in understanding how innovation evolves, peaks, and ultimately declines. Through six phases, from technology design to obsolescence, this cycle provides guidance for companies, academics, and governments in managing technology effectively. The S-curve becomes a visual tool that depicts the growth and performance of technology over time, helping stakeholders identify opportunities and challenges in each phase of the technology cycle. By continuing to conduct research, development, and innovation, technology can become a key driver of economic growth and sustainability in the future. Collaboration among the industrial sector, academia, and the government is key in optimizing the technology life cycle to produce innovations that have a positive impact on society.

11.2. Organizational Aspects

In the innovation process, the organizational aspect plays a crucial role in overseeing technological development from the development stage to the commercialization phase. Organizations act as a forum that coordinates various important components, such as human resources, management, structure, and strategies needed to implement innovation. The main impartial of the organizational aspect in the innovation process is to ensure that the technology produced can be developed efficiently and effectively to be able to provide added value in the form of products and/or services at every stage of the innovation life cycle. The organizational aspect acts as a facilitator to integrate technology into various business functions. This includes cross-departmental coordination, resource allocation, and innovation project management arrangements. According to a study from (Gunday et al., 2023), the role of a flexible organizational structure is the main factor in supporting the success of the innovation process in the corporation. Organizations with adaptive structures tend to be better able to respond to changes in the dynamic and complex technology environment. Rigid organizational structures, on the other hand, have the potential to hinder technology development because it is difficult to adapt to market demands and new technologies.

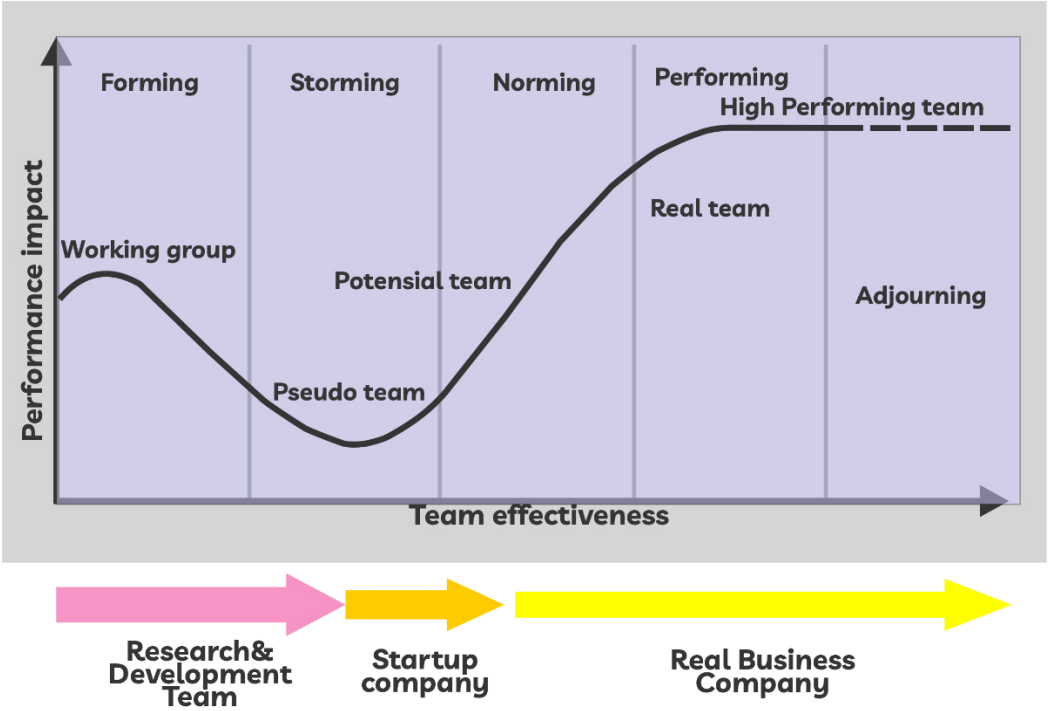

Figure 11.2. Organizational development theory (Bartee, 1979).

In theory, organizational development also has a cycle like the one developed by Tuckman (1965). This model can be used to contextualize the development of other relationships both within the organization and in

personal settings. This model became the basis for the linear progressive model because of its simplicity in explaining very complex processes. The Tuckman model has four stages of progressive development, which range from group orientation to performance. The four steps of the model are form, Storm, Norm, and Perform (Figure 11.2.). Organizational aspects play a different role at each stage of the technology life cycle, which include:

1. Technology Design Phase, at this stage, the organization focuses on basic research and development of technology concepts. The role of the organization is to create an environment that supports creativity, collaboration among scientists, and investment in research. Support from top management is crucial in providing the necessary direction and resources to kickstart an innovation project.
2. Technology Application Phase, once the technology is developed, the organization is in charge of identifying the potential applications of the technology in the market. It includes the process of testing and validating the technology through collaboration with terminate users or external partners. Success at this stage depends on effective communication among the organization's internal teams as well as coordination with external parties such as suppliers or business partners.
3. Implementation Development Phase, in this phase, organizations need to prepare infrastructure that supports the widespread implementation of technology. Operational support, investment, and workforce skill development are key to success. A study by (Cohen et al., 2023) emphasizes the importance of organizational involvement in providing continuous training to employees to increase their capacity to adopt new technologies.
4. Technology Maturity Phase, at this stage, organizations focus on optimizing technology to achieve efficiency and effectiveness in the production process. A good organizational structure will support increased productivity through the continuous apply technology. Organizations also need to establish monitoring systems to evaluate the performance of the technology used as well as identify opportunities for improvement.
5. The Technology Transfer Phase, the technology transfer process involves cooperation among organizations and other parties, such as partner companies, governments, or research institutions. Organizations act as mediators that ensure the transfer of knowledge runs smoothly and can be further developed in various industry sectors. These collaborations are often arranged in the form of strategic partnerships that support the process of technology diffusion.

6. Technology Obsolescence Phase, at this stage, organizations have a role to plan for the replacement of obsolete technology and start a new innovation cycle. This includes research and development activities of new technologies as well as product or service diversification strategies to maintain competitiveness in the market.

To support technological development, organizations need several supporting factors, including: Innovative Leadership: Visionary and innovation-oriented leadership has a central role in driving the success of technology development. Leaders who are able to inspire teams will accelerate the adoption of new technologies. Organizational Culture that Supports Innovation: A work culture that advises creativity, collaboration, and tolerance for risk is essential to creating an innovative environment. Human resource management: contractor competency development through training and continuing education is an important step in supporting technology implementation. Flexible Organizational Structure: An adaptive and responsive structure will make it easier for organizations to adapt to changes in the technology and market environment.

While organizational aspects play a significant role, there are some challenges that are often faced in the innovation process, including: Resistance to Change: Many organizations face internal challenges in the form of contractor resistance to new technologies. Lack of Resources: The implementation of technology requires large investments, both in financial and human resources. Process Complexity: Cross-departmental coordination and external collaboration are often barriers to innovation implementation. The organizational aspect has a strategic role in overseeing technological developments at every stage of the technology life cycle. Organizations that are able to create flexible structures, innovative cultures, and visionary leadership will be better equipped to effectively adopt and commercialize technology. As such, the success of technological innovation is highly dependent on the extent to which the organization can manage resources, coordinate processes, and collaborate with various parties. Literacy regarding the organizational aspect of innovation can be found in Scopus indexed studies that discuss organizational dynamics in supporting technology and innovation, such as studies from Gunday et al. (2020) and Cohen et al. (2021).

11.3. Market Aspects

In the modern business world, understanding the Product Life Cycle (PLC) is one of the key elements in marketing strategies. This concept reflects the stages that a product goes through since its introduction until it finally

declines or abandons. (Kotler dan Keller, 2016) explain that the life cycle of a product is divided into several stages, namely the stages of introduction, growth, maturity, decline, and abandonment. Each of these stages has different competitive dynamics and demands different strategies in marketing, production, finance, and resource management.

1. Introduction stage: building market awareness, at the introduction stage, new products commence to be introduced to the market. The corporation is still in the research and development stage, as described in Figure 53, where sales have not shown a significant increase. The marketing strategy at this stage focuses on product promotion, with the goal of building brand awareness and creating initial demand. Investing in marketing activities such as advertising, sales promotion, and media campaigns is crucial. On the other hand, production and distribution costs tend to be high because the scale of production is still limited. A study by (Adilova, 2023) confirms that success in this phase depends on the corporation's ability to recognize market needs as well as position products strategically.
2. Growth stage: increased sales and initial competition, after passing the introduction phase, the product enters the growth stage, where sales start to increase rapidly. In this phase, the corporation focuses on increasing production and expanding distribution to meet the growing market demand. As illustrated in Figure 53, competition began to emerge along with the entry of the first competitors who tried to imitate or adapt technology and product innovation. Product differentiation is an important factor at this stage, where companies must be able to show the superiority of their products over competitors. In addition, competitive pricing strategies and improved service quality are important elements in maintaining market share. According to recent research by (Homburg et al., 2017), a good differentiation strategy can increase customer loyalty and provide a competitive advantage for companies.
3. Maturity stage: stability and fierce competition, the maturity stage is characterized by sales growth that begins to slow down and eventually reaches a stable point. At this stage, the product has reached a wider market, but the competition in the market is getting fiercer due to the large number of competitors offering similar products. Marketing strategies in this phase focus on improving production efficiency, reducing costs, and trying to maintain customer loyalty through more innovations in products or services. This is where companies must be careful in segmenting the market and developing differentiation strategies to face competitive pressures. Research by (Ulaga & Michel, 2019) highlights the importance of

continuous innovation and after-sales service in maintaining the product's position in a saturated market.

4. Decline Stage: Responding to Product Obsolescence, the decline stage is the phase where product sales commence to decline along with reduced market demand. The main factors that caused this decline include changes in consumer preferences, the emergence of new technologies or more innovative products, and changing market cycles. In this phase, companies must decide on the right strategy, such as diversifying products, reducing production costs, or withdrawing products from the market. Another strategy that can be applied is to reposition the product or find new markets that still need the product. As stated by (Kotler dan Keller, 2016), the PLC not only affects sales and profitability, but also affects the direction of a corporation's long-term strategy.

In every stage of the PLC, marketing strategy has a very important role in determining the success of a product in the market. At the introduction stage, the main focus is on building market awareness and creating demand. In the growth stage, companies must maximize market share through increased production and distribution. At the maturity stage, product differentiation strategies are the main key to maintaining customer loyalty. Meanwhile, in the decline stage, companies need to innovate or reposition products to remain relevant in the market.

The concept of the product lifecycle provides an in-depth understanding of market dynamics and marketing strategies that must be implemented in each phase. By understanding the PLC, companies can plan more effective strategies in the face of market changes and competition. A study by (Ghezzi & Balocco, 2016) shows that flexible and innovative marketing strategy adaptation is one of the main factors for product success in its life cycle. The PLC is a fundamental concept in marketing management that reflects the important stages that a product goes through while in the market. Each stage requires a different strategy to face the challenges and dynamics of the competition. From the stage of introduction, growth, maturity, to decline, companies must be able to identify market needs, understand changing customer preferences, and devise innovative strategies to maintain a competitive advantage. With a good understanding of the PLC, companies can be better prepared to deal with market changes and increase the chances of product success in the long run.

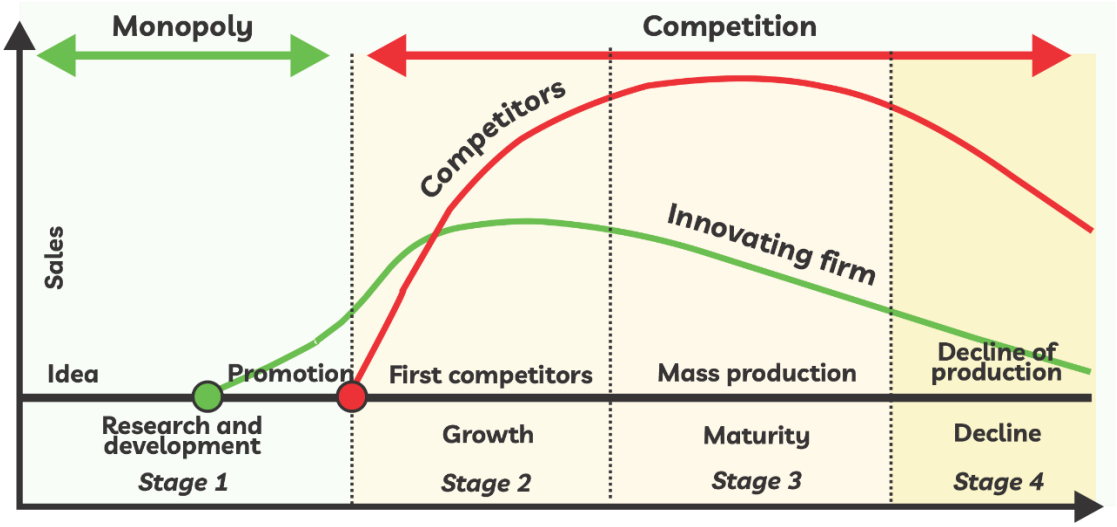

Figure 11.3. PLC and marketing strategy (Kotler dan Keller, 2016).

There are various stages in the PLC of a product. Some people classify them into introduction, growth, maturity, decline and discontinuation. Meanwhile, there are also those who state that all stages of the PLC consist of introduction (pioneering), fast growth (market acceptance), slow growth (turbulance), maturity (saturation), and decline (obusescence). However, generally what is used is the classification into four stages, namely introduction, growth, maturity and decline (figure11.3.).

The PLC is an important concept in marketing because it provides a deep understanding of the competitive dynamics of a product. Things to consider related to products and markets include:

- Can the product currently being developed really solve the customer's problem?

  This question emphasizes the importance of product relevance to real problems faced by customers. A good product not only meets the needs of customers, but also offers effective solutions. Before developing a product, companies need to conduct in-depth research to understand customer-specific problems through surveys, interviews, and market analysis. Additionally, product validation processes, such as prototyping and trials, are essential to ensure the product can solve customer problems. Research by (Coccia, 2018) shows that companies that focus on customer needs-based innovation have a higher chance of creating successful and sustainable products. Therefore, a deep understanding of customer problems will help companies create solutions that have a positive impact.

- Can the solutions offered solve the customer's current problems?

  The main focus of this question is to ensure that the product or solution offered can answer customer needs in a relevant, fast, and efficient manner. A good solution must be practical to use and adapt to the development of technology, economic trends, and customer behavior. In this context, companies need to develop features that especially solve customer bottlenecks and remain flexible in the face of market changes. A study by (Gomaa, 2023) states that solutions that have a significant impact on increasing productivity or reducing customer costs will be more easily accepted by the market. As such, the solutions offered must serve as concrete answers to customer challenges in changing market conditions.

- Are the solutions offered superior to competitors?

  Market competition requires companies to create products that are not only effective but also have advantages over similar products on the market. These advantages can be realized through product differentiation, such as technological innovation, better features, competitive prices, or superior after-sales service. To achieve this, companies need to conduct competitor analysis to understand their position in the market and find opportunities to create added value. Benchmarking against competitors will help companies know the strengths and weaknesses of their products, so that improvement strategies can be implemented effectively. In addition, sustainable competitive advantage can be achieved by innovating consistently. (Porter & Heppelmann, 2015) research shows that companies that invest in sustainable innovation have greater potential to outperform competitors and maintain a position in the global market. Therefore, the solutions offered must be better, faster, and more economic than competitors to create a solid competitive edge.

Overall, answering these three questions—the product's ability to solve customer problems, the effectiveness of the solutions offered, and the advantage over competitors—is an important foundation for the success of a product. Companies that are able to meticulously understand, design, and validate solutions will have a greater chance of creating products that are relevant, valuable, and competitive in the market.

11.4. Partnership Aspects

Maturity in the partnership aspect can be seen from developments by the innovation life cycle that is being undertaken. According to (Brinkerhoff, 2023), the maturity of partnerships built by innovation development teams at each stage of the innovation cycle is characterized by some specific conditions or progress. These aspects include the concept development stage, opponent development, completion stage, chasm stage and competition, and the termination stage. Each stage has characteristics in partnership management that must be considered so that innovation can run effectively and achieve optimal results. Thus, understanding and managing partnerships at every stage of the innovation lifecycle is crucial for the success of an innovative project. The second stage is opponent development, where the partnership begins to move toward a more formal and systematic structure. At this stage, partners have been selected based on the results of the analysis in the previous stage, and the standardization of the partnership begins to be built. This standardization involves defining the roles and responsibilities of each party, drafting a clear framework, and establishing indicators for the success of partnerships. Research from (Christofi et al., 2022) emphasizes that success in this stage depends on transparency of communication and binding agreements among partners to create shared value. With clear standardization, the innovation development process can run more purposefully and measurably, minimizing the risk of conflict or misunderstanding among the parties involved.

The next stage is the completion stage, which is marked by the official confirmation of the partnership among the parties involved. At this stage, all aspects of the partnership have been clarified and agreed, including commitments in resources, implementation schedules, and targets to be achieved. The officially confirmed partnership reflects the readiness of all parties to fully collaborate in completing the innovations being developed. According to a recent study by (Albats, 2021; Albats et al., 2023), successful partnerships at this stage are usually characterized by the presence of effective conflict management mechanisms and continuous evaluation systems. Thus, the completion stage is an important milestone in ensuring that the innovation can move toward implementation and generate real benefits for the market or society.

The fourth stage is the chasm and competition stage, where the dynamics of the partnership commence to experience more complex challenges. At this stage, partnerships are tested by market pressures and increasingly fierce competitive demands. Cooperation in a dynamic network is the main key to maintaining the sustainability of innovation. In addition,

sustainable management is essential to ensure that all parties remain committed in the face of changes in external and internal conditions. A study conducted by (Christensen, 2023) shows that partnerships that are able to adapt quickly to market changes have a greater chance of maintaining their position in the industry. Therefore, flexible cooperation and sustainable management must be a priority in facing the challenges of competition at this stage.

The final stage is the termination stage, where partnerships that are no longer relevant or effective will be terminated. At this stage, an evaluation process is carried out to assess the success of the partnership as well as identify lessons that can be learned for future partnership development. In addition, companies or innovation teams can also start looking for new partners, including academic partners, to support further innovation development. Research from (Brogaard, 2021) emphasizes the importance of post-partnership evaluation as a means to identify success and failure factors, so that this process can provide valuable insights for subsequent partnerships. Thus, the termination stage is not only the terminate of a partnership, but also the beginning of a process of reflection and better strategic planning. The maturity of partnerships in the innovation lifecycle reflects a structured and systematic development from the identification of potential partners to the final evaluation of the partnership. Each stage has its own challenges and opportunities that must be carefully managed so that innovation can run effectively. By understanding the dynamics of partnerships at each stage, companies or innovation teams can build more solid, adaptive, and sustainable collaborations. Deep literacy of this aspect of partnership, as expressed by (Brinkerhoff, 2023) and supported by the latest research, is the main key in creating successful innovations and having a significant impact on the market and society.

What is stated in the main activities in the partnership aspect is, in theory, also has a dynamic life cycle such as technology, markets, and organizations (Figure 11.4). Figure 54 shows the stages of team or group development in the context of work productivity. These stages are often associated with the group development model that has historically developed through the research of various experts, particularly in the fields of team management, organizational psychology, and productivity theory. The graph shows the four key stages, namely Forming, Frustration, Functioning, and Flying, before finally facing the risk of Failing. This article will comprehensively discuss the history, theory, and relevance of the stages of group development in relation to team productivity. The concept of group development in productivity can be traced back to the classical theory developed by Bruce W.

Tuckman in 1965 (Tuckman, 2019). In his research entitled Developmental Sequence in Small Groups, Tuckman identified four main stages in group formation and development, namely Forming, Storming, Norming, and Performing. This model was then updated in 1977 with the addition of a fifth stage, namely Adjourning.

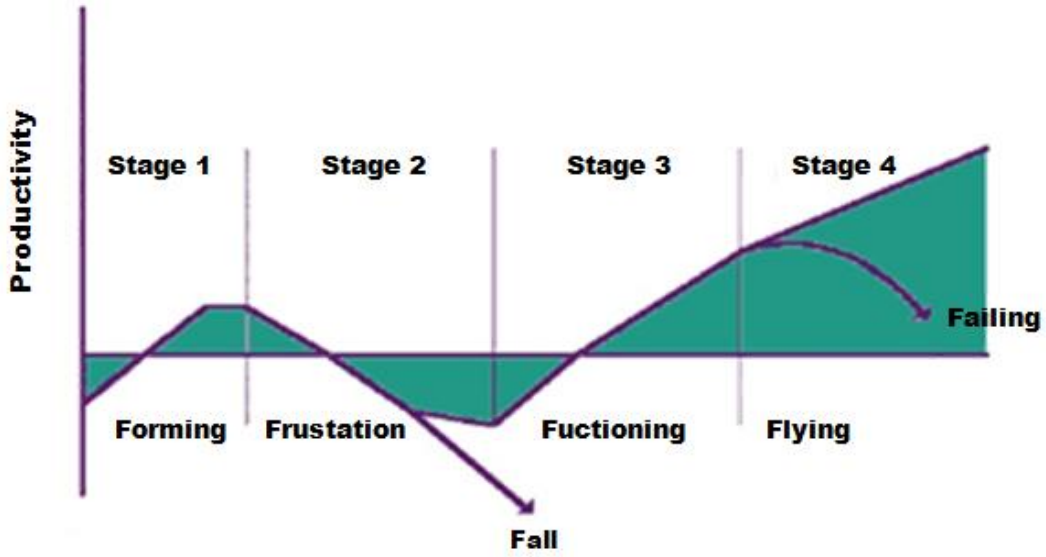

Figure 11.4. Partnership life cycle (Tuckman, 2019).

Forming: The team formation stage, where new team members begin to get to know each other, understand each other's roles, and identify common goals. Productivity at this stage is usually still low because team members focus on adaptation and structure search. Storming (Frustration): This stage is characterized by the emergence of conflicts, tensions, and differences of opinion between team members. Team members begin to express their sometimes conflicting ideas and feelings, which triggers frustration. Productivity tends to decline at this stage due to efforts to resolve internal conflicts. Norming (Functioning): After going through the conflict stage, the team will begin to find an understanding in how to work, norms, and shared values. Productivity increases as team members begin to collaborate more effectively and understand each other's roles and responsibilities. Performing (Flying): At this stage, the team works optimally and efficiently to achieve a common goal. Team members have a strong understanding of their respective roles and work with high synergy, so productivity is at its peak. Adjourning (Failing): This stage occurs when a project is completed or the team is disbanded. The risk of decreased productivity can arise if there is no good planning to end work or move on to new tasks. The graph shown above adopts similar stages with simpler term adjustments, namely Forming, Frustration, Functioning, and Flying. However, this stage adds the Fall (drastic decrease in

productivity) and Failing (team failure) components as a warning against the risks that may be faced.

1. Stage 1 - Forming: this initial stage is the time of team formation. The main focus at this stage is the introduction, exploration, and determination of common goals. Team members are often still cautious in their interactions and tend to avoid conflict. Team leaders have a crucial role in guiding members in a clear direction. Productivity at this stage is relatively low because the team's focus is still on adaptation, not task completion.
2. Stage 2 - Frustration: this second stage is characterized by the emergence of dissatisfaction and internal conflicts within the team. Team members start to feel frustrated due to disagreements, misaligned goals, or inefficiencies at work. If these conflicts are not managed properly, then the team can experience a significant decrease in productivity. The solution to this stage is to ensure open communication, build trust between members, and the leader must act as a mediator who helps resolve the conflict.
3. Stage 3 - Functioning: this stage is the phase where the team begins to work more stably and effectively. Conflicts that arose in the previous stage have been resolved, and team members understand their respective roles and responsibilities. Productivity began to increase along with improved coordination and work efficiency. At this stage, team leaders focus on monitoring performance, ensuring the team stays on track, and encouraging better collaboration.
4. Stage 4 - Flying: at this stage, productivity reaches its peak. The team works with full synergy, communication runs effectively, and team members are highly motivated. A project or shared goal can be completed optimally because all members are working towards the same outcome. However, the graph shows that there is a risk of decreased productivity or failure (Failing) if the team loses focus, motivation, or there is a major change that is not anticipated. This risk must be watched out for by leaders and team members.

Each stage of productivity shown in the graph has its own challenges and solutions. The role of the team leader is crucial in maintaining positive dynamics and group productivity: Forming Stage: The leader must provide clear direction, build positive relationships, and ensure the team's goals are understood by all members. Frustration stage: The leader acts as a conflict mediator and facilitator of open communication. Functioning Stage: Leaders ensure consistent performance through monitoring and feedback. Flying Stage: The leader acts as a motivator and prevents the team from experiencing fatigue or loss of focus. The concept of team development like this has been widely studied in modern literature. Research published by (Kozlowski & Yusof, 2022) emphasizes the importance of group dynamics in

achieving optimal performance. They state that conflict management and role coordination are key factors in building sustainable team productivity. In addition, research by (Salas-Vallina & Alegre, 2021) emphasizes that an effective team through the formation stage can improve overall organizational performance. They emphasized the role of leaders in managing transitions between stages to ensure optimal productivity. The graph of the stages of team development in work productivity shows the importance of understanding group dynamics to achieve optimal results. By following the stages of Forming, Frustration, Functioning, and Flying, the team can work more effectively and efficiently. However, poor management can lead to the risk of decreased productivity (Failing). Therefore, the role of leaders in every stage is crucial to maintaining sustainable team productivity.

The first stage in the maturity of a partnership is the development of the concept. At this stage, the main focus is on identifying potential partners who can contribute to the development of innovation ideas. This identification is carried out through an analysis of the strengths and weaknesses of each party, both in resources, technical capabilities, and the suitability of the vision in developing innovative products or services. At this stage, the initial collaboration tends to be exploratory, where the parties involved commence to build communication and formulate basic strategies for working together. According to recent research from (Joniškienė et al., 2020), partnerships at this stage play a crucial role in determining the strategic direction of innovation and ensuring the necessary resources are adequately available. As such, a careful initial step in identifying the right partner will help ensure a strong foundation for the next stage.

11.5. Risk Aspects

In an increasingly dynamic business world, risk is an inevitable part of the journey of building a startup. Risk (figure 11.5.), which is defined as the effect of uncertainty on goals, is often related to deviations from what is expected, whether in the form of positives, negatives, or both. This is crucial because studies show that 90% of startups fail, which is mostly due to a lack of risk management in their operational processes. Risks in innovation process management include technology, market, organization, business model, and execution risks. If these risks are not addressed effectively, their impact can become significant as the project lifecycle progresses. The figure provided by (T. Wang & Chen, 2023) on the project life cycle shows that the chance of risk is greatest at the beginning of the project, but the impact of risk at this stage is still small. Risk management from the early stages is the key to minimizing the impact during the implementation phase. In the context of startups, the ability

to recognize, analyze, and manage risk is an important foundation in creating business sustainability.

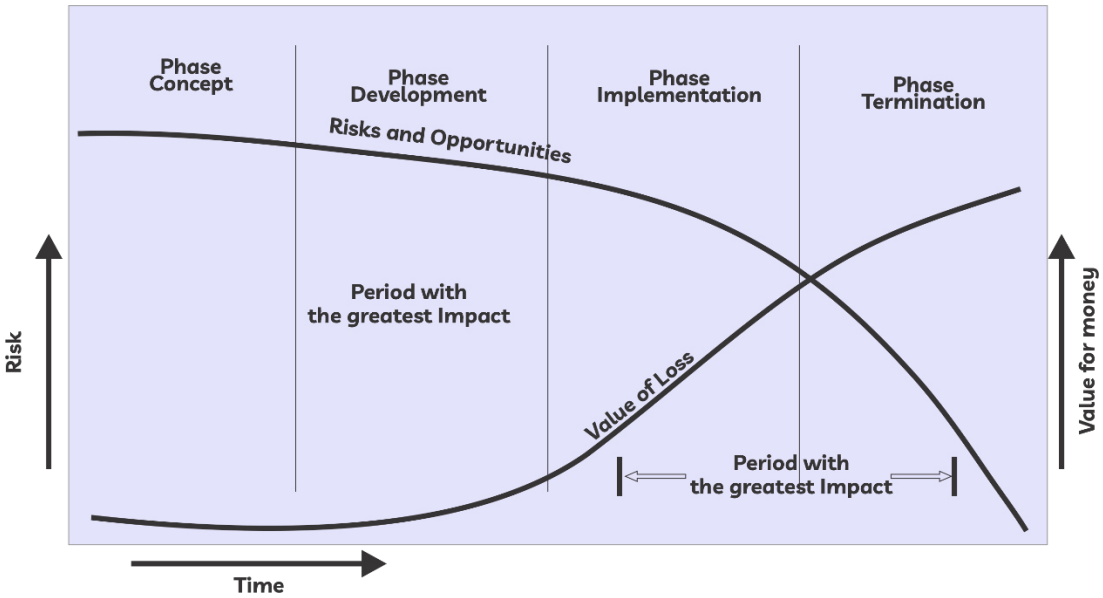

Figure 11.5. Risks in the Project Life Cycle (Source: Budi Suanda, 2011).

Technology risks arise due to uncertainty about the effectiveness of technology used in the development of startup products or services. Technology is a key pillar of innovation in modern business, but it often comes with the risk of malfunction, misalignment with market needs, or falling behind in the adoption of the latest technology. High-tech startups, such as in the fields of artificial intelligence, Internet of Things (IoT), or blockchain, face greater challenges in ensuring their technology can provide relevant and sustainable solutions. According to research conducted by (Kumar et al., 2021), the adoption of new technologies in business must be accompanied by a thorough evaluation of technical capabilities and the readiness of human resources in implementing these technologies. The study emphasizes the importance of research and development (R&D) as a way to minimize technological risks in innovation. Startups need to conduct prototyping, product testing, and market validation on an ongoing basis so that the technology used can run according to expectations.

Market risk is uncertainty related to demand, customer behavior, and competitive dynamics in the business environment. Innovative products or services do not always get a positive response from the market. Many startups fail because the products they develop do not match the needs or expectations of the market, or because of rapid trend changes. In a study conducted by (Baig & Chen, 2022), it was stated that market risk mitigation strategies should commence with a comprehensive market analysis, including the identification

of target segments, understanding customer behavior, and adapting to changing market preferences. The study also emphasizes the importance of a lean startup approach, which allows companies to develop a Minimum Viable Product (MVP) and get direct feedback from customers. Thus, market risk can be minimized through a fast and responsive iteration process.

An unclear or ineffective business model is one of the main risks faced by startups. These risks include incompatibilities among products, markets, and planned sources of revenue. A startup may have sophisticated and innovative technology, but if its business model does not support financial sustainability, then the risk of failure is very high. A study by (Teece et al., 2022) highlights the importance of flexible and innovative business model design in dealing with market dynamics. In this context, startups need to ensure that the business model adopted can provide added value for customers while creating a sustainable revenue stream. For illustration, subscription-based or freemium-based business models have been widely used to reduce financial risk in the early stages.

Execution risk is related to the ability of the startup team to execute the planned business strategy. Limited human resources, lack of managerial skills, and poor coordination are often the main factors for failure in execution. Even the best business ideas will be difficult to realize if their execution is not well organized. In a study conducted by (Chatterjee et al., 2019), execution risk can be minimized through careful planning, efficient resource allocation, and continuous development of team skills. Strong leadership and the ability to manage the team well are key in ensuring effective execution. This research also emphasizes the importance of an adaptive and innovative organizational culture in facing challenges in the field.

Risk is an integral part of any innovation process, especially in the context of startup development. Technology, market, business model, and execution risks must be properly managed so as not to hinder business growth. The use of a systematic approach to identifying and addressing risks can increase the chances of startup success in a competitive market. By leveraging the innovation itself, startups can increase their adaptive and responsive capacity to evolving market and technology dynamics. The speed of innovation is the main key in mitigating risks. Institutions or companies that are able to move quickly in developing innovative solutions have a greater chance of overcoming risks and creating added value for customers. Thus, risk management is not just an effort to avoid failure, but also a strategy to achieve long-term success.

11.6. Manufacturing Aspects

Manufacturing is a key stage in realizing innovative ideas into real products or services that can be used by consumers. As a systematic process, manufacturing combines technological and economic elements to produce goods with quality according to standards and quantities that meet market demand. In a technical sense, manufacturing is the apply various physical and chemical processes to change the shape, properties, and appearance of basic materials into components or products that have added value. This includes the process of joining various parts to produce the final assembled product. As an economic process, manufacturing focuses on processing basic materials into more valuable products, through operational efficiency and production cost optimization.

Manufacturing can be categorized in two dimensions, as a technological process and as an economic process. Technologically, manufacturing requires the integration of various factors such as machines, equipment, labor, as well as effective production methods (figure 11.6.). This process leverages cutting-edge technologies, such as additive manufacturing, automation, and artificial intelligence (AI)-based technologies, to improve efficiency, precision, and production capacity. Modern manufacturing technologies, such as the IoT and smart manufacturing, enable real-time data collection and analysis, which supports data-driven decision-making to improve product quality. Meanwhile, from an economic perspective, manufacturing focuses on creating added value (value added).

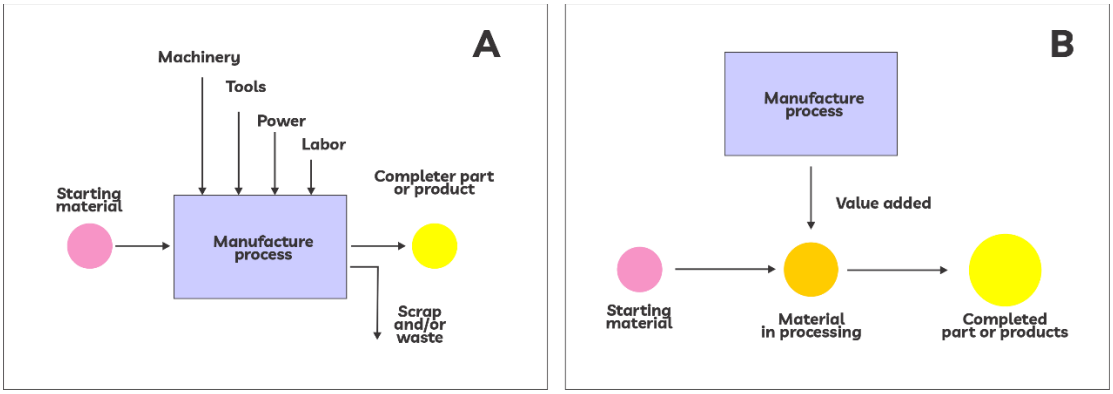

Figure 11.6. Manufacturing as a technological and economic process; (a). Manufacturing as an economic technological process; (b). Manufacturing as an economic process (Vamos, 1988).

This process includes processing raw materials into final products that have a higher economic value than their initial condition. The apply economic principles in manufacturing includes resource optimization, production cost

efficiency, and effective supply chain management. Therefore, manufacturing plays a key role in economic growth, as it produces value added products that are able to meet global market demand. In practice, the manufacturing process involves several main stages, namely:

1. Material Solutions: Choosing the right material is the first step in the manufacturing process. Material innovation, such as the use of composite materials, environmentally friendly materials, and high-performance materials, is an important concern in the development of modern products. For illustration, composite materials are widely used in the automotive and aerospace industries due to their lightweight yet strong characteristics.
2. Production Technology Development: Production technology includes the selection of methods and equipment used in the manufacturing process. Examples of current technologies include 3D printing (additive manufacturing), robotic automation, and sensor-based technology for quality monitoring. This technology not only improves production efficiency but also enables the development of products with complex designs that are difficult to realize with conventional methods.
3. Production Engineering and Testing: Before entering full-scale production, products must go through the stages of engineering and testing to ensure the quality and performance of the products are by specifications. These tests include mechanical testing, functional testing, and product sustainability analysis to ensure the product meets applicable safety and environmental standards.
4. Full-Scale Production: At this stage, the manufacturing process is carried out on a large scale to meet the market demand. Full-scale production requires good production management to ensure process efficiency and effectiveness. The apply lean manufacturing and Six Sigma systems is the key to reducing waste and improving production quality.
5. Production Management: Production management involves planning, controlling, and monitoring the entire manufacturing process. Modern production management systems utilize digital technology to improve coordination among departments, monitor workflows, and ensure the availability of vital materials and components.
6. Innovation and Development of Production Technology: Innovation in manufacturing processes focuses on increasing productivity, flexibility, and sustainability. The development of new production technologies, such as manufacturing based on cyber-physical systems, allows for more flexible and adaptive production to changing market needs.

In the era of Industry 4.0, manufacturing is becoming increasingly important as a driving force for innovation and economic development. The concept of smart manufacturing integrates digital technologies, such as AI, IoT, Big Data, and cloud computing, to create a more efficient and adaptive production process. This technology allows manufacturers to monitor production performance in real-time, quickly identify production problems, and respond to market demand dynamically. In addition, the apply environmentally friendly technology in the manufacturing process is a major concern in answering sustainability challenges. The principles of the circular economy, where materials can be reused and recycled, are beginning to be integrated in manufacturing systems to reduce waste and carbon emissions. Research by (J. Wang et al., 2018) shows that the apply smart manufacturing and environmentally friendly technology can significantly reduce the environmental impact of the production process.

Despite its strategic role, manufacturing also faces various challenges. One of the main challenges is the increase in material and labor costs. In addition, increasingly fierce global competition requires manufacturing companies to continue to innovate and improve efficiency. In this case, the adoption of advanced technology is an important solution in overcoming these challenges. Manufacturing in the future will be increasingly dominated by automation technology, robotics, and AI. Recent research by (Dolgui et al., 2018) underscores that the integration of digital technologies can improve supply chain resilience and flexibility amid global uncertainty. Manufacturing has a crucial role in delivering the innovation process into real and valuable products or services. As a technological process, manufacturing relies on modern machines, equipment, and technology to create high-quality products. Meanwhile, as an economic process, manufacturing focuses on increasing added value through resource optimization and process efficiency. With technological advances in the era of Industry 4.0, manufacturing has great potential to create smarter, more efficient, and sustainable production processes. However, challenges such as production costs and global competition still need to be overcome through technological innovation and the development of adaptive production systems.

11.7. Investment Aspect

Investment plays a crucial role in transforming research results or discoveries into innovative products that can be accepted by the market. In this case, the role of venture investors is very significant, both from angel investors such as Corporate Social Responsibility (CSR) programs and from venture capitalists such as banking institutions or other financial institutions. Apart

from being a capital provider, venture investors have a strategic role in supporting the development of a sustainable business ecosystem. Basically, the success of leveraging investments to bring innovation to market largely depends on the business model used. A business model is a framework that explains how a corporation creates, delivers, and captures the value produced. This model also serves as a guide for companies in designing the right strategy to optimize revenue and reduce costs. One of the most widely used approaches to formulating a business model is the Business Model Canvas developed by Alexander Osterwalder. This model offers a simple yet comprehensive visualization of the various key elements in business operations. In this context, two important aspects of the Business Model Canvas are the Revenue Stream and the Cost Structure. These two aspects play a vital role in financial analysis projections that are a reference for investors in assessing the potential profitability of a business.

Revenue stream: primary and more revenue sources, revenue stream is a opponent that explains where and how a business earns revenue. This revenue stream can come from a variety of sources depending on the type of product or service offered. In the scope of product innovation, the main revenue can come from the direct purchase of products to customers or terminate users. In addition, the business model can also identify more sources of income, such as:

1. Subscription: Revenue is earned through recurring payments over a period of time for the use of a product or service.
2. Freemium: Provides basic services for free but offers paid premium features.
3. License: Income from granting license rights to use technology or patents to other parties.
4. Ad Revenue: For businesses that rely on digital platforms, ad revenue is one of the important pillars.
5. Strategic Partnerships: Revenue from cooperation with other parties, such as technology providers or distributors.

By understanding and optimizing various sources of revenue, companies can increase their potential profitability and attract investors. According to research conducted by (Ghezzi & Balocco, 2016) in the journal Technological Forecasting and Social Change, flexibility in revenue models is essential for innovative companies to accommodate changing market preferences and technological dynamics.

1. Cost structure: cost optimization in product development, the second aspect of the Business Model Canvas is the cost structure that includes all

the costs incurred to run the business. In the context of turning inventions into innovative products, some of the dominant cost components include:

2. Production cost: includes the cost of raw materials, labor, equipment, and manufacturing processes needed to produce products.
3. Development and research costs: investment in R&D activities is the main key to the success of innovation. This process is often time-consuming and costly, but it is the main foundation for a quality and competitive product.
4. Marketing costs: to introduce innovative products to the market, marketing costs such as advertising, promotion, and distribution are essential. An effective marketing strategy will increase product acceptance by customers.
5. Administrative and tax costs: operational costs such as administrative staff salaries, office rent, as well as tax liabilities should also be factored into the cost structure.

Cost optimization is an important factor that is often noticed by investors. They tend to support companies that are able to minimize costs while maximizing the value provided to customers. As stated by (Gupta et al., 2017) in their study in the Journal of Business Research, innovation in cost management through digital technology approaches can significantly improve business efficiency.

The relationship among investment and business models is symbiotic. Venture investors, both angel investors and venture capitalists, tend to look for business models that are not only innovative but also sustainable. The Business Model Canvas is a very effective tool in explaining the business vision to investors because it simplifies complex elements into one easy-to-understand framework. Investors will focus on aspects such as revenue potential, cost efficiency, competitive advantage, and strategies to achieve break-even points. Research by (Dobrowolski & Sułkowski, 2021) highlights that investors are more likely to invest in companies that have clear business models and realistic financial projections. The use of the Business Model Canvas helps in mitigating investment risks by providing a comprehensive overview of the business structure and revenue streams (Dobrowolski & Sułkowski, 2021). Investment plays a central role in bringing innovation into a product that is accepted by the market. Through the support of venture investors such as angel investors and venture capitalists, companies can access the capital needed for product development and marketing strategies. The success of this investment is highly dependent on the business model used, where the Business Model Canvas is an effective approach to visualizing the important elements of the business.

The two key components of the Business Model Canvas, namely the Revenue Stream and the Cost Structure, form the basis for the financial analysis projections used to attract investors. By optimizing revenue sources and cost structures, companies can improve business efficiency and achieve long-term sustainability. As shown in the current literature, flexibility in business models and cost management capabilities are key to the success of innovative companies in the digital economy. Thus, this approach can be a strong foundation for companies to gain the trust of investors and achieve the goal of commercialization of innovative products. The Business Model Canvas-based approach not only provides benefits for companies and investors, but also creates greater value for customers and society as a whole.

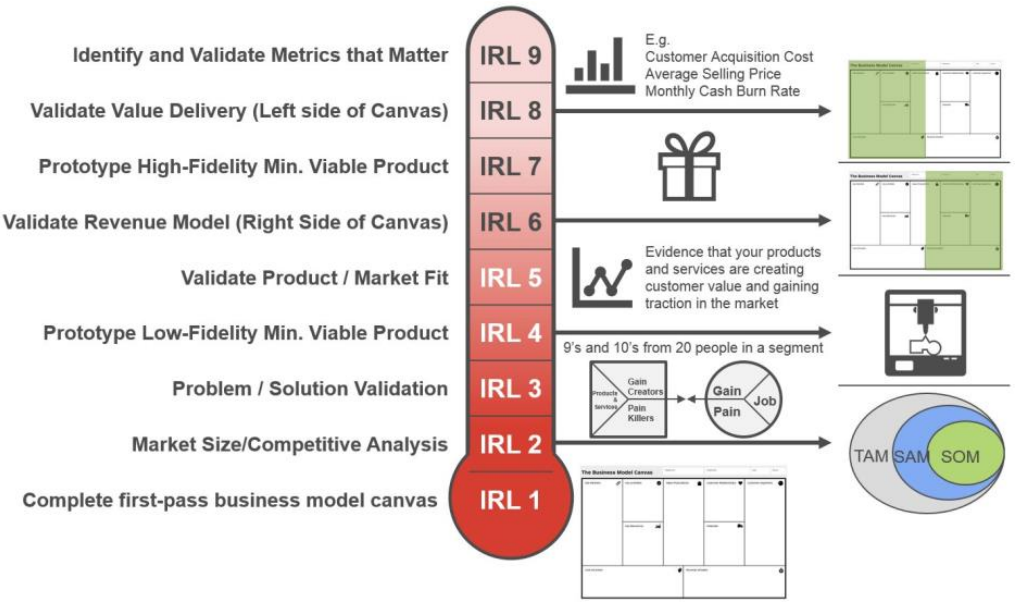

Figure 11.7. Investment Readiness Level (Source: Jake Nielsen, 2015).

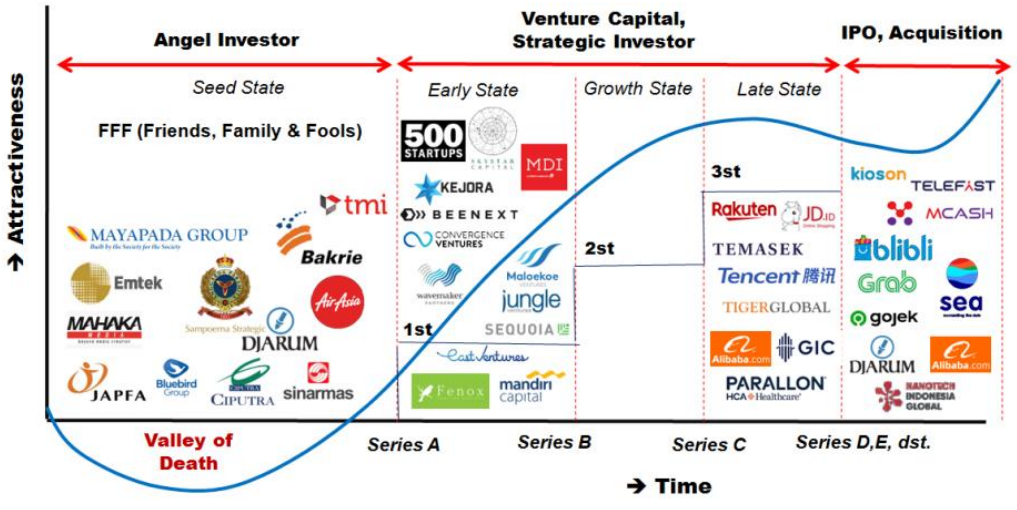

Figure 11.8. Business life cycle (Source: Susalit SW, 2023).

This investment aspect includes business model concepts, market value propositions, business validation, increased market acceptance, market expansion, and a review of market needs and demands. In principle, the concept of investment in KATSINOV refers to the concept of Investment Readiness Level developed by Steve Blank (Figure 11.7.). Through this investment aspect, it is hoped that the achievements of this innovation process can be easily seen by investors and the industry. In addition, this aspect is useful for startups and large companies that want to build a new product line or business model.

A Business Model is a plan that describes how your business can make money, either in the form of revenue streams from the business or venture capital from investors (Figure 11.8.). The following is an explanation of the sources of innovation financing:

1. Grand Research. For research activities, both basic research and applied research, most of the funding is through large research from the government and a small part from the private sector.
2. Initial Capital or Initial Funding. Initial capital or initial funding is the initial stage of funding for a startup. In the early stages, startups are in a position to look for the potential of the product created and also potential users or markets that are suitable for the product. Through this initial stage of funding, startups can recruit some talented staff and offices that fit the product prototype they want to develop. The amount of initial funding usually ranges from IDR 500 million to IDR 2.5 billion, depending on the needs needed by the startup.
3. Angel Investor. The more startups grow, the more funds are needed. In this phase, startups usually require an injection of funds from external parties or investors. On the other hand, at this stage, startups have begun to attract the attention of angel investors to invest their capital in companies. The amount of funding from angel investors usually ranges from 50,000 US to 500,000 USD, or the equivalent of IDR 750,000,000 to 7,500,000,000.

This phase will usually be reached by startups within six months of the business running. Startups have started marketing their products widely, getting feedback and improving the products they have. The uniqueness of the startup is also starting to attract media attention and make the corporation interesting to review. With reviews from the media, more and more people are knows the existence of this startup.

1. **Seri**es A (Venture Capital). This series A funding stage is the stage where the startup has reached the Beta stage and is ready to get a larger number of new users. In this phase, startup founders are usually in a position to

scale their products to other regions while maintaining the same characteristics. At this stage, startups need to find the most appropriate and appropriate characteristics of the business model. Here, startups need to continue to innovate and continue to develop and spread their wings. The key is to find the right venture capitalist and a suitable partner. In this series A funding phase, startups can usually get funding ranging from IDR 10 billion to IDR 33 billion.

2. Series B (Mezzanine Financing & Bridge Loans). In the next phase, startups have started to have a fixed income after running for about 2-4 years. The benefits that can be obtained from startups have also begun to be seen with the presence of a potential user base. Series B funding here is usually used to further maximize market expansion, business models and also a wider user base. In addition, incoming funds are also needed to start a merger, business acquisition, or to prepare for an Initial Public Offering (IPO). Not many Indonesian startup companies have reached this phase, therefore it is still quite difficult to estimate the range of funding that startups may receive in this phase. The estimated Series B funding is around IDR 22 billion to IDR 80 billion.
3. IPO**.** After the startup continues to grow, at this stage the startup is increasingly ready to develop itself and go public by selling shares on the exchange. This stage is the last stage of funding obtained by a startup. After this stage, the startup is ready to buy and sell its shares publicly on the stock exchange. If you have conducted an IPO and traded shares on the stock exchange, from now on the corporation needs to publish its financial statements in general.

To get to this stage, a startup usually takes about 5-10 years to prepare. Because conducting an IPO can be said to be quite complicated compared to the previous funding stages. By conducting an IPO, managed startups are ready to expand and develop even bigger businesses. illustration: PT GoTo Gojek Tokopedia Tbk (GOTO) has used funds from an IPO of IDR 10.13 trillion. The successful development and commercialization of innovative products requires certain financing schemes to cross the valley of demise (Figure 11.9). The first step to get a VC is to submit a business plan, either to a law firm or an individual investor. Interested investors will conduct a thorough investigate the corporation's business model, business products, management, and operating history compared to anything else.

VC plays an important role in the growth of the startup ecosystem as a provider of risk capital for early-stage to growth stage companies. The investment methods carried out by VCs are usually divided into two main

ways, taking direct shares produced by the startup or buying convertible bonds that can be converted into equity in the future. Both approaches have unique advantages and risks, so it is important to understand the implications for investors and startups that receive funding.

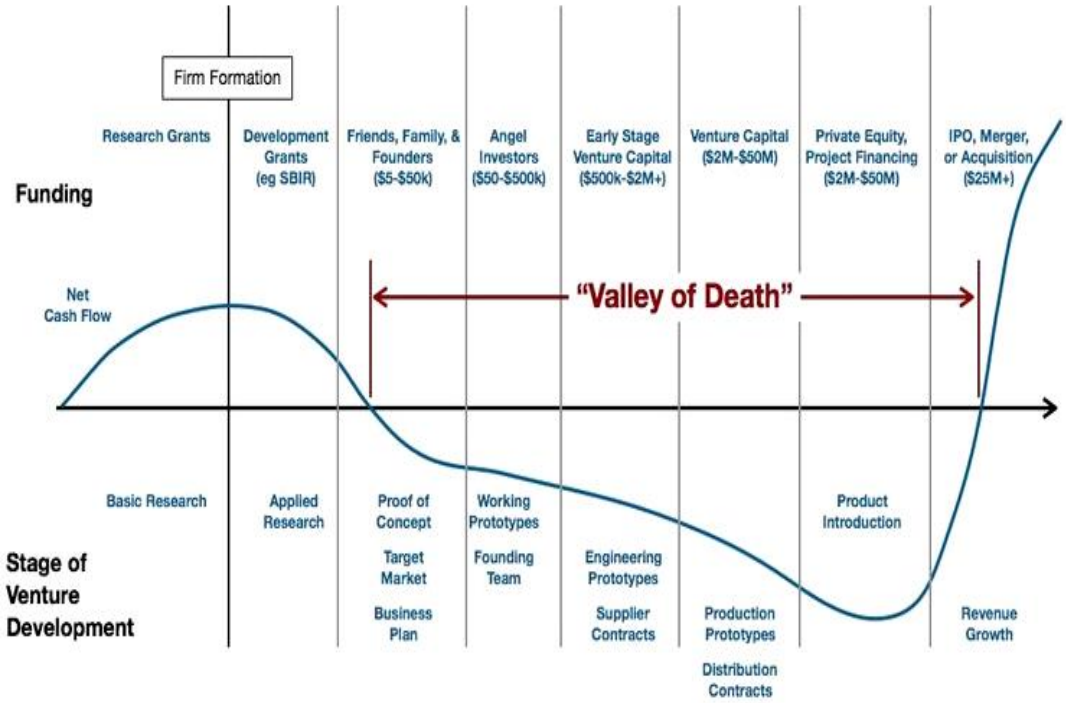

Figure 11.9. Research and innovation financing scheme (Source: Anna Dementyeva, 2021).

Direct equity investment means that VCs take a portion of shares issued directly by startup companies. The shares reflect the ownership of part of the corporation by VCs and provide rights to investors, such as voting rights, strategic decision-making, and profit sharing in the form of dividends. In this approach, startups usually issue new shares through a private placement scheme or direct purchase of shares to certain investors. This method not only provides capital injection, but also increases the working capital of startups to support their operations and business growth. Based on a study from (Goldfarb et al., 1985), direct investment in startup stocks often provides significant potential returns if the corporation experiences rapid growth or success through exit strategies such as IPOs or acquisitions. Nonetheless, direct equity investments carry a high level of risk. Startup stocks tend to be liquid, and the value of their investment is highly dependent on the startup's future performance. VC investors also have challenges in valuing early-stage companies due to limited information and high volatility of startup businesses.

Convertible bonds are debt instruments that provide investors with the right of refusal to convert the bonds into shares within a certain period or conditions that have been agreed. Generally, convertible bonds have debt characteristics, such as interest coupons and maturities, but they also provide potential stock ownership when converted. This instrument is becoming increasingly popular in the startup funding ecosystem as it reduces the initial risk of the investment while providing profit opportunities from the startup's future growth. According to the research of (C. Wang et al., 2022), convertible bonds are preferred in the early stages of startups because of their flexibility. Startups do not directly provide shares and can obtain funding without having to do a definite valuation. This is important for companies that have not reached significant milestones. At the same time, convertible bonds provide risk protection for investors, because if the startup fails to achieve the expected growth, the bond can still function as debt. On the other hand, convertible bonds have some challenges. For VC investors, the process of converting to shares can be complicated, especially if the startup has liquidity or valuation issues that do not match expectations. Startups also need to consider the bond interest structure so as not to burden the corporation's cash flow in the development stage.

In comparing these two investment methods, VCs often consider the following factors:

1. Risks and benefits: direct equity investments carry higher risks, but offer the potential for greater returns through rising startup valuations. In contrast, convertible bonds reduce the initial risk but still provide profit opportunities.
2. Startup valuation: in the early stages, convertible bonds are more suitable for use due to valuation uncertainty. Direct equity investments are more common in the growth stage when valuations are more stable and predictable.
3. Ownership and control: direct equity investments grant immediate ownership rights to VCs, while convertible bonds defer ownership until the conversion process is done. This affects the dynamics of control among investors and startup management.
4. For illustration, research by (D. Cumming et al., 2019, 2022; D. J. Cumming et al., 2022) shows that convertible bonds are more widely used in the fast-growing technology industry, where valuations are often difficult to determine and business risks are higher.

Capital investment by VC in a startup corporation can be done through two main approaches, direct equity investment and convertible bonds. Direct equities provide high potential returns but have significant risks associated

with startup volatility. Meanwhile, convertible bonds offer greater flexibility with initial risk reduction, although they still have challenges in their implementation. The decision among these two methods depends on the investor's risk profile, the stage of the startup's development, and the market conditions at the time of funding. Through a deeper understanding of these two instruments, VC investors can make more deliberate strategic decisions, while startups can choose funding schemes that support their long-term growth.

The profit sharing mechanism is one of the main approaches in the fair distribution of profits among parties involved in a business or joint investment. This mechanism allows profits to be distributed based on predetermined performance, contributions, or agreements. In practice, there are three main ways to implement a profit sharing system, namely, profit sharing based on revenue, profit sharing based on net profit, and profit sharing according to contract. Each mechanism has its characteristics, advantages, and challenges that affect its effectiveness in various business contexts.

1. Revenue sharing based on revenue, a revenue-based profit sharing mechanism involves directly sharing profits from the total revenue earned, before deducting operational costs and other expenses. This method is typically used in situations where capital owners want to get quick and fixed returns, without being too affected by fluctuations in operating costs. The advantages of this mechanism are simplicity in implementation and transparency in calculations. All parties can immediately see the revenue generated and the percentage to which they are entitled. However, one of the drawbacks of this approach is the lack of incentives to improve cost efficiency as the primary focus is on gross revenue. According to (Mujahidin, 2021), the revenue sharing mechanism is often used in sectors such as Islamic banking, where income from customers is managed to be distributed to investors based on a previously agreed percentage.
2. Profit sharing based on net profit, this mechanism involves the sharing of profits earned after all operating expenses, taxes, and other expenses are deducted from total revenue. This method is more complex than revenue-based profit sharing, but it is considered fairer because it considers each party's contribution to the financial success of the business. Profit sharing based on net profit provides incentives for business partners to improve operational efficiency and optimize net profit. However, the challenge is the need for high transparency in recording costs and expenses. Ambiguity in the books can cause conflicts among the parties. In research by (C. Wang et al., 2022), this mechanism is often applied to collaboration-based projects that involve many parties, such as the construction sector or high-

tech projects. This study shows that net profit sharing can improve overall accountability and operational efficiency.

3. Profit Sharing Based on contract, This mechanism offers flexibility because the distribution of profits is carried out based on an contract that has been agreed upon by the parties, regardless of revenue or net profit obtained. This approach is often used in strategic partnerships or trust-based investments, where the primary goal is not only financial gain but also the strengthening of long-term business relationships. The advantage of this mechanism is the flexibility in adjusting the profit sharing according to non-monetary contributions, such as market access, technical expertise, or business networks.

The profit sharing mechanism is an important element in the distribution of business profits involving various parties. The selection of the right mechanism must consider the business needs, the purpose of the partnership, as well as the characteristics of the industrial sector. Revenue sharing by revenue is suitable for situations with a focus on simplicity, while net profit sharing provides a fairer approach by considering operational efficiency. On the other hand, profit sharing by deal offers appropriate flexibility for strategic partnerships. With a deep understanding of these mechanisms, businesses can ensure a fair distribution of profits while building sustainable partnership relationships. The current literature shows that the adoption of the right mechanism not only increases profitability but also supports long-term business stability and sustainability.

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Chapter 12
KATSINOV LEVEL

Sigit Santosa, Sunarto

Innovation is the main catalyst in endeavors to encourage economic and social development in various countries. In an increasingly competitive global context, the success of a country or organization in creating and managing innovations determines their ability to compete in the international market, improve people's quality of life, and support environmental sustainability. However, the biggest challenge in the innovation process is not only creating new ideas, but ensuring that those innovations can be implemented effectively and sustainably. One significant approach to answering this challenge is the KATSINOV or Innovation Readiness Level, a model designed to measure the maturity of an innovation based on its life cycle. KATSINOV is an evaluation tool designed to help researchers, developers, and industry players understand the extent to which their innovations are ready to be commercialized or implemented. The model has six levels of readiness that reflect the stages of the innovation lifecycle, from initial concept to discontinuation or transition to new innovation. In the process, KATSINOV not only evaluates the technical dimensions, but also considers aspects of the market, organization, risks and investments. This makes it a holistic tool to assess the feasibility of an innovation before it is launched into the market or implemented in the community. As an evaluation tool, KATSINOV plays an important role in identifying potentials and obstacles at each stage of innovation development. (Fithri et al., 2021; Raditya Faisal Waliulu et al., 2020) in their research on the apply KATSINOV at Andalas University showed that this model helps researchers and MSME actors to measure the level of readiness of their research products, which in turn increases the chances of successful commercialization. The study also emphasizes the importance of socialization and understanding of KATSINOV to increase the effectiveness of its application in the field.

In the era of globalization and digitalization, the need for fast, efficient, and relevant innovation is increasing. KATSINOV offers a relevant framework for meeting these challenges by providing clear guidance on the steps to be taken at each stage of development. For illustration, research by (Nur Rahmawati and & Amalia Suzianti, 2023) shows that the apply KATSINOV in a triple helix-based funding model allows for increased efficiency in the management of research and innovation projects. This approach not only integrates academia, industry, and government but also helps to overcome barriers to communication and coordination among stakeholders. In

addition, (Santoso et al., 2022) in their research on measuring infrastructure readiness using the Innovation Readiness Level (IRL) approach show that models such as KATSINOV can be used to measure innovation readiness not only in technology products but also in large projects such as sharia infrastructure financing schemes. The results of this study highlight the importance of data-driven innovation assessment and multi-stakeholder collaboration to ensure the successful implementation of innovation at scale.

Table 12.1. Explanation of the six levels of KATSINOV

6 Levels of Innovation Readiness (KATSINOV)

(IRL, Innovation Readiness Level)

KATSINOV		Explanation
6	Move (change-over) or stop (close-down)	The market decline stage, and the determination of two choices, namely moving (change-over) with new technological innovations, or stopping (close-down) by seeing the innovation as obsolete and deciding to leave.
5	Competition	This is the market maturity phase, when a market equilibrium is reached in the absence of meaningful growth or innovation.
4	Chasm	Chasm is between the early adopters (the enthusiasts & visionaries) and the early majority (the pragmatists). The initial stages of introducing the innovation results to the market have been carried out. At this stage there are challenges and difficulties whether the innovative product meets customer needs or demands when it is first introduced to the market.
3	Completion	Technology development has been completed and all system functions have been proven in the field.
2	Component	Components have been developed and validated, and prototypes have been developed demonstrating the technology.
1	Concept	The basic scientific principles of the innovation have been observed and reported, and the critical functions and/or characteristics have been confirmed through experiments.

source: author, 2024.

The implementation of KATSINOV offers various strategic benefits for organizations, governments, and communities. First, this model allows for early identification of potential risks and obstacles in innovation development, thus aiding in better decision-making. Second, KATSINOV advises cross-sector collaboration by providing a standardized framework for communication and coordination among various stakeholders. Third, this model supports efficient resource allocation by ensuring that investments are directed to the most prepared and impactful

innovations. A study by (Ozcan et al., 2024) underscores the importance of an integrated innovation readiness framework to support investment decisions in product development. This research results in a multidimensional framework that connects technology, market readiness, and organizational capabilities to ensure the success of innovation in the market. This approach is very relevant in facing the challenges of a dynamic and uncertain global market. KATSINOV is an essential tool in managing innovation effectively and efficiently. By evaluating the readiness of an innovation at each stage of its lifecycle, it provides clear guidance for developers, investors, and other stakeholders to ensure that innovations are not only successfully created but can also be implemented with maximum impact. In the modern context, where innovation is the key to economic and social success, consistent and targeted implementation of KATSINOV can help accelerate the transformation toward a more innovative and competitive society. KATSINOV is not just an evaluation tool, but also a strategic pillar in building a sustainable and inclusive future.

The KATSINOV model has six levels of readiness that reflect the innovation life cycle (table 12.1.), namely KATSINOV 1 (concept), KATSINOV 2 (opponent), KATSINOV 3 (completion), KATSINOV 4 (chasm), KATSINOV 5 (competition), and KATSINOV 6 (changeover/closedown). Each level has an important role to play in assessing the feasibility of an innovation before it is launched to the market. KATSINOV is designed as an innovation evaluation tool that considers not only technical aspects, but also market, organizational, risk, and investment elements.

12.1. Concept

At the first level in the framework of KATSINOV, innovation is at the "concept" phase, in which the characteristics of basic scientific principles have been observed and reported. This stage focuses on strengthening the scientific foundation through initial experiments to confirm the critical functions or key characteristics of innovation. At this stage, the main milestone is the proof of concept or scientific feasibility, which becomes the basis for moving on to the next phase in the innovation development cycle. The "concept" stage is a very important stage because it is the basis for evaluating the potential success of innovation. This is in line with the view of (Fithri et al., 2024) who emphasized the importance of early testing as a critical step in building confidence in the scientific and technical feasibility of innovation. In their study, the researchers showed that experiments in the early stages often determine the direction of the later development strategy. This stage is also known as "proof of concept," which aims to answer fundamental questions such as: Is this innovation scientifically possible? Is there any early evidence that the basic principles of technology can work as intended? According to (Nur Rahmawati and & Amalia Suzianti, 2023), this stage is the first step in creating a measurable path to

improve technological readiness and innovation through a triple helix model involving collaboration among academia, industry, and government.

Experiments at the "concept" level usually involve a controlled laboratory environment. Research conducted by (Santoso et al., 2022) highlights that in this phase, stakeholders need to establish clear hearing parameters to evaluate the effectiveness of the technology and ensure the initial data is reliable as a foundation for subsequent development. This ensures that resource investment in the next phase is more targeted and evidence-based. In the modern context, the "concept" stage is also an ideal time to consider various non-technical aspects such as sustainability, environmental impact, and market potential. For illustration, research by (Ozcan et al., 2024) shows that the integration of market dimensions and technology at an early stage can increase the probability of innovation success when entering the product development and commercialization phases. By considering these aspects early on, innovations can be designed to meet market needs while remaining socially and economically relevant.

While the "concept" level offers many opportunities, it also presents challenges that cannot be ignored. One of the main challenges is ensuring that the scientific evidence obtained is strong enough to attract support from investors or other stakeholders. This often requires an interdisciplinary approach and close collaboration among researchers, engineers, and market experts. According to (Webster & Gardner, 2019), another major challenge at this stage is overcoming the "gap" among technology readiness and institutional acceptance. They suggest that an inclusive socio-technical approach is essential to ensure that the results of early research can be translated into solutions that can be adopted by markets and societies. The level of "concept" in KATSINOV is the foundation for the successful development of innovations. By ensuring that the basic scientific principles have been confirmed and reported through robust experiments, this phase gives the development team the confidence to proceed to the next stage. In an increasingly complex and competitive world, a structured approach like KATSINOV not only helps manage risk but also maximizes the chances of innovation success in the global market. Therefore, the "concept" level is not just a first step, but also a strategic foundation for sustainable and positively impactful innovation.

12.2. Opponent

At the second level in the framework of KATSINOV, innovation reaches a critical phase in which the characteristics of technological components are developed and validated. This stage marks the transition from theoretical concepts to physical realization through the development of an initial

prototype or known as the alpha prototype. At this level, the technology is tested on a small scale to ensure that each opponent can function according to the planned design and specifications. A milestone at this level was the achievement of an alpha prototype, which became the basis for further development toward the final product. Alpha prototypes play a very important role in the innovation life cycle. This model is designed using components that resemble the actual shape, dimensions, and types of production materials, although it does not cover the entire production process. The main purpose of an alpha prototype is to identify weaknesses or limitations in the initial design, thus allowing developers to make the necessary adjustments before moving into the large-scale production stage. According to research (Holden, 2022; Lee et al., 2011; Ozcan et al., 2024), effective prototype development requires a deep understanding of the market and consumer needs to ensure that the final product is not only technically feasible but also commercially relevant.

Alpha prototypes are designed to test the performance of the technology in conditions close to reality without involving the full complexity of mass production. This allows the development team to get early input from live testing, both through technical simulations and through user feedback. (Santoso et al., 2022) in their study highlighted the importance of validating technological components at this stage to ensure that innovations can meet technical standards and expectations of potential users. Alpha prototype trials cover a wide range of aspects, including reliability, efficiency, and compatibility of the technology with the expected operational environment. In many cases, this testing also includes a risk analysis to identify potential issues that may arise in future implementations. According to (Nur Rahmawati and & Amalia Suzianti, 2023; Sari et al., 2020), the alpha prototype can be used as a strategic tool to evaluate innovation readiness under the triple helix model, which involves collaboration among academia, industry, and government.

Once the alpha prototype is tested, the results of the evaluation are used to improve the design and production process. This stage is iterative in nature, with the aim of eliminating design defects and improving product performance. In this context, alpha prototypes serve as a bridge among basic research and commercial product development. According to (Van Cauwenbergh et al., 2022; Webster & Gardner, 2019), the validation obtained from the alpha prototype provides a solid basis for approaching the stage of institutional readiness and market acceptance. Additionally, it is important to understand that alpha prototype development not only includes technical aspects, but also involves evaluating factors such as cost, sustainability, and market competitiveness. Research by (Fithri et al., 2024; Holden, 2022)

confirms that the integration among technical validation and market evaluation is essential to ensure the success of innovation in the long term. The second level in KATSINOV, i.e. the development and validation of technological components through alpha prototyping, is a very important phase in the innovation cycle. This stage ensures that the technology is not only technically feasible but also ready to be tested in conditions close to reality. By leveraging feedback from iterative trials and evaluations, developers can refine the design and optimize product performance before moving on to the next stage. In an increasingly competitive world, a systematic approach like this provides a strategic advantage in delivering innovations that are not only technically superior but also relevant and accepted by the market.

12.3. Settlement

At the third level in the framework of KATSINOV, the development of technology has reached the stage of maturity at which a complete system is tested and its functionality is proven in the field. At this stage, the main milestone was the achievement of a beta prototype, which served as a near-perfect representation of the final product. The beta prototype includes all design elements and materials that are close to the final product, allowing for regulatory testing and user evaluation with minimal risk to future design changes. Beta prototypes are designed to represent the entire product in a form that is close to the final product. The design focuses not only on aesthetics and materials, but also on the overall functionality and performance of the product. According to research by (Lee et al., 2011; Ozcan et al., 2024), beta prototypes play a strategic role in the innovation cycle by providing a basis for user testing and regulation that can reveal potential problems before the product is commercially launched. This is critical to ensuring that products can meet consumer expectations while complying with applicable legal and industry standards.

Beta prototype testing gives users the opportunity to apply the product in real conditions. This allows developers to identify "bugs" or problems that may occur in everyday use. The main purpose of these tests is to ensure that the product not only functions properly but is also reliable in a variety of operational environments. According to (Nur Rahmawati and & Amalia Suzianti, 2023; Van Cauwenbergh et al., 2022), testing in a real environment can uncover weaknesses that are not detected during laboratory testing, ultimately helping to improve product quality before mass launch. Additionally, beta prototype testing allows developers to get direct feedback from consumers. This creates opportunities to improve products to better suit market needs. According to (Holden, 2022; Santoso et al., 2022), consumer

involvement in beta prototype testing increases the likelihood of commercial success because the resulting product is more responsive to the needs of the terminate user.

The beta prototype stage is iterative, which means the results from the tests are used to improve the product before it goes into mass production. The design changes made at this stage are usually minimal, as most design issues have been identified and fixed at the alpha prototype stage. (Sari et al., 2020; Webster & Gardner, 2019) emphasized that this iterative process is important to improve product reliability while ensuring that any changes do not disrupt the product launch schedule. In addition to the technical aspects, this stage also includes testing against factors such as sustainability, cost efficiency, and regulatory compliance. (Fithri et al., 2024) in their research showed that the success of a product in the market is highly dependent on the ability to integrate these factors in beta prototype design and testing.

In the context of modern innovation, beta prototype testing is becoming more relevant as consumer expectations for high-quality products are increasing. With increasing competition in the global market, developers must ensure that their products not only meet technical requirements but also provide an optimal user experience. Research by (Ozcan et al., 2024) shows that comprehensive beta prototype testing can increase the chances of commercial success while strengthening the brand's position in the market. Digital technology also plays an important role in beta prototype testing. For illustration, computer-based simulations and data analytics can be used to evaluate product performance in a variety of scenarios without the need for extensive physical testing. This allows developers to identify issues more quickly and efficiently, ultimately speeding up product launch times. The KATSINOV 3 level, which is characterized by the development and testing of beta prototypes, is a critical phase in the innovation cycle. At this stage, the product is thoroughly tested to ensure that its design, function, and performance meet the highest standards before being launched into the market. By leveraging an iterative approach and involving consumers in testing, developers can identify and fix potential issues, ensuring that the final product is not only technically feasible but also commercially relevant. In an increasingly competitive world, effective beta prototype testing provides a strategic advantage in delivering successful and positively impactful innovations in the global market.

12.4. Chasm

In the process of adopting technology or innovation, there is a critical phase known as "chasm". The term was first introduced by Geoffrey Moore in

his book Crossing the Chasm (A. Moore, 2014; Moore, 2015) which describes the challenges that new innovations face when moving from the initial market to the primary market. This gap is a huge gap that an innovative product must navigate to ensure acceptance in a wider market. Fail cross this gap can hinder product development, even leading to complete failure for the corporation. Conceptually, a gap arises when there is a significant difference among consumer behavior in the initial market and consumer behavior in the primary market. Consumers in the early market, known as visionaries or early adopters, have characteristics that tend to be enthusiastic about new products. They are interested in revolutionary innovations, have the courage to try unestablished technologies, and are willing to take risks to be the first users. These consumers often have strong intrinsic motivations, such as the satisfaction of being a leader in adopting new technologies or the expectation of gaining a competitive advantage in a particular market. In contrast, consumers in primary markets, known as pragmatists or early majority, have different characteristics. They are more conservative in their decision-making and tend to be cautious in adopting new innovations. Pragmatic consumers need tangible evidence that the product can provide significant added value and benefits before they are willing to use it. They also tend to wait until the technology or product is stable and has enough references or testimonials from other users before deciding to buy. This characteristic creates a significant challenge for companies in bridging the gap among the two consumer groups, at this stage it is a gap that must be passed to determine the acceptance of the product in the market (Figure 12.1).

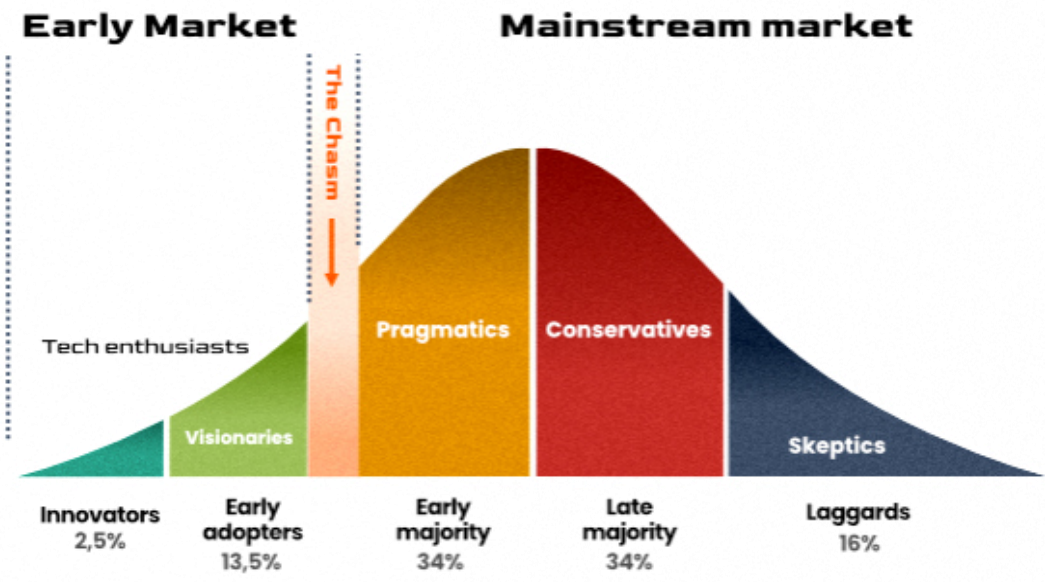

Figure 12.1. *Crossing the chasm (A. Moore, 2014; Moore, 2015).*

Gaps arise due to differences in expectations, needs, and behaviors among consumers in the initial market and the primary market. Some of the main factors that cause the occurrence of chasm include:

1. Early consumers tend to be attracted to new products because of their innovation potential, even if they still have weaknesses or shortcomings. In contrast, pragmatic consumers expect products that are stable, reliable, and have obvious practical benefits.
2. Lack of Proof of Success: Innovative products often do not have real evidence of their success in the market. Pragmatic consumers tend to need references in the form of case studies, testimonials, or product evaluations before deciding to adopt the technology. A study by (Milios, 2022) shows that peer influence and social proof play an important role in convincing pragmatic consumers to adopt new products.
3. Resistance to Change: Consumers in key markets tend to have resistance to change, especially if the innovation requires major adjustments in their way of working or habits. Research by (D. Huang et al., 2020; Y. Huang et al., 2023) on Airbnb adoption in China confirms that resistance to change can hinder the adoption of new technologies.
4. Limited Infrastructure and Support, Innovative products often do not have an adequate supporting ecosystem, such as after-sales service, distribution network, or compatibility with existing systems. This makes pragmatic consumers hesitant to adopt the technology.

To ensure product success in crossing the abyss, companies need to implement the right strategy. Here are some strategic approaches that can be used:

1. Determining the target market segment, companies need to focus on specific market segments that have specific needs and can be addressed by these innovative products. Choosing the right market segment can help companies build a strong initial market share and create momentum to cross the abyss.
2. Creating clear and measurable value, pragmatic consumers need tangible evidence of the benefits of a product before they are willing to adopt it. Therefore, companies need to present case studies, testimonials, and empirical evidence that demonstrate the product's superiority. (Lu et al., 2022) mentioned the importance of designing a strategy that focuses on the user community to drive early adoption of the technology.
3. Building a support ecosystem, companies need to ensure that innovative products have adequate support, including after-sales service, user

training, and compatibility with existing systems. This will help reduce risk for pragmatic consumers.

4. Adopting the right marketing strategy, effective marketing strategies, such as educational campaigns, the use of influencers, and a community-based approach, can help increase pragmatic consumer trust in new products. A study by (Dangwal & Rani, 2021) shows that marketing strategies focused on market segmentation can accelerate the adoption of innovative technologies.
5. Building a bridge among visionary and pragmatic consumers, companies need to bridge the gap among visionary consumer expectations and pragmatic consumers. This can be done by creating a more stable beta version of the product, reducing the risk of failure, and building positive references from early users.

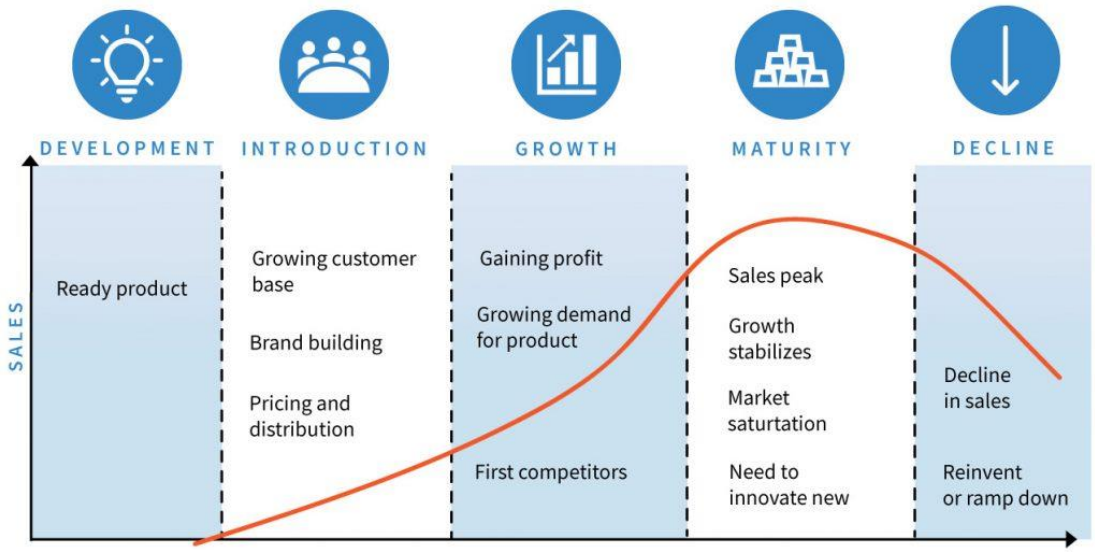

Figure 12.2. The marketing life cycle and its implications (Mitchell & Clark, 2019; Wang, 2022)

Product Life Cycle (PLC) is a fundamental concept in product management that describes the journey of a product starting from development to finally experiencing a decline in the market. The figure 12.2. shown visualizes the four main phases in the PLC, namely development, introduction, growth, maturity, and decline. An in-depth understanding of each of these phases is essential for companies to implement the right strategies to ensure that their products are able to survive and provide sustainable profits.

1. Development Stage: The development stage is the initial phase in the PLC. At this stage, the product is still in the research and development (R&D)

phase before it is launched to the market. The main activities in this phase include product design, prototype testing, and economic and technical feasibility analysis. The product developed has not yet generated revenue because it is still to prepare for launch. Companies face major challenges in this phase, including high costs incurred for research as well as the risk of product failure. Therefore, the strategy that must be carried out is to ensure that the product meets the needs of the market and has a clear value proposition. According to research from (Dong et al., 2018), success in the development phase is highly dependent on an open innovation approach and collaboration among stakeholders to accelerate the R&D process and minimize the risk of failure.

2. Introduction Stage, Once the product is ready to be launched, the next stage is the introduction of the product to the market. The main focus in this stage is to build consumer awareness through marketing and promotional activities. The image above shows the important elements in this stage, such as building a customer base, forming a brand image, and setting product prices and distribution. The main strategy in the introduction stage involves an aggressive marketing approach to grab consumers' attention and introduce the product widely. However, at this stage, the corporation is often not yet profitable due to high promotion and distribution costs. According to an analysis from (Kotler dan Keller, 2016), marketing strategies in the introduction phase should focus on educating the market and creating demand pull to encourage product adoption by early consumers.
3. Growth Stage: The growth stage is characterized by an increase in demand for products, which has an impact on revenue and profit growth. In this phase, the corporation began to get a positive response from the market along with increasing awareness and acceptance of the product by consumers. The main driving factor for growth is the effectiveness of the marketing strategy carried out previously. Figure 63 emphasizes several important elements in this phase, such as increased profits, growing demand, and the emergence of the first competitors. Competition is a new challenge for companies, so differentiation and quality improvement strategies are the key to success. According to (X. Zhang, 2023; X. Zhang et al., 2023), continuous product innovation and improved customer experience can help companies maintain growth amid increasingly fierce competition.
4. Maturity Stage, The maturity stage is the peak of the PLC, where sales reach their highest point and growth begins to slow down due to a saturated market. In this phase, companies face challenges to maintain

market share amid increasingly fierce competition and declining profit margins. The main strategies in the maturity stage are maintaining customer loyalty, reducing production costs, and innovating to extend the PLC. Companies can also implement product differentiation or expansion strategies into new markets to prevent early declines. A study from (Zott & Amit, 2009) emphasizes the importance of business model innovation in the maturity phase as a step to create added value and extend the life of products.

5. Decline Phase, The decline phase occurs when the demand for products begins to decline due to changes in consumer preferences, new technology, or the emergence of replacement products. In the picture, this phase is characterized by declining sales and the need to innovate or terminate product production. In the downturn phase, companies must decide on the best strategy to manage products, such as reinventing, diversifying products, or pulling products from the market (ramp down). Research by (Zhu et al., 2021) states that sustainability approaches and continuous innovation can help companies mitigate the risk of product degradation.

Each stage in the PLC has different characteristics, challenges, and strategies. A deep understanding of PLCs allows companies to design strategies that suit market needs and product development stages. In a dynamic and competitive business environment, the ability to adapt and innovate is the key to success in managing the product lifecycle. In a recent study by (Chiaroni et al., 2022), companies that are able to implement sustainable innovation throughout the product lifecycle have a greater chance of maintaining growth and competitiveness in the global market. The PLC is a very important framework in product management, which includes five main phases, development, introduction, growth, maturity, and decline. Each phase has unique challenges, and companies need to implement the right strategies to ensure the product can survive in a competitive market. By understanding the product lifecycle and implementing continuous innovation, companies can maximize profits, extend product lifecycles, and stay relevant amid rapid market changes.

Chasm in innovation diffusion is a significant challenge that companies must face to ensure product acceptance in a wider market. This gap arises due to the difference in characteristics among visionary consumers in the early market and pragmatic consumers in the primary market. To overcome these challenges, companies need to implement strategies that include selecting the right market segments, providing evidence of product success, developing a supporting ecosystem, and implementing effective

marketing strategies. With the right approach, companies can overcome this gap and ensure the success of the product in reaching the majority of the market. Along with the development of technology and market dynamics, further research is needed to understand the factors that affect the success of products in crossing the abyss. Recent research has shown that peer influence, resistance to change, and community-focused strategy design are key factors in this process. Therefore, companies need to continue to innovate and adapt their approach to face the challenges of this increasingly competitive digital era.

12.5. Competition

The maturity phase in the PLC is a critical stage where the market has reached a point of equilibrium or saturation. This is characterized by slowing sales growth, increasing competition intensity, and reduced opportunities for further market penetration. In these conditions, the product is at the peak of its life cycle, where growth has stabilized and the market share begins to be competitively divided. The main mission for companies in this phase is to maintain the market position that has been achieved and increase competitiveness through innovation. Competition in this phase is getting tougher as market players focus on retaining existing customers and capturing competitors' customers through various creative and innovative strategies.

According to (Kotler dan Keller, 2016) in Marketing Management, the maturity phase requires a more strategic approach than the growth phase because companies can no longer rely solely on natural market growth, but must develop product innovation and marketing strategies to maintain competitiveness. Without consistent innovation, products will face the risk of declining faster due to market pressures and increasingly strong competition.

1. Characteristics of the Market Maturity Phase: The maturity phase is characterized by several characteristics that reflect market conditions that have reached the point of saturation. First, sales growth slowed down or even stagnated, although sales volumes were still relatively high. Second, competition among companies is intensifying, especially to maintain existing market share. Third, the emergence of pressure on prices as a result of aggressive competition. In this phase, a cost leadership strategy or operational efficiency is important to maintain profitability. According to (J. Zhang & Wang, 2022) in the framework of competitive strategy, companies need to focus on differentiation strategies and cost advantages to face the challenges of competition in a saturated market. Differentiation can be achieved through product innovation, improved customer service, and the creation of a unique value proposition that is difficult for

competitors to replicate. One of the main challenges in the maturity phase is the change in consumer behavior that is increasingly selective in choosing products. With a variety of options available in the market, consumers tend to choose products that bid greater added value, both in quality, features, and cost. Therefore, companies need to deeply understand consumer needs and respond to these changes quickly and appropriately.

2. Competition Dynamics in the Maturity Phase: Competition in the maturity phase of the market is often destructive if not managed properly. This condition is characterized by cost war strategies, excessive promotion, and increased marketing costs to retain customers. However, competition can also be a driver of innovation if companies are able to take advantage of challenges as opportunities to create a competitive advantage. A study from (W. Zhang & Pankratova, 2023) shows that companies that are able to innovate continuously and utilize digital technology have a greater chance of surviving in a saturated market. Continuous innovation includes product improvement, diversification, and exploration of new markets through digital transformation. Competition in this phase also involves the emergence of increasingly sophisticated substitution products, especially due to technological developments. Companies must be vigilant against this threat by continuing to conduct market intelligence and anticipate market needs before competitors take the same step. In this context, innovation includes not only products, but also business models, distribution, and communication with customers.
3. Strategies to Face Competition in the Maturity Phase, To overcome the challenges of competition in the maturity phase, companies must adopt a proactive and innovative strategy. Some effective strategies include:
    a. Product Innovation, Product innovation is the key to maintaining the attractiveness of products in the eyes of consumers. Companies can add new features, improve quality, or launch product variations to meet market preferences. According to research by (Chiaroni et al., 2022), companies that carry out incremental innovation tend to be more successful in extending the PLC than companies that only rely on pricing strategies.
    b. Differentiation and Service Improvement: Product differentiation and customer service are crucial factors to create a competitive advantage. Companies can focus on improving after-sales service, product personalization, and improving customer experience to maintain customer loyalty.

c. Operational Efficiency: Pressure on prices in the maturity phase forces companies to improve operational efficiency. The implementation of automation and digitalization technology can help companies reduce production and distribution costs.
d. Market Expansion and Diversification, Another strategy that can be adopted is to expand into new markets, both geographically and demographically. Product diversification is also a strategic choice to create new sources of income and reduce dependence on one product.

4. Innovation as a Driver of Competitive Advantage, In a saturated market, innovation is a key element to ensure that products remain relevant and competitive. Innovation includes not only the development of new products, but also processes, marketing, and business models. According to (Christensen, 2023), disruptive innovations can help companies find new market niches that competitors have not yet tapped into. The apply technologies such as artificial intelligence (AI), data analytics, and the Internet of Things (IoT) allows companies to understand customer needs more accurately and respond quickly to market changes. Digital transformation is an important pillar in maintaining the competitiveness of companies in the industrial era 4.0.

The maturity phase in the PLC is a critical stage characterized by high competition intensity and slowing market growth. To survive in these conditions, companies must adopt an innovation strategy that focuses on product development, service differentiation, operational efficiency, as well as market expansion. Continuous innovation and digital transformation are the keys to success in facing competitive challenges and creating a sustainable competitive advantage. With a deep understanding of market dynamics and the right strategies, companies are not only able to maintain market share, but also create new opportunities for long term growth.

12.6. Substitution / Closure

This level provides two options after a downtrend in the market, which is a turn or a close. Turnover refers to reinventing, opening up new markets, changing business models, and reinventing to seek and develop a competitive advantage. Meanwhile, closure is an act of stopping re-innovation due to the consideration that the technology is obsolete, and the object of innovation must be replaced. Business transformation is a crucial strategy for companies in dealing with market changes and technological advancements. One of the important steps in responding to market dynamics is to choose among switching or closing. Turnover focuses on re-innovation, opening up new

markets, and changing business models to create a competitive advantage. Instead, a closure is a decide stop a business when the technology used has become obsolete and no longer relevant to the needs of the market.

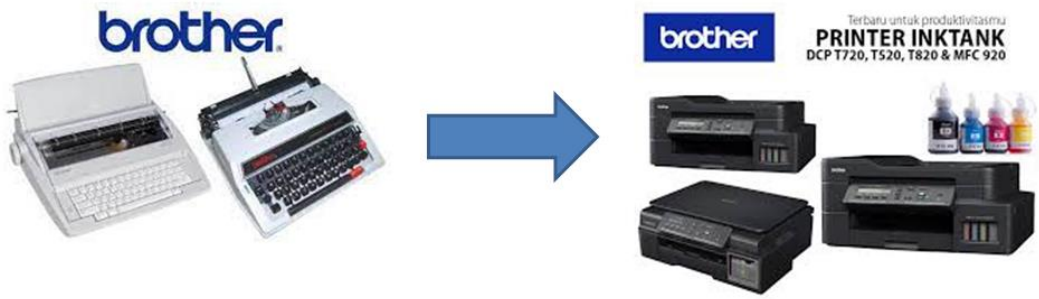

Figure 12.3. Brother's business transformation.

Brother Case Study (Figure 12.3), business transformation from typewriter to printer, Brother Company is a clear illustration of how a successful turnaround strategy is carried out. In the beginning, Brother was known as a typewriter manufacturer. However, as technology develops, especially in the era of computers and digitalization, the demand for typewriters has decreased drastically. This indicates that typewriter technology is obsolete and can no longer meet market needs. Rather than retaining an irrelevant business, Brother chose to innovate by leaving the typewriter business and switching to a printer manufacturer. Brother's business transformation demonstrates strategic adaptation to market changes. By developing innovative printer products, such as ink tank technology, Brother can enter new markets and create a competitive advantage. Ink tank printers bid better print cost efficiency and quality, in line with the needs of modern consumers, such as in the office and education sectors.

The decide make a switch has major challenges, including technology investment, innovation development, and business model changes. However, this strategy can open up new opportunities in the midst of technological disruption. In the context of the industrial revolution 4.0, innovation is the main key for companies to remain relevant in the market. According to (Baetens, 2020), successful business transformation requires a combination of technology, leadership vision, and organizational readiness to respond to change. In addition, research by (Azzam, 2023) emphasizes that companies must be able to solve innovation dilemmas by combining the exploration of new opportunities and the exploitation of old, still productive businesses. Brother, in this case, managed to identify new opportunities through modern

printer products while leaving old technologies that were no longer competitive.

Business transformation is not always easy. The main challenges include large investments, developing new technologies requires significant capital. Internal resistance: Change often encounters resistance from the internal side of the corporation. Market risk: Not all innovations are successfully accepted by the market. However, the opportunities offered by business transformation are enormous. Brother has successfully capitalized on this opportunity by entering the printer market and meeting consumer demand for more efficient and modern technology. This decision not only saved the corporation from the decline of the typewriter market but also brought Brother to become a global player in the printing industry. On the other hand, closure is a choice taken when innovation is no longer possible. Some companies choose to close their businesses due to limited technology and competitiveness. Closing can be a wise decision if investment for re-innovation is no longer profitable. Brother's case is clear proof that turnover through innovation and business transformation can be a strategic solution in the face of technological change. The decide leave the typewriter business and switch to the printer industry shows the importance of flexibility and adaptability in maintaining business sustainability. Turnover, while challenging, provides opportunities for companies to create a competitive advantage in the digital age.

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Chapter 13
KATSINOV INDICATORS

Amos Lukas, Eko Bhakti Susetyo

Innovation is the key to supporting economic growth and social development. In an effort to understand and manage the innovation process, appropriate measurement or metrics are critical. (Carayannis et al., 2018) explained that innovation metrics have undergone significant development, reflecting the needs and dynamics of each era. This chapter will discuss these developments which are divided into four generations, including input indicators, outputs, innovation indexes, and process indicators, which support various approaches to measuring innovation today.

13.1. Understanding the Ordinal Scale and Its Relevance in KATSINOV

First Generation: Input Indicators, The first generation of innovation metrics focuses on input indicators. This approach aims to measure the resources invested in the innovation process, such as research and development (R&D) budgets, the number of experts, and laboratory facilities. This input indicator describes the innovation potential that an organization or country has. In its time, this metric was very important because it provided an initial picture of an entity's scientific and technical capabilities in creating innovations. However, this approach has been criticized for focusing only on inputs, without reflecting the real results produced by such investments (Ovchinnikova & Dorf, 2024). In further analysis, this approach is considered less able to capture the impact of innovation at large.

Second Generation: Output Indicators, Answering the limitations of the first generation, the second generation of innovation metrics began to use output indicators. This indicator focuses on the results resulting from the innovation process, such as the number of patents issued, scientific publications, and new products that are successfully marketed. Output indicators are particularly relevant in this era, where countries are competing to show concrete results from their R&D activities. Research from (Boyanov, 2022) underscores the importance of output indicators in supporting data-driven decision-making related to innovation policies. This indicator provides a more real picture of the success of investment in innovation.

Third Generation: Survey-Based Innovation Index and Benchmarking, In the third generation, innovation measurement develops more complex. The

focus shifted from simple indicators to indices that integrate various related indicators. The index includes survey-based analysis, cross-country benchmarking, and measurement of organizational innovation capabilities. The use of this index reflects the need for a more holistic approach to understanding the innovation ecosystem. (Radziszewski, 2020) developed an innovation metric model based on fluid flow analogy to measure organizational innovation performance. The model is able to describe the position, speed, and obstacles to innovation at the macro and micro levels, providing valuable insights for improving innovation performance.

Fourth Generation: Process Indicators, The fourth generation presents a new approach with a focus on the innovation process itself. This approach includes measuring collaboration between agents, information flow, and innovation process efficiency. Process indicators are particularly relevant in the context of open and digital-based innovation, where speed and efficiency are the main determinants of innovation success. (Wang et al., 2021) mentioned that evolutionary game models can be used to analyze knowledge transfer in collaborative innovation between universities, industry, and research institutions. This approach helps identify obstacles and strategies to encourage sustainable innovation.

The development of innovation metrics from input indicators to process indicators reflects the transformation of our needs and understanding of innovation. Each generation presents a more comprehensive and relevant approach to global dynamics. In the digital era and open innovation, process-based metrics are a critical tool to drive collaboration and innovation efficiency. More research is needed to develop more adaptive metrics to future challenges.

13.2. Evaluation Process and Assessment Steps

In the context of understanding the KATSINOV indicators, participants are expected to be able to understand the key indicators or activities at each level of KATSINOV as the progress or achievement of an innovation process that is being carried out by innovation developers. Thus, the key activities on the worksheets and in the columns in the online KATSINOV are the conditions that describe the progress of the achievement up to the moment the measurement is made. So in the assessment it is associated with the following percentage of achievements: 0 = not met; 1=20%; 2=40%; 3=60%; 4=80%; 5=100% or fulfilled. If the stated progress in the condition of the main activity has not been met, then a value of 0 (zero) is given. If the progress as stated in the condition of the main activity is fulfilled by 20%, then a value of 1 (one) is given. And so on until the condition of progress reaches 100%, then a score of

5 (five) will be given. The KATSINOV (Innovation Readiness) indicator is an important evaluation tool to measure the progress of innovation from a process or product to the commercialization stage. In this context, each major activity related to innovation has a key indicator that reflects the achievement at the time the measurement is made. The KATSINOV assessment is carried out through a percentage system that represents the level of fulfillment of the main activities, ranging from 0% (not met) to 100% (fully met). This system is a comprehensive framework for identifying and evaluating the development of an innovation based on its stages.

The KATSINOV approach maps the progress of innovation based on measurably defined key activities. The evaluation is carried out by giving a score based on a scale of 0 to 5:

- 0: Not met.
- 1: Progress 20%.
- 2: Progress 40%.
- 3: Progress 60%.
- 4: Progress 80%.
- 5: 100% progress.

This framework provides objective guidance in determining the extent to which innovation developers meet the criteria or key activities that have been planned. This process is not only relevant in the research and development (R&D) stage but also in ensuring the readiness of innovations towards market implementation. KATSINOV assesses seven main aspects which include technology, market, organization, partnerships, risk, manufacturing, and investment (Fithri et al., 2024; Nur Rahmawati and & Amalia Suzianti, 2023; Zhao et al., 2021). Each of these aspects has specific indicators that aim to measure the readiness and potential for innovation in each relevant dimension. For example, in the technological aspect, indicators include the maturity of the technology or prototype being tested. In the market aspect, the evaluation focuses on the potential for market penetration and consumer segmentation. In the organizational aspect, the assessment includes internal capacity and innovation management mechanisms. The KATSINOV evaluation process is often carried out through a digital-based system, where developers can record and report on the progress of their innovations on a regular basis. This online-based system allows for better accessibility and transparency in evaluation (Mamasioulas et al., 2020; Radziszewski, 2020). In addition, the KATSINOV-based application allows real-time measurement of progress, so developers can identify constraints and devise mitigation measures. A study by (Fithri et al., 2024) shows that the

KATSINOV approach can help researchers and small and medium enterprises (MSMEs) in understanding the level of readiness of their innovations before entering the market. This process is essential to reduce the risk of innovation failure at the commercialization stage.

One of the main benefits of KATSINOV is its ability to provide a clear and systematic evaluation framework for innovation developers. Percentage-based assessments allow for flexibility in the interpretation of results and provide insight into priorities that need to be improved. In addition, the KATSINOV indicator can help create a more structured innovation roadmap. However, the implementation of KATSINOV also faces challenges, such as the need for consistent and reliable data in every major activity. Additionally, developers often face difficulties in assessing subjective aspects, such as risk and partnerships, which may require a qualitative approach. The KATSINOV indicator provides an effective tool for evaluating the progress of innovation at various stages of development. Through a simple but comprehensive percentage system, KATSINOV ensures that innovation developers have clear guidance in identifying the strengths and weaknesses of their innovations. The digital-based implementation of KATSINOV further strengthens the role of this framework in encouraging more prepared and competitive innovation.

In the world of innovation, the KATSINOV indicator is an important tool to measure the readiness and progress of an innovation. One of the main aspects that distinguishes the KATSINOV approach is the use of ordinal scales as the basis for measurement. This scale provides an overview of the percentage of achievement of innovation characteristics at each stage of development. A deep understanding of this ordinal scale is essential to assist innovation developers, assessors, and stakeholders in evaluating and directing strategic measures. Ordinal Scale-Based Assessment Steps

1. Identify Key Processes, The first step is to understand the key activities that the innovation project team needs to undertake. This includes activities that reflect critical stages of innovation development, such as technology trials, market validation, or prototyping.
2. Evaluation of Evidence of Progress, Once key activities have been identified, relevant data or evidence should be analyzed to assess the level of achievement. This evidence includes test reports, technical documents, or market survey data that can show real progress from key activities.
3. Giving Suggestions for Improvement, In addition to assessing progress, assessors can advise innovation developers on the steps needed to improve achievement. For example, recommendations to increase collaboration with external partners or allocate additional resources for research activities (Ozcan et al., 2024).

The ordinal scale approach provides significant benefits in the innovation assessment process:

1. Simplicity and Flexibility, The ordinal scale system is easy to understand by a wide range of stakeholders, including innovation developers and evaluation teams. Its percentage-based assessment also allows for flexibility in the interpretation of results.
2. Support for Decision Making, Information generated from ordinal scales can be used to determine priorities and more effective strategies. For example, activities with low scores can be used as the main focus to improve (Sartas et al., 2020).
3. Increased Collaboration, In many cases, innovation development involves various parties, such as researchers, technology developers, and investors. Ordinal scale-based assessments allow for better collaboration by providing a transparent evaluation framework.

While it offers many benefits, the implementation of ordinal scales also has its challenges. One of the main challenges is ensuring the consistency and accuracy of the data used for assessment. In addition, innovation developers may face difficulties in providing relevant evidence to support progress assessments. The use of ordinal scales in the measurement of KATSINOV indicators is a strategic step to ensure that the innovation process runs in a directional and measurable manner. With a focus on key activities, analysis of evidence of progress, and suggestion for improvement, this approach provides a clear and reliable evaluation framework. In the long term, the use of ordinal scales not only helps to improve innovation readiness but also supports the successful implementation of innovations in the market. To give an idea that each of the main activities contained in the KATSINOV indicator has a process "content" that will help the developer of innovations improve his innovation readiness, it can be seen in the following tables.

Table 13.1. KATSINOV 1

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
1	**T1**	New ideas that provide solutions to problems faced by society.	Review ideas	answer/solution to problems	No new ideas found that provide solutions.	New ideas are Incremental, don't offer a solution yet.	Ideas are Incremental and offer solutions.	Ideas are Distinctive and do not yet offer a solution.	Ideas are distinctive and offer the right solution.	Ideas are breakthrough and changing, and provide the right solution.
2	**T2**	Observations of basic scientific principles and scientific publications have been carried out	Scientific observations and publications	innovation topic	Observations of basic scientific principles and scientific publications have not yet been carried out.	Observations have been made but do not yet have strong scientific support.	Observations have been made that provide weak but scientific support for the success of realizing the idea.	Observations have been made that provide scientific support and are strong enough for the success of realizing the idea.	Observations have been made to provide strong scientific support for the success of realizing the idea.	Observations have been made so as to provide very strong scientific support for the success of realizing the idea.
3	**T3**	Uniqueness (USP/Unique Selling Point) or novelty has been identified.	Product novelty has been identified.	Products to be produced	The product to be produced does not have an element of novelty and is different from other findings.	Has the power to differentiate from other findings but does not have an element of novelty.	Has novelty but the power to differentiate from other findings is weak.	Novelty is incremental (develops little by little regularly) and has a strong differentiating force.	Novelty is distinctive, and the power of differentiation is strong.	Novelty is a leap and a strong force of difference.
4	**T4**	Research stages and targets have been identified	Creating research stages and setting targets	innovation topic	The research stages and targets cannot be identified yet.	The research stages and targets have reached the planning stage.	the target has reached the Planning and Implementation stage.	The research stages and their targets have reached the Planning, Implementation and Research Reporting stages.	Research stages and targets: Already Have a Prototype.	The prototype has been proven correct and safe.

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
5	**T5**	The technology to be developed is scientifically feasible	Test the feasibility of the technology used	Technology used	Not yet tested.	In preparation for Testing.	Preliminary Theory	Testing has been carried out, Preliminary Theory Testing has been carried out, intensively, but it cannot be concluded.	Preliminary Theory Testing has been carried out, intensively, almost conclusions have been obtained.	Preliminary Theory Testing has been carried out, intensively, conclusions have been obtained.
6	**M1**	Innovation is carried out based on customer requests and/or needs (as fulfillment of community needs as a solution to the problem)	Identifying potential customer requests	Product Plan	Product Innovation has not paid attention to market needs.	Innovation products pay little attention to market needs.	Innovation products are market needs oriented.	Innovation products are oriented towards market needs, but there has been no market research.	Innovation products are market needs oriented, there is market research, there has been no feedback from customers.	Product innovation is already oriented to market needs, there is market research, there has been no feedback from customers.
7	**M2**	Customer needs, wants and requests have been identified	Market Research	Product Plan	No market research done.	Market research has been carried out, but has not yet identified: customer wants, needs, demands.	Market research has been carried out and identified: customer needs.	Market research has been carried out and identified: customer desires.	Market research has been carried out and identified: customer demand.	Market research has been carried out, customer wants, needs and demands have been identified.
8	**M3**	The target market location has been identified	Identify market locations	Product Plan	Market research has not been carried out.	Prepare and start doing market research.	Market research has been carried out and identified: Geographic Variables.	Market research has been carried out and identified: Market location options to be targeted.	Market research testing is currently being carried out on the target market options.	Market research has been carried out and the market location to be targeted has been selected.
9	**O1**	Have an innovation strategy	Developing an innovation strategy	Innovation topic	Doesn't have an innovation strategy yet.	Preparatory stage for formulating an	In preparing innovation strategies.	Have developed a strategy, but not yet implemented.	Has developed a strategy, and has established	Has developed a strategy, and has defined and implemented an

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
						innovation strategy.			an innovation strategy.	innovation strategy.
10	**O2**	The project scope and tasks of the Innovation Team have been defined	Create a team work structure	Innovation topic	The project scope and team tasks have not been defined.	Preparatory stage for preparing the project scope and team tasks.	The stage of compiling the project scope and team assignments.	The preparation of the project scope and team tasks has been completed.	The preparation of the project scope and team tasks has been completed and is still in the process of being determined.	The preparation of the project scope and team tasks has been completed and has been determined.
11	**O3**	Required resources and services have been ascertained	Create activity plans and budgets	Innovation topic	There is no certainty about the human resources, natural resources and funding and research facilities needed.	Only has one certainty among: human resources, Laboratory, Source of Funds.	Already have two certainties between: human resources, Laboratory, Source of Funds.	Already have certainty of human resources, laboratories, sources of funds.	Already have certainty of human resources, laboratories, sources of funds, but still need other service support.	Already have certainty of human resources, laboratories, sources of funds, but still need other service support.
12	**O4**	Seamless communication channels are available	Plan communication mechanisms	Team	No Digital communication access.	There is only a Telephone line.	There are only telephone lines and a library.	There is a Telephone line and one of them: Internet Network or Library.	There is a telephone line and a library as well as an internet network.	There are telephone lines, internet networks, libraries and e-libraries.
13	**Mf1**	Identified the implications (consequences or direct results of the findings of a scientific research) basic manufacturing.	Identify manufacturing implications	Product plan	The basic implications for manufacturing have not yet been identified.	Preparation for the implementation of the initial identification of the basic implications of manufacturing.	An initial identification of the basic implications of manufacturing has been carried out.	Technical implications of manufacturing have been identified.	The basic implications of manufacturing technically and in the process of identifying the basic manufacturing economically	Identified the implications (consequences or direct results of the findings of a scientific research) basic manufacturing.

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
									have been identified.	
14	**Mf2**	Identified manufacturing concept	Identify manufacturing concepts.	Product plan	The manufacturing concept has not yet been identified.	Preparation for the implementation of the manufacturing concept identification.	An initial identification of the manufacturing concept has been carried out.	Manufacturing concept has been identified in terms of technical manufacturing processes.	The process of finalizing the manufacturing concept in the sense of an economical manufacturing process.	Manufacturing concept has been identified: Manufacturing process technically and economically.
15	**Mf3**	There is proof of manufacturing concept through analytics or laboratory experiments.	Validate the manufacturing concept	Product plan	The manufacturing concept validation has not been carried out through analytics or laboratory experiments.	The preparation stage validates the manufacturing concept through analytical or laboratory experiments.	An initial validation of the manufacturing concept has been carried out through analytics or laboratory experiments, with an achievement of 40%.	Manufacturing concept validation has been carried out through analytics or laboratory experiments with an achievement of 60%.	Manufacturing concept validation has been carried out through analytics or laboratory experiments with an achievement of 80%.	Validation of the manufacturing concept has been completed through analytical or laboratory experiments, and a manufacturing proof of concept has been obtained.
16	**I1**	There is a business model concept for the idea being developed.	Creating a Business Model	Product plan	Do not have a business model concept for the idea being developed.	Preparation and start drafting a business model concept based on the ideas developed.	Currently drafting a business model concept for the idea being developed.	The concept of a business model for the idea being developed is not complete and clear.	The business model concept for the idea developed is quite complete and clear.	The concept of a business model for a developed idea is complete and clear.
17	**I2**	There are results of customer, market and competitor analysis of the ideas developed.	Analyze.	Potential customers, markets, competitors product plans.	No customer, market and competitor analysis of the idea developed.	Currently starting to compile customer, market and competitor	There are only competitor analysis results from the developed idea.	There are only customer analysis results of the ideas developed.	There are only customer and competitor analysis results from the idea developed.	There are customer, market and competitor analysis results

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
						analysis of the idea being developed.				from the idea developed.
18	**I3**	There is evidence that the idea developed has provided a solution for the customer.	Validate product ideas.	Prospective customers	There is no evidence that the ideas developed have provided solutions for customers.	Starting to carry out experiments and pilots on the ideas developed that can provide solutions for customers.	Experiments and pilots have been completed (not yet analyzed based on strengths, weaknesses, opportunities and challenges-SWOT).	There is Weak evidence that the idea developed has provided a solution for the customer.	There is strong evidence that the idea developed has provided a solution for the customer.	There is very strong evidence that the idea developed has provided a solution for the customer.
19	**P1**	Develop a strategy to build networks and partnerships	Create a SWOT analysis	Plan a partnership model	There is no strategy to build networks and partnerships.	The preparation stage for developing a strategy to build networks and partnerships.	Identify strengths, weaknesses, opportunities and threats in building networks and partnerships.	SWOT analysis.	Analysis of internal and external factors to derive strategy.	A strategy for building networks and partnerships has been obtained.
20	**P2**	Potential partners have been identified.	Identify partners	Potential partners	Potential partners have not been identified.	Preparatory stage for identifying potential partners.	Initial identification regarding the relevance of partners to the development program being carried out.	Further identification, including: the relevance of partners to the development program being carried out, as well as maps of partners' roles and contributions.	The identification completion stage includes: the relevance of partners to the development program being carried out, a map of partner roles and contributions, as well as efforts to maximize	The results of identifying potential partners are available, including: the relevance of partners to the development program being carried out, a map of partner roles and contributions, as well as efforts

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
									partner roles and contributions.	to maximize partner roles and contributions.
21	**R1**	Technology risk assessment has been a consideration in every step of the research.	Carry out risk assessment	Stages of research/ development carried out	There was no technological risk assessment and it was not taken into consideration in any step of the research.	Research materials or technology risk studies are being prepared.	Technology risk assessment has been completed (not yet considered).	Risk assessment has been taken into consideration in several steps of the research.	Risk assessment has been a consideration in almost every step of the research.	Risk assessment has been a consideration in every step of the research.
22	**R2**	Preparation of technology risk control plans at the research stage.	Carry out risk assessment	Technology used	No technology risk control plan was prepared at the research stage.	Having ideas/ideas for technology risk control at the research stage.	The material outline of the technology risk control plan at the research stage has been prepared.	Begin to develop a technology risk control plan at the research stage.	The stage of completing the preparation of a technology risk control plan is at the research stage.	Developed a technology risk control plan at the research stage.

Table 13.2. KATSINOV 2

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
1	**T1**	Validation has been carried out on the individual components of the technology.	Validate by testing in laboratory and simulation environments.	Individual components and overall technology.	There has not been validation of the individual components of the technology.	Preparation for implementation of validation and testing of individual components of the technology separately.	Began to validate and test individual components of the technology separately in a laboratory setting.	Completed and passed the validation and test of individual components of the technology separately in a laboratory environment.	Began validation and testing in a simulation environment.	It has been completed and passed validation and tests in laboratory and simulation environments
2	**T2**	The prototype has been demonstrated in the relevant environment.	Creating a Prototype.	Product Design.	A (alpha) prototype demonstration has not yet been carried out in the relevant environment.	Preparation to carry out the stages of making prototypes (prototype) a (alpha).	A (alpha) prototype has been obtained and the actual operating environment conditions have been identified.	A prototype (alpha) has been obtained, the actual operating environment conditions are known, the success of modeling & simulation for the performance of technology systems in the operating environment.	Prototype a (alpha) has been obtained, the actual operating environment conditions, investment requirements for equipment, manufacturing processes, successful modeling & simulation for the performance of technology systems in the operating environment are known.	Prototype A (alpha) has been obtained, the actual operating environment conditions, investment requirements for equipment, manufacturing processes, modeling success, simulations for technological system performance in the operating environment, and based on the results of technical feasibility tests

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
										(engineering feasibility) have been obtained.
3	**T3**	The technology is declared technically feasible.	Doing modeling & simulation testing.	Prototype.	The technology is not yet technically feasible.	The preparation stage for making a prototype (prototype) a (alpha).	A prototype (alpha) was obtained.	Prototype (prototype) a (alpha) was obtained, and initial testing was carried out.	Prototype (prototype) a (alpha) was obtained, and testing iterations were carried out.	Technology is declared technically feasible (engineering feasibility) through testing.
4	**T4**	Intellectual property registration has been carried out (for example: patents, industrial designs, copyrights, brands, etc.).	Carrying out KI registration.	The resulting technology, industrial design, etc.	Intellectual property registration has not yet been carried out.	Stage of studying the requirements for registration of intellectual property.	The stage of preparing the requirements for intellectual property registration.	Stage of completing intellectual property registration requirements	Stage of intellectual property registration.	Have registered and have received proof of payment of the application fee.
5	**T5**	Technically able to provide solutions to problems faced by society.	Conduct technical feasibility studies.	Technology/ products produced.	Technically it has not provided a solution to the problems faced by the community.	The stage of identifying the need for solutions to the problems faced by the community.	The proposed system is quite practical because the available technology is sufficient to be applied.	Only conditions 1 and 2 have been met.	Only conditions 1, 2, and 3 have been met.	All four Technical Feasibility Requirements have been met.
6	**M1**	End customers identified.	Market research.	Potential end customers.	There is no identification of the end customers you want to target.	End customer identification process has started.	The initial process of identification of the final customer has been carried out.	The process of identifying the final customer has been completed.	End customer profile has been analyzed.	Detailed profiles of potential final customers are described in full.

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
7	**M2**	A detailed market launch plan has been issued.	Create a specific product launch plan or general business plan.	The resulting product.	Does not have a plan to launch a product to the market (business plan).	Have ideas about plans to launch products to the market.	An outline of the strategic plan for launching the product to the market has been prepared.	The product launch strategy document to the market is being prepared.	The analysis and finalization stage of the preparation of the product launch strategy document to the market.	A complete product launch strategy document (business plan) including STP and 4P has been completed.
8	**M3**	Intellectual capital has begun to be prepared.	Identify.	Infrastructure data, Human Resources qualifications & partner list.	There is no information regarding intellectual capital.	There are ideas/ideas for preparing intellectual capital.	Starting to prepare the details of intellectual capital.	Finalization stage of preparation of intellectual capital details.	Details of intellectual capital have been prepared and described incompletely.	Intellectual capital details have been prepared and described in full.
9	**O1**	An analysis and a business plan have been issued.	Make a business plan.	The resulting product.	Analysis and business plan have not yet been prepared.	Preparation of a business plan.	Start preparing the initial business plan.	Business analysis completion stage.	Business analysis has been completed, and business plan completion stage.	An analysis and a business plan have been issued.
10	**O2**	There is involvement of key individuals.	Make team qualification details.	Team and personnel qualification.	Does not own and involve key individuals.	Has several key individuals who have unique expertise, but are not actively involved.	Having several key individuals with their unique expertise, but not being given enough responsibility in strategic positions.	Having several key individuals with their unique expertise and given responsibility in strategic positions.	Having key individuals with unique skills who are difficult to replace (in relation to numbers), but have not been optimally given responsibility in strategic positions.	Having key individuals with unique skills who are difficult to replace (in relation to numbers) and given responsibility in strategic positions.

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
11	**O3**	The project requirements and list of project partners have been approved.	Prepare proposals and obtain approval from agency leadership.	Project requirements (time, budget, safety and partner plans).	There are no project requirements and a list of project partners yet.	In the process of identifying project requirements and a list of project partners.	There are already project requirements, but no partners yet, or vice versa.	There are project requirements and a list of project partners, but they have not been approved.	There are project requirements and a list of project partners, and are in the approval process.	There are project requirements and a list of approved project partners.
12	**O4**	Responsibilities and time limits have been agreed.	Identify types of work, authority and time limits.	Project plans.	There is no responsibility or agreement on the project deadline yet.	In the process of identifying burdens and responsibilities in project implementation, and the schedule preparation process.	There are project responsibilities, but there is no project deadline, or vice versa.	There are responsibilities and agreed project deadlines, but they have not been approved.	There is already a person in charge and a project deadline, and it is in the approval process.	There is a person in charge and an agreed project deadline.
13	**Mf1**	Identification of technology and critical components is complete.	Identify critical technologies and components.	Developed technology/products.	The technology and critical components have not been identified.	Preparation of technology identification and critical components.	Initial identification of technology & critical components began with 40% achievement.	Identification of technology and critical components in progress with 60% achievement	Identification of critical technology and components in progress with 80% achievement.	Completely (100% achievement) technology and critical components have been identified.

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
14	**Mf2**	Materials, tools and prototype test equipment, as well as personnel expertise have demonstrated the readiness of the sub system/system in a relevant production environment.	Prepare materials, tools and prototype testing tools, as well as personnel expertise.	Developed technology/ products.	It has not been shown the readiness of the sub system/ system in a relevant production environment.	The initial preparation stage builds the readiness of the sub system/system in a relevant production environment.	It has been demonstrated that the readiness of the sub system/ system in a relevant production environment includes material readiness.	It has demonstrated the readiness of the sub system/ system in a relevant production environment which includes the readiness of materials and tools.	Have demonstrated the readiness of the sub system/ system in a relevant production environment which includes the readiness of materials, tools and prototype test equipment.	Have demonstrated the readiness of the sub system/ system in a relevant production environment which includes the readiness of materials, tooling, prototype test equipment, and personnel expertise.
15	**I1**	There is a selling point advantage (Market Value Proposition/MVP) and has been tested on customers.	Identify the advantages of selling points (value proposition).	The resulting product.	Not yet identified the advantages of selling points.	Has superior selling points but has not conducted a maret survey.	The superior selling value (value proposition) is being tested through a market survey.	Having superior sales value compared to competitors for a limited market.	The superior selling value (value proposition) is being verified and validated through applied trials for a wider market.	Has advantages over competitors and has been tested in a wider market survey.
16	**I2**	The solutions offered to customers generate favorable traction in the market.	Conduct market research and testing.	The resulting product.	There is no evidence that the solutions offered to customers generate a profitable appeal in the marketplace.	The idea developed into a prototype according to customer needs.	The prototype developed has more value than competitors.	The prototype developed is market tested.	Profit projections are carried out for the prototype developed.	Obtained profit projections from the prototype being developed.

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
17	**I3**	There is evidence that validation of the value proposition, channels, customer segments, relationship models with existing customers, and revenue streams has been carried out.	Validate MPV, customer segments, channels, relationships with existing customers and revenue streams.	The resulting product.	There is no evidence of: validating the value proposition, channels, customer segments, relationship models with existing customers, and revenue streams.	Defined MPV and customer segments.	Channels and relationship models with existing customers have been defined.	Revenue flow analysis has been produced.	Validation has been carried out between MPV, customer segments, channels, relationships with existing customers and revenue streams.	The evidence is interrelated in determining the flow of revenue.
18	**P1**	Information mining and partner selection have been carried out.	Dig up partner information, partner selection criteria and prepare partner database.	Prospective Partners.	Information exploration and partner selection have not been carried out yet.	Partner information mining is carried out.	Obtained partner database, and preparation of criteria for partner selection.	Obtained partner database and criteria for partner selection.	Partner database and partner selection criteria were obtained, and partner selection began.	Information mining and partner selection has been carried out, and a partner database, partner selection criteria and potential partner selection results have been obtained.

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
19	**P2**	Building a more appropriate partnership pattern.	Review partnership patterns.	Potential partners.	The right partnership pattern has not yet been developed.	Examining the concept of partnership patterns.	A more precise partnership pattern concept has been obtained.	A more precise partnership pattern concept has been obtained.	Efforts to build a partnership pattern based on the drafted concept.	A more appropriate partnership pattern has been built in business development to achieve common business goals.
20	**R1**	Technology risk studies have been carried out in every step of technology development	Risk assessment.	Technology development activities.	There is no technology risk assessment and is not considered in every stage of technology development.	Research materials or technology risk assessment are being prepared at each stage of technology development	Technology risk assessment at each stage of technology development have been completed (not yet considered).	Risk assessment has been considered in several stages of technology development	Risk assessment has been considered in almost every stage of technology development.	Risk assessment has been considered in every stage of technology development
21	**R2**	Preparation of technology risk control plans at the technology development stage.	Develop a risk control plan.	Technology development activities.	There is no technology risk control plan prepared at the technology development stage.	Have ideas/ideas for technology risk control at the technology development stage.	The material outline for the technology risk control plan at the technology development stage has been prepared.	Begin to prepare a technology risk control plan at the technology development stage.	Completion of the technology risk control plan preparation at the technology development stage.	Compile a technology risk control plan at the technology development stage.

Table 13.3. KATSINOV 3

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
1	**T1**	The actual system of technology has been demonstrated in a real environment.	Finishing the prototype ***β*** (beta) and testing in a real environment.	Prototype.	No prototype yet.	Prototype in the process of completion.	The prototype is complete.	The prototype is currently in the testing phase in a real environment.	The prototype has been completed in testing in the actual environment.	Has been successful in the prototype testing stage.
2	**T2**	External testing of the technology developed has been carried out completely in order to meet technical requirements and regulatory compliance.	Perform external test.	Prototype.	External testing has not been carried out.	Prepare external tests.	Starting to carry out external tests.	External test runs 60%.	External test runs 80%.	A certificate of external testing results has been obtained.
3	**T3**	Documentation of the developed technology has been carried out. Recording activities, documenting work instructions, and periodic technical reports.	Technology development activities.	No documentation done.	Stage: recording of activities, documentation of work instructions, and periodic technical reports.	In the process of managing activity records, documentation of work instructions, and technical reports systematically.	In the management of activity records, documentation of work instructions, and technical reports systematically.	But not yet documented.	In the management of activity records, documentation of work instructions, and technical reports systematically.	Documented but not organized & structured. Documentation is organized and structured.
4	**T4**	The technology being developed has been launched, or the	Introducing innovations.	Innovation results.	Not yet introduced the results of innovation.	Planning introduces innovation results. But it	Planning introduces innovation results. It's been	In preparation for introducing innovation results.	The results of the innovation have been introduced.	Innovation results have been introduced, and

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
		innovation results have been launched.				hasn't been decided yet: when, where, who, and how.	decided: when, where, who, and how.			are acceptable to the market.
5	**T5**	Intellectual property has been obtained (e.g. patents, industrial designs, copyrights, brands, etc.).	Manage Intellectual Property certificates.	Innovation results.	No intellectual property has been acquired.	Study the requirements for obtaining intellectual property.	Preparation of requirements for obtaining intellectual property.	Have received a submission letter from the Director General of Intellectual Property Rights.	Waiting for the issuance of the intellectual property certificate.	An intellectual property certificate has been obtained.
6	**M1**	Specific needs and customer requirements (as fulfillment of community needs as a solution to the problem) are known.	Identify and analyze customer needs and expectations.	Prospective customers.	Identification and analysis of customer needs and expectations have not been carried out.	Initiating identification: analysis of customer needs and expectations.	Pouring the results of the analysis of customer needs and expectations into writing.	Identification and analysis of customer needs and expectations are being carried out.	Identification and analysis of customer needs and expectations has been completed.	Identification and analysis of customer needs and expectations has been completed and validated.
7	**M2**	Segment, size and market share have been predicted.	Surveys and studies to predict segments, size and market share.	Prospective customers.	Segments not yet predicted.	Preparation of surveys and studies for market segment, size and share predictions.	The baseline and outline of the data research material have been prepared.	The baseline and outline of the data research material are in the implementation stage.	The basic outline and outline of the data research material have been completed.	The baseline and outline of the data research material have been completed and validated.
8	**M3**	Prices and product launches have been issued.	Make price estimates, product introduction plans.	The resulting product.	There is no price estimate yet.	There are already price estimates, but there are no plans for product introductions yet.	There is already a price estimate, there is already a product introduction plan.	Prices have been estimated, thereare plans for introduction, but product types have not been detailed.	Prices are estimated according to product type, but not complete.	Prices are estimated according to the complete product type.

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
9	O1	Formalize the organization (business structure with staff and collaborators).	Carrying out de jure and de facto organizational formalization.	The organization that will run the business.	There has been no demand for organizational determination.	There are already business demands but no effort has been made to establish an organization.	Because there were business demands, efforts began to be made to establish an organization.	Efforts for organizational formalities have been carried out, although not yet de jure or de facto.	Efforts to formalize the organization have been carried out but this has only been done one way, either de facto or de jure.	De jure and de facto organizational formalities have been carried out to meet business demands.
10	O2	Identify any additional staff needed.	Identify, evaluate and plan Human Resources.	Human Resources.	There are no ideas related to: Human Resources identification, evaluation and planning to determine the need for additional staff.	The need for additional staff was carried out without identifying, evaluating and planning human resources.	In determining the need for additional staff begins to consider the identification, evaluation and planning of human resources.	The need for additional staff has been made based on the results of Human Resources identification, evaluation and planning, although not yet structured and systematic.	The need for additional staff has been structured based on the results of HR identification, evaluation and planning.	The need for additional staff has been structured and systematic through the process of identifying, evaluating and planning human resources.
11	O3	Distribution of responsibilities and workload..	Dividing responsibilities and workload, in a structured and systematic manner	Human Resources and its Structure.	There is no division of responsibilities and workload.	Stage of identifying the division of responsibilities and workload.	The division of responsibilities and workload has been identified.	Start implementing the division of responsibilities and workload.	The division of responsibilities and workload has been implemented, although not yet in a structured and systematic manner.	The division of responsibilities and workload has been implemented in a structured and systematic manner by adapting to business demands.
12	Mf1	The system design is mostly stable and	Make a system design and conduct	Product design.	System design has not yet been obtained.	The process of forming a system design.	System design formation process.	The system design began to be tested and evaluated.	Repetition of system design tests and evaluations to	It has been obtained that the system design is mostly

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
		proven in tests and evaluations.	tests and evaluations.						obtain system design stability.	stable through testing and evaluation.
13	**Mf2**	Proven manufacturing processes and procedures on a pilot scale.	Perform testing and validation of manufacturing processes and procedures on a pilot scale.	Beta Prototype.	Still at the stage of developing manufacturing processes and procedures on a laboratory scale.	In the process of testing and validating manufacturing processes and procedures on a laboratory scale.	Manufacturing process and procedure development activity stage on a pilot scale.	Manufacturing processes and procedures have been obtained on a pilot scale, and testing and validation of manufacturing processes and procedures on a pilot scale has begun.	In the process of repeating the test and validation of manufacturing processes and procedures on a pilot scale.	Manufacturing processes and procedures have been proven in pilot scale tests and validations.
14	**Mf3**	Production is carried out at low rates.	Carrying out production at low rates.	Product design.	A detailed system design or production method has not yet been made.	Detailed system or production method design is being carried out through engineering and manufacturing development activities.	A detailed system design or production method has been obtained.	The testing phase is currently being carried out on the results of the system design or detailed production methods.	The test iteration stage of the system design results or detailed production methods has been shown to be stable.	Low rate initial production has been implemented.
15	**I1**	Successfully define the end state of a technology product taking into account the entire target person, vertical market, and/or geography.	Analyzing the market against customer categories (target person, vertical market and preferences or trends in geographic areas).	The resulting product.	Has not yet defined the final conditions of the technology product by considering the target person, vertical market, and geography.	Business chain analysis has been carried out.	The target person, vertical market and preferences or trends in the geographic area have been identified.	Market analysis has been carried out on 2 of 3 customer categories.	Market analysis has been carried out on all customer categories.	Products are developed according to the preferences of all customer categories.

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
16	**I2**	Validation of the business carried out.	Analyze business feasibility (market potential, technical feasibility, and financial feasibility).	The resulting product.	Not yet validating the business carried out.	There is already a canvas business concept.	The canvas business model concept is comprehensive	Aspects of financial feasibility analysis have been identified.	A financial feasibility analysis has been carried out.	The business being developed has fulfilled the financial feasibility analysis.
17	**I3**	Identification and validation of key performance indicators that indicate business success.	Develop a business plan with KPI (Key Performance Indicators).	The resulting product.	There is no evidence of a feasibility study for establishing key performance indicators for business feasibility and success.	There is weak evidence that key performance indicators (KPI) are indicative of business success.	Weaknesses in the evidence are being refined.	Refinement of the proof has been completed.	Evidence of KPI determination of business feasibility and success has been analyzed.	KPI's determination of business feasibility and success has been validated
18	**P1**	A formal partnership was carried out.	Draw up a formal agreement.	Engaged partners.	In exploring establishing partnerships.	Partnerships are starting to be established that are not yet formal and binding.	The stage of looking for a formal and binding partnership pattern.	It was agreed to enter into an agreement that is binding on both parties involved.	Preparation of agreement documents that are binding on both partners.	The partnership pattern has been agreed in the form of an agreement, legally the partnership has provided a bond for the two partnering parties.
19	**P2**	Develop and implement cooperation plans.	Develop cooperation plans (MOU, Gentlemen's agreement,	Engaged partners.	Partnership cooperation plans have not yet been made.	The exploration phase of the cooperation plan that will be prepared.	Began to jointly draft a plan of cooperation.	Completion of cooperation plan documents.	The cooperation plan document has been obtained.	There have been documents and implementation of the

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
			work contracts).							cooperation plan.
20	**R1**	Technology risk studies are the basis for technical decision making at the engineering & operation stage.	Conduct a risk assessment of potential failure.	Application of technology or implementation in projects, products, processes and business.	No risk control plan was prepared at the engineering and operation stages.	Start initiating and preparing risk control plans at the engineering and operation stages.	An outline of the risk control plan has been prepared at the engineering and operation stages.	A technology risk control plan is being prepared at the engineering and operation stages.	Completed preparation of technology risk control plans at the engineering and operation stages.	The technology risk control plan at the engineering and operation stages has been validated.
21	**R2**	Preparation of technology risk control plans at the engineering & Operation stage.	Develop a technology risk control plan.	Stages of application of technology.	No risk control plan was prepared at the technology implementation stage.	Start initiating and preparing risk control plans at the technology implementation stage.	An outline of a risk control plan has been prepared at the technology implementation stage.	A technology risk control plan is being prepared at the technology implementation stage.	Completed preparation of technology risk control plan at technology implementation stage.	The technology risk control plan at the technology implementation stage has been validated.

Table 13.4. KATSINOV 4

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
1	T1	Expertise related to the operation and maintenance of technology products has been formed.	Prepare a manual containing technical specifications, how to use/operate, how to maintain, and technical instructions if problems occur (trouble shooting), and includes a Customer Service address.	The resulting product.	There is no manual yet.	Technical specifications are available only.	Available technical specifications and how to use.	Available technical specifications, how to use and how to care.	There are technical specifications, how to use, how to maintain and technical instructions if a problem occurs.	There are technical specifications, how to use, how to care, technical instructions if a problem occurs and is equipped with a customer service address.
2	T2	The general use of technology products by the broad market (as meeting people's needs as a solution to their problems) has been identified.	Identify the general and specific uses of the product offered.	The resulting product.	Common uses have not been identified.	At the test and validation stage in the laboratory environment.	At the test and validation stage in conditions that almost resemble the environment.	At the test and validation stage in actual environmental conditions.	It has obtained a stable technological system.	It has established the general use of technology products by the broad market.
3	T3	Identification of key benefits has been carried out through test results.	Conducting new product testing, including testing: 1). technical (Technical Testing); 2). preferences and satisfaction; 3). market	The resulting product.	Tests have not been carried out to identify the advantages of technology.	Test preparation stage for identification of technological advantages.	Began testing to identify the advantages of technology.	Intensive testing has been carried out, but the technological advantages cannot be identified.	Intensive testing has been carried out, the technological advantages have been identified.	The identification of the advantages of the technology has been obtained.

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
			simulation; and, 4). market.							
4	T4	There is support for the adoption of technology products by the market.	Creating educational media for the market through information on the advantages of the products offered, as well as emphasizing the solutions offered.	Target customers.	There is no support for the adoption of technology products by the market.	Initial stage: The process of educating the market.	Market awareness has been awakened for technology products.	Market awareness and interest in technology products has been awakened.	Awareness, interest and trying technology products have been built.	There has been adoption of technology products by the market.
5	M1	Do market positioning.	Carrying out market analysis and competitor analysis in an internal company analysis (total situation analysis).	The market for the products produced.	Not yet building an image of technology products to the market.	Preparation to build the image of technology products to the market.	Develop a strategy outline and content analysis to build the image of technology products to the market.	Stage of completing strategy and content analysis to build the image of technology products to the market.	Strategies and content analysis to build the image of technology products to the market have been prepared.	The results of content analysis and strategies for building the image of technology products to the market have been implemented factually.
6	M2	Business model set.	Define a Business Model Canvas (BMC).	Developed business.	The business model has not been defined.	Preparation of business model design.	An outline of the business model concept and materials has been prepared.	Business model design and completion.	The results of the business model design have been analyzed.	The business model has been defined.

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
7	M3	Competitors are well identified. Analyzing	Competitors.	Completeness, quality, design and product form; the price offered; distribution channels or branch locations owned; promotions carried out; future competitor activity plans.	Competitors have not been identified.	Preparation of competitor identification studies.	An outline of the competitor identification concept has been prepared.	A competitor identification study has been designed and completed.	The results of the competitor identification study have been analyzed.	Competitors have been identified and determined.
8	M4	Marketing is emphasized on properly introducing technology products to customers.	Develop an outline of strategy and product introduction (promotion) materials to customers in the market.	Products offered.	The product introduction stage has not yet been carried out to its customers in the market.	Preparation of product introduction (promotion) strategy to its customers in the market.	Began to develop an outline of the strategy and product introduction (promotion) materials to its customers in the market.	Introductory (promotion) strategy and materials have been analyzed.	Strategy and introductory material (promotion) began to run.	Promotion and marketing run effectively so that the company gets added value.
9	O1	Determine the form of organization.	Taking care of the legal entity of the planned business organization.	The planned organization is formed.	There is no organization yet.	There has been an R&D organization.	The process of changing an R&D organization into a business organization, even though the organizational form has not	The R&D organization has become a business organization, although the organizational form has not yet been determined.	The R&D organization has become a business organization and the organizational form has been determined. But not yet a legal entity.	There have been forms of business organization and legal entity.

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
							yet been determined.			
10	O2	Develop partnerships with independent organizations.	Introducing products (promotions) to attract the interest of distributors so they want to sell the products offered.	The resulting product.	Partnership development with independent organizations has not yet been carried out.	Preparatory stage for developing partnerships with independent organizations.	Starting to develop partnerships with independent organizations.	Partnerships with independent organizations have developed, but they are not yet formal and binding.	Starting to build partnerships with independent organizations that are formal and binding.	A formal and binding partnership with an independent organization has been established.
11	O3	Identify opportunities for product introduction to new partners and markets.	Manage Company Establishment Deed, TDP (Company Registration Certificate), SIUP (Trade Business License), Company Domicile Information, and Interference Permit, etc.	Established business organization.	There have been no new products introduced to new partners and markets.	New product development stage.	Completion stage of new product development	A new product has been obtained which is ready to be introduced to the market.	The process of identifying opportunities to introduce products to new partners and markets.	Opportunities to introduce the product have been identified and introductions have begun.
12	Mf1	Shows production at full speed and execution.	Carry out full-scale production.	Production activities.	A detailed design and production method system has been obtained, but it has not shown a financially	The test phase is being carried out on the results of detailed system design or production methods that are financially profitable.	Repeated test stages against the results of detailed system design or production methods, and have shown stability.	Production has been carried out but the financial profit is still low.	Financially profitable production preparation in the test and evaluation phase.	A financially profitable production has been carried out.

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
					profitable production.					
13	Mf2	Start implementing production to meet safety, quality and legal requirements, for example: GMP (Good Manufacturing Practice) or CPPOB (Good Manufacturing Practices), GMP (Good Manufacturing Practices of Drugs), CPIB (Good Fish Hatchery Practices), Standards Car Manufacturing, etc.	Implement production that meets safety, quality and legal requirements, for example: GMP or CPPOB (Good Processed Food Production Practices), GMP (Good Medicine Production Practices), CPIB (Good Fish Hatchery Practices), Car Manufacturing Standards, etc.	Production activities.	Production has not met the safety, quality and legal requirements imposed nationally and internationall y.	Preparatory stage for managing safety, quality and legal requirements that apply nationally and internationall y.	Administrative arrangements for safety, quality, and legal requirements that are enforced nationally and internationall y have begun.	The verification and/or appraisal stage by authorized institutions in order to obtain provisions on safety, quality and legal requirements that are enforced nationally and internationall y.	It has been declared to comply with safety, quality and legal requirements imposed nationally and internationally.	Production has implemented and complied with the safety, quality and legal requirements imposed both nationally and internationally.
14	Mf3	Start implementing quality assurance according to certain required standards.	Implement quality assurance according to certain required standards.	The resulting product.	Not yet implementing quality assurance.	Preparatory stage for implementing quality assurance.	Start implementing quality assurance.	The management stage of obtaining quality assurance accreditation	Verification and/or appraisal stage by authorized institutions in order to obtain quality assurance accreditation according to	Has obtained a certificate and implemented quality assurance according to certain required standards.

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
									certain standards.	
15	Mf4	There are public demands for the quality, safety and security of the products used.	Conduct surveys and questionnaires.	Customer feedback. Regarding the quality, security and safety of the products used.	There is no awareness of paying attention to society's demands regarding the quality, safety and security of the products used.	The stage of emergence of initial awareness to accept and meet the demands of society for the quality, safety and safety of the products used.	The stage of making efforts to obtain responses or feedback from the public or their customers regarding the quality, safety and safety of the products used.	Have received responses or feedback from the public or their customers regarding product quality, safety and safety, but have not made efforts to meet these demands.	Has received and fulfilled demands for product quality, security and safety.	Has received and optimally fulfilled the demands of the community or its customers for the quality, safety and safety of the products used.
16	I1	Identified market potential.	Analyzing market potential, we can estimate consumer absorption of the products/services we want to offer.	Target market.	Market potential has not yet been identified.	Starting to identify market potential.	Market potential has been identified.	The identified results of market potential began to be analyzed.	The results of identifying market potential have been analyzed.	The consumer's absorption capacity for the products/services offered has been estimated through identification and analysis of market potential.
17	I2	Identified product/service acceptance in the market.	Identify the acceptability of products/services in the market, and consider this in preparing marketing strategies.	Market for the products produced.	The product/service acceptance in the market has not yet been identified.	Preparation for identifying product/service acceptance in the market.	The acceptance of products/services in the market has been identified.	The results of identifying product/service acceptance in the market have been analyzed.	The results of identifying product/service acceptance in the market have been analyzed.	The results of the analysis identifying the acceptability of products/services in the market have been taken into consideration in preparing

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
										marketing strategies.
18	P1	Collaboration within the network has been carried out dynamically.	Arranging cooperation in networks: production; marketing; service; cooperation, etc.	Partner.	Does not see the partner network as strategic for the success of the business.	Awareness is starting to emerge that building collaboration within networks dynamically is strategic for business success.	Start searching for networks that can support your business.	Has found and started to build cooperation in networks that can support its business.	Has done and utilized cooperation in networks but not yet dynamic.	Has carried out and utilized collaboration within the network dynamically.
19	P2	Management of existing collaborations is carried out.	Implementing all agreed cooperation plans, and managing (maintaining, strengthening and developing) existing cooperation.	Collaboration Plan created.	Collaboration has been built, but there is no follow-up.	Still in the planning stage for implementing the collaboration	There has been an agreed cooperation implementation plan, but implementation is still zero.	Part of the agreed cooperation plan has been implemented	Has implemented all agreed cooperation plans.	Has implemented all agreed cooperation plans, and managed ongoing cooperation.
20	R1	Preparation of non-technological risk control plans (organizational and social) at the stage of product introduction to the market.	Develop a non-technological risk control plan (organizational and social).	Stages of product introduction to the market.	There is no plan for controlling non-technological risks at the stage of product introduction to the market.	Have a plan and preparation for non-technological risk control at the stage of product introduction to the market.	Start preparing non-technological risk control plans at the stage of product introduction to the market.	The stage of completing the preparation of a non-technological risk control plan is at the stage of product introduction to the market.	Compiled a non-technology risk control plan at the stage of product introduction to the market.	The non-technology risk control plan at the product introduction stage has been validated.

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
21	R2	Assessment of organizational risks (in particular financial indicators) at the stage of product introduction to the market.	Conduct organizational risk assessment (especially financial indicators).	At the stage of product introduction to the market.	Organizational risk assessment (especially financial indicators) have not been carried out at the stage of product introduction to the market.	Preparation for carrying out organizational risk assessment (especially financial indicators) at the stage of product introduction to the market.	The concept and outline for implementing organizational risk studies (especially financial indicators) at the stage of product introduction to the market have been prepared.	Start conducting organizational risk assessment (especially financial indicators) at the stage of product introduction to the market.	The results of the organizational risk assessment (especially financial indicators) at the stage of product introduction to the market have been compiled.	Validated results of organizational risk assessment (especially financial indicators) at the stage of product introduction to the market have been obtained.
22	R3	Study of social impact risks at the stage of product introduction to the market.	Social impact risk assessment.	Stages of product introduction to the market.	A social impact risk assessment has not been carried out at the product introduction stage to the market.	Preparation for carrying out social impact risk studies at the stage of product introduction to the market.	The concept and outline of the social impact risk assessment for the product introduction stage to the market have been prepared.	Starting to carry out social impact risk studies at the stage of product introduction to the market.	The social impact risk assessment at the stage of product introduction to the market has been completed.	The results of the social impact risk study at the product introduction stage to the market have been validated.

Table 13.5. KATSINOV 5

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
1	**T1**	There is a guarantee for technology products that are marketed.	Providing a full official guarantee (free service, replacement of spare parts, or replacement of new units) as an effort to protect consumers and an effective promotional tool.	Marketed products.	Have not considered warranty as a means of consumer protection and an effective promotional tool.	A collective awareness has emerged from manufacturers to provide guarantees to consumers.	Stage of review of granting guarantees to consumers.	Has provided an official warranty in the form of a free warranty service.	Has provided an official warranty in the form of a free warranty service and replacement of spare parts.	Has provided a full official guarantee (free service guarantee, spare part replacement, new unit replacement) as an effort to protect consumers and an effective promotional tool.
2	**T2**	Technology product maintenance and/or repair services are provided.	Provide maintenance and/or repair services for technology products.	Customer.	There is no after-sales service center available, either during warranty or after warranty.	Preparation for the provision of an after-sales service center, both during warranty and post-warranty.	Becoming available centralized (at the manufacturer's main office) after-sales service center, both during warranty and post-warranty.	An after-sales service center is available, both during warranty and after warranty, in the city where the manufacturer is located.	After-sales service centers are available, both during warranty and after warranty, in several major cities.	There are after-sales service centers, both during warranty and after warranty, in all major cities.

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
3	**T3**	Supply of spare parts for technology products is provided.	Provide supply of spare parts for technology products.	Produced product market.	There is no supply of spare parts for technology products.	Preparation of supply of spare parts for technology products.	Began to provide centralized (at manufacturers' headquarters) supply of spare parts for technology products.	There is a supply of spare parts for technology products, through after-sales service centers and distributors in the city where the manufacturer is located.	Supply of spare parts for technology products is available through after-sales service centers and distributors in several major cities.	Supply of spare parts for technology products is available, through after-sales service centers and distributors in all major cities.
4	**T4**	There are development activities with a lower intensity in order to increase the performance of technology products according to customer requests.	Feedback on customer complaints through improvements in product quality, function and performance.	Product competitiveness in the market.	No longer doing development	There has been no significant development, only quality improvement through Quality Assurance mechanisms during production.	Activities not only improve quality through Quality Assurance mechanisms during production.	Continuous development activities have been carried out in an effort to answer customer complaints by improving product quality according to customer requests.	Continuous development activities have been carried out in an effort to answer customer complaints through improving product quality and function.	Continuous development activities have been carried out in an effort to answer customer complaints by improving product quality, function and performance.
5	**M1**	Providing complete services and solutions.	Providing complete services and solutions.	Customer.	Product/technology guarantee letter marketed.	List of product/technology components that are easily worn or damaged.	List of spare parts that must be provided to support after-sales service.	List of technical services to be provided to support after-sales service.	List of after-sales service locations.	Information on after-sales service locations, service access, service facilities, service accountability, product availability and human resource competency

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
										based on product needs.
6	**M2**	Carry out product differentiation.	Carry out product differentiation.	Products marketed.	There is no product differentiation.	There is a product differentiation strategy plan.	A product differentiation strategy plan has been prepared.	Product differentiation strategies are starting to be implemented.	The company has not optimally implemented a product differentiation strategy.	The company implements product differentiation strategy optimally.
7	**M3**	Business model refinement.	Evaluate and refine the business model.	Business models.	No evaluation and improvement of the business model was carried out.	Evaluation planning stage and refinement of the business model.	Starting to evaluate and refine the business model business model.	Obtained the results of the evaluation and stage of refinement of the business model.	The business model has been refined based on the evaluation results.	Business model enhancements have been verified and validated.
8	**M4**	Using partnerships to compete in the marketplace.	Using partnerships to compete in the marketplace .	Marketing.	Partnerships have not been considered as a factor influencing competitiveness.	Already have a business partnership strategic plan	Partnership strategy plan has been implemented but not optimal.	Partnership has been optimized for technical aspects (product development, production process improvement, quality improvement, and access to technology).	Partnerships are optimized for aspects of market expansion, distribution, raw material suppliers, increasing profits and acquiring new customers.	Partnerships have been established in various aspects from upstream to downstream with mutual benefit.

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
9	**O1**	Increase organizational effectiveness and collaboration.	Improving organizational effectiveness and collaboration.	Existing organization.	There has been no effort to increase organizational effectiveness and collaboration	Awareness is starting to emerge about efforts to increase organizational effectiveness and collaboration	Consciously make efforts to increase organizational effectiveness & cooperation.	Organizational effectiveness & cooperation has been increased so that the achievement of the organizational vision, organizational human resources and aspirations are fulfilled	Organizational effectiveness and cooperation has been increased so that the achievement of the organizational vision, organizational human resources, fulfillment of aspirations & generating profits for the organization has been achieved.	Fulfilling the achievement of the organization's vision, developing organizational human resources, fulfilling aspirations, generating profits for the organization, customer satisfaction & providing a positive impact on society.
10	**O2**	Make the necessary restructuring.	Carrying out the necessary restructuring, through performance evaluation and carrying out a series of continuous improvements so that it continues to grow and be able to compete.	Business and organizational performance.	No restructuring effort is required.	There is starting to be an awareness that restructuring is needed in the company.	The company is preparing for the necessary restructuring.	The company began carrying out the necessary restructuring, starting with performance evaluation.	The company has carried out performance evaluations and made several improvements in implementing the required restructuring.	Carrying out the necessary restructuring, through performance evaluation and carrying out a series of continuous improvements so that it continues to grow and be able to compete.

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
11	**O3**	Identification of increasing opportunities to match technology products with market needs.	Identify increasing opportunities to bring together technology products with new markets.	Part of the organization there who do this process.	There has not yet been identified an increase in opportunities for meeting technology products with market needs.	It has been prepared to carry out the identification of increasing opportunities to match technology products with market needs.	The identification of increasing opportunities to match technology products with market needs has been identified.	Increasing opportunities for new markets that can be entered have been identified.	It has been identified an increasing number of new market opportunities to enter and new customers in the existing market.	It has been identified an increase in opportunities to match technology products with market needs, namely in the form of new markets that can be entered, new customers in existing markets, and new products that have potential.
12	**O4**	Review of technical and commercial processes to improve rices and profits.	Reviewing technical and commercial processes to increase effectiveness, efficiency, productivity and profit for the company.	Factory layout, production, labor, materials, distribution, etc.	There has not been a review of technical and commercial processes.	Preparation is carried out by reviewing technical and commercial processes.	A review of technical and commercial processes has been carried out to increase effectiveness.	A review of technical and commercial processes has been carried out to increase effectiveness and efficiency.	A review of technical and commercial processes has been carried out to increase effectiveness, efficiency, and productivity.	The results of a review of technical and commercial processes have been obtained and used to increase effectiveness, efficiency, productivity and profit.
13	**Mf1**	Implementing Lean Manufacturing in total.	Applying Lean manufacturing as a philosophy, method and management strategy to increase	Related to Manufacturing.	Not yet implementing Lean Manufacturing completely.	Preparation at the top management level to implement Lean	The initial stage of implementing Lean Manufacturing in total.	The initial stage of implementing Lean Manufacturing in total.	The iterative process of implementing Lean Manufacturing in total.	Lean Manufacturing has been implemented in total, and benefits have been obtained

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
			efficiency in manufacturing or production lines.			Manufacturing in total.				for companies and consumers.
14	**Mf2**	There is a need for input (both internal and external) to management to improve performance.	Carrying out management control as a unified idea of management accounting methods to collect and report data and evaluate company performance.	Related to Manufacturing.	In order to improve performance, input (internal/external) to management is not required.	There is starting to be a need for input (internal and external) to management to improve performance.	Limited internal input has been provided to management to improve performance.	360 degree internal input has been provided to management to improve performance.	360 degree internal and external (micro) input has been provided to management to improve performance.	360 degree internal and external input (micro and macro) has been provided to management to improve performance.
15	**Mf3**	Implement quality assurance according to standards (SNI) intensively.	Implement quality assurance according to standards (SNI) intensively.	Marketed products.	Not yet implementing standard quality assurance (SNI) intensively.	Awareness has emerged in implementing standard quality assurance (SNI).	Efforts to socialize the implementation of standard quality assurance (SNI).	Start preparing for the implementation of quality assurance according to standards (SNI).	Has implemented quality assurance according to standards (SNI), but not yet intensively.	Has implemented quality assurance according to standards (SNI) intensively, and has been used as a tool for management.
16	**Mf4**	There is a guarantee of the quality, safety and security of products used by the public.	Pursue to obtain quality assurance certificates and accreditations.	Products marketed.	There is no guarantee regarding the quality, safety and security of products used by the public.	Build awareness and commitment.	Socialization of plans for implementing product certification and institutional accreditation.	Administrative and technical preparation for the implementation of product certification and institutional accreditation.	Product certification process and institutional accreditation.	Has received product certificates and institutional accreditation as a form of guarantee for product quality, safety and

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
										security in the community.
17	**I1**	Identified market expansion needs.	Identifying market expansion needs.	Investment plan.	There was no identification of the need to expand the market.	Preparation to identify the need to expand the market.	In the process of completing the identification of the need to expand the market.	In the process of completing the identification of market expansion needs.	Identification of market expansion needs has been completed.	The results of identifying the need for market expansion have been validated.
18	**I2**	There is an increase in production capacity.	Increase production capacity according to installed scale.	Corporate finance to invest in this activity.	There has been no increase in production capacity.	There is a trend of increasing market demand.	There is an increase in production capacity but the optimum production capacity has not been achieved.	There is an increase in production capacity, and the optimum production capacity has been reached.	There is a need to increase production capacity.	Production capacity additions have been made upon market demand.
19	**P1**	Dynamically increasing collaboration within the network.	Increasing cooperation in dynamic networks, including: production networks, marketing networks and service networks.	Existing partners.	There has not been a dynamic increase in collaboration within the network.	Efforts to evaluate ongoing collaboration within the network have not been carried out.	It has been determined that there is a need for increased cooperation within the existing network.	Efforts have been made to increase cooperation within the production network.	Efforts have been made to increase cooperation within the production and marketing network.	Efforts have been made to increase cooperation in networks dynamically, including: production networks, marketing networks and service networks.

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
20	**P2**	Improving the quality of cooperation management that has been running.	Improving the quality of cooperation management that is already underway includes the principles of equality, openness and mutual benefit.	Existing partners.	There has not been any improvement in the quality of management of existing collaborations.	Evaluation of ongoing collaboration management.	Several weaknesses in the management of ongoing collaboration have been identified.	Planning efforts to improve the quality of ongoing collaboration management.	Execution of efforts to improve the quality of cooperation management that is already underway.	The quality of ongoing cooperation management has been carried out, including the principles of: equality, openness and mutual benefit.
21	**P3**	Cooperation in product distribution and marketing.	Expanding product distribution and marketing cooperation with partners, so that the market reach becomes wider..	Partner for market expansion	There has not been any cooperation in product distribution and marketing with other parties.	Identify potential partners for product distribution and marketing collaboration.	Have determined partners for product distribution and marketing cooperation.	Product distribution and marketing cooperation agreement.	Execution of product distribution and marketing cooperation.	Collaboration in product distribution and marketing with partners has been underway, so that the market reach has become wider.
22	**R1**	Preparation of non-technological (organizational and social) risk control plans at the stage of market maturity.	Develop a non-technological risk control plan (organizational and social).	At the market maturity stage is reached.	A non-technological risk control plan has not been prepared at the stage of market maturity reached.	The outline of the non-technological risk management plan has been completed at the stage of market maturity.	Preparation of non-technological risk control plans at the market maturity stage.	A non-technological risk control plan is being prepared at the stage where market maturity is reached.	Completion of the preparation of non-technological risk control plans at the market maturity stage.	Develop a non-technological risk control plan at the stage where market maturity is reached.
23	**R2**	Organizational risk assessment (especially financial indicators) at the	Conduct organizational risk studies (especially	At the stage of market maturity is reached.	An organizational risk assessment (especially financial	An outline for the preparation of an organizational risk assessment	Preparation is carried out to study organizational risks (especially	The stage of completing the organizational risk study (especially	The results of the organizational risk study (especially	Composed assessment of organizational risks (especially financial

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
		market maturity stage is reached.	financial indicators).		indicators) has not yet been carried out at the stage of market maturity.	(especially financial indicators) has been prepared at the stage of market maturity being reached.	financial indicators) at the stage of market maturity.	financial indicators) at the stage of market maturity is obtained.	financial indicators) are obtained at the stage of reached market maturity.	indicators) at the stage of market maturity reached.
24	**R3**	Social impact risk assessment at the market maturity stage is reached.	Conduct a social impact risk assessment.	At the market maturity stage is reached.	A social impact risk assessment has not yet been carried out.	The outline for the preparation of the social impact risk assessment has been completed.	Preparation for social impact risk assessment is carried out at the stage of market maturity is reached.	The completion stage of the social impact risk assessment at the market maturity stage is reached.	The results of the social impact risk assessment are obtained at the stage of market maturity reached.	Compiled social impact risk assessment at the stage of market maturity is reached.

Table 13.6. KATSINOV 6

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
1	**T1**	Conducted a review of competitors' technology products.	Reviewing.	Competitor's technology.	There has not been a review of competitors' technology products.	Discussion of the urgency of reviewing competitors' products at the top management level.	Preparation for carrying out reviews of competitors' products at the top management level.	Start reviewing competitors' products at the top management level.	Review of competitors' products in progress.	The results of reviews of competitors' technology products have been obtained.
2	**T2**	Conduct a review of its technological capabilities to support re-innovation or new technology development.	Reviewing.	Own technology.	There has not been a review of the technological capabilities possessed.	Discussion at the top management level regarding the urgency of the review.	Preparation for the implementation of a review of technological capabilities possessed.	Began to review the capabilities of technology.	Review of technological capabilities in progress.	A review of technological capabilities has been obtained.
3	**T3**	It has been decided whether to re-innovate existing technology products, or develop new technology products.	Deciding on re-innovation / new products.	Re-innovation / new products.	It has not been decided whether to innovate again or develop new products.	The decision to conduct a study to determine the choice: re-innovation or new product development	Preparation for carrying out studies to determine options: re-innovation or new product development.	A study has begun to be carried out to determine the choice: re-innovation or new product development.	Determining the choice: re-innovation or new product development in progress.	There has been a decision from management regarding the choice of re-innovation or new development.
4	**M1**	The market drop has been confirmed.	Confirming.	Market decline.	The market drop is yet to be confirmed.	There are symptoms of a downward market trend;	Market trends are being analyzed	Market decline is starting to be confirmed based on analysis results;	Market decline confirmed based on analysis results	Market decline has been factually confirmed.
5	**M2**	Market research to approve re-innovation (as incremental innovation) or	Market Research.	The need for re-innovation.	Market research has not been carried out for incremental	Preparation for implementing market research for	Starting to carry out market research for incremental re-innovation and	Market research is being carried out for incremental re-innovation and	Completed market research for incremental re-innovation	The results of market research analysis become a consideration for top

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
		abandon it for the development of more advanced technology (as breakthrough innovation).			re-innovation and switching to more advanced technology;	incremental innovation and switching to more advanced technology.	switching to more advanced technology;	switching to more advanced technology;	and switching to more advanced technology.	management to determine incremental re-innovation and switch to more advanced technology.
6	**M3**	Review market demand.	Reviewing.	Market demand.	A review of market demand has not yet been carried out;	Has prepared a market demand review concept;	Preparation of market demand review;	Start implementing market demand reviews;	The results of a review of market demand have been obtained;	The results of the review of market demand become a consideration for top management in making decisions for re-innovation (close down or change over)
7	**M4**	Identify opportunities for market growth or new market expansion.	Identify.	New market.	Opportunities for market growth or new market expansion have not been identified;	Preparation for identifying opportunities for market growth or new market expansion;	Begin to identify opportunities for market growth or new market expansion;	The stage of completing the identification of market growth opportunities or new market expansion;	Results of identification of market growth opportunities or new market expansion have been obtained;	The results of identifying opportunities for market growth or new market expansion become considerations for top management in making decisions for re-innovation (close down or change over)
8	**O1**	There is a role for organizations in supporting Re-Innovation or New	Organizational support.	Re-innovate	There is no management commitment support and	The organization does not yet have real	The organization has provided direction, but its role is not yet	There is an organizational role in the form of resource	There is an organizational role in the form of real	There is an organizational role in the form of real support in

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
		Technology Development.			resource support in the company environment;	direction and action in supporting Re-Innovation or New Technology Development	evident in supporting Re-Innovation or New Technology Development;	support in the company environment;	support in the form of management commitment within the company;	the form of management commitment and resource support in the company environment.
9	**O2**	There is a role for networking in supporting Re-Innovation or New Technology Development.	Network support.	Re-innovate.	Does not have a network to support Re-Innovation or New Technology Development	Has a network, but no role in supporting Re-Innovation or New Technology Development	Having a network and a lack of role in supporting Re-Innovation or New Technology Development;	Having a network and a significant role in supporting Re-Innovation or New Technology Development;	Having a network and a big role in supporting Re-Innovation or New Technology Development	Has a network and has a very big role in supporting Re-Innovation or New Technology Development.
10	**Mf.1**	There is a need for production innovation or the development of new production technologies.	Decide.	production/ technological innovation.	Production innovation or development of new production technology has not become a necessity for the company;	Began to appear pressure from competitors in the market indicated by a decline in sales;	The company began to make efforts to find various alternatives to survive;	Alternative production innovations or the development of new production technologies have not become a priority;	Alternatives to production innovation or development of new production technology are considered as a priority;	Production innovation or development of new production technology has been decided to be an urgent need for the company.
11	**I1**	Identified further innovations of products/services based on current and future market needs and demands.	Identify investment requests.	Market demand.	Further innovations related to additional investment schemes based on current and future market demand have	Preparation for identification of further innovations related to additional investment schemes based on current and	Starting to identify further innovations related to additional investment schemes based on current and future market demand;	Completion stage of identifying further innovations related to additional investment schemes based on current and	The results of identifying further innovations related to additional investment schemes have been obtained based on current and	The results of the identification of advanced innovations become a consideration for top management in making decisions for reinvestment.

NO	ASPECT	KEY ACTIVITIES	PROCESS	OBJECT	PROGRESS VALUE (0=0%; 1=20%; 2=40%; 3=60%; 4=80%; 5=100%)					
					0	1	2	3	4	5
					not been identified;	future market demands;		future market demand;	future market demands;	
12	**P1**	A review of existing partnerships was carried out.	Reviewing.	Ongoing partnership.	There has not been a review of existing partnerships;	In the preparation stage for carrying out a review of existing partnerships;	Start reviewing existing partnerships;	In the process of completing reviews related to the quality of partners and existing partnerships;	Review results have been obtained regarding the quality of partners and existing partnerships;	The results of a review of existing partnerships have been obtained, and the quality, advantages and disadvantages of existing partners and partnerships have been identified.
13	**P2**	Search for potential partners to support re-innovation or new technology development.	Identify partners.	Potential new partnerships.	Have not yet searched for potential partners to support re-innovation or new technology development	Identify the need for Re-innovation or New Technology Development	Evaluation of internal capabilities in implementing Re-Innovation or New Technology Development;	Identify potential partners to support Re-Innovation or New Technology Development;	The need and role of potential partners to support Re-Innovation or New Technology Development has been determined;	Potential partners have been obtained to support re-innovation or new technology development.
14	**R1**	A risk assessment is conducted to support a decision to Re-Innovate or New Technology Development.	Risk assessment	investment for reinnovation/ new technology development	A risk assessment has not been carried out to support the decision to Reinnovate or New Technology Development	Preparation for the implementation of a risk assessment to support the decision to Reinnovate or New Technology Development	Began to carry out a risk assessment to support the decision to Re-Innovate or New Technology Development;	A risk assessment is being carried out to support a decision to Re-Innovate or New Technology Development;	Completion of a risk assessment to support the decision to Reinnovate or New Technology Development	The results of the risk assessment analysis become a consideration for top management in making decisions to re-innovate or develop new technologies.

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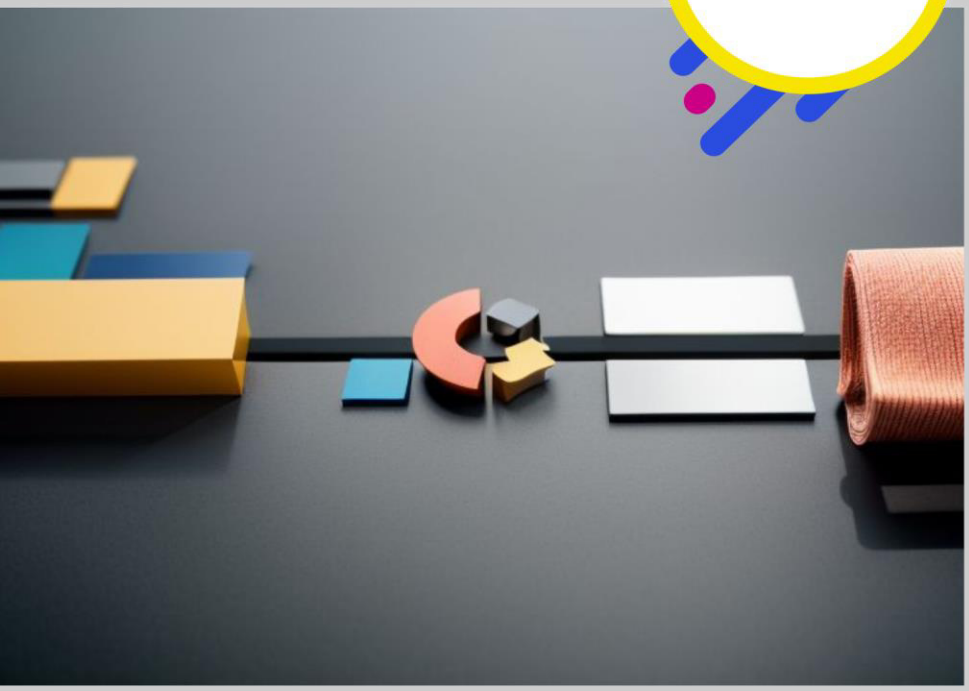
Part 4



KATSINOV MEASURING INSTRUMENT

“No organization has ever created innovation. People innovate, not companies."

- Seth Godin

Chapter 14
THE KATSINOV MEASUREMENT MODEL

Fauzie Dahmir, Djarwadi

14.1. KATSINOV Measuring Instrument Model

Measuring and Determining the Level of Innovation Readiness (KATSINOV) or Innovation Readiness Levels (IRL) is an effort to answer the demand for measuring tools that can describe the development of innovation and implement innovation over the life cycle more effectively. Measuring and Determining the Level of Innovation Readiness (KATSINOV) in detail officially regulated in the Minister of Risk, Technology and Higher Education Regulation Number 29 of 2019. Measurement and determination of KATSINOV is necessary since new research is started and at the same time serves as a guide for the managerial aspects of the innovation process. Thus, the role of Innovation Management is very important in organizing the innovation process through the stages of the innovation cycle. This innovation management includes how technological, market, organizational, partnership, manufacturing, investment and risk aspects can be managed optimally so that innovative products can become solutions and be utilized by society, as well as providing sustainable competitiveness for companies.

The KATSINOV Measuring and Determining Method is applied so that innovation steps can be faster or the life cycle shorter, to face fierce competition. This is because this measurement method is designed to be able to describe the development of innovation and help implement innovation over the life cycle more effectively. Measurement and determination of KATSINOV is carried out using the KATSINOV-Meter. KATSINOV-Meter is a spreadsheet-based software from Microsoft Excel that compiles several standard statements for each level and displays the achieved KATSINOV graphically. This software can be done repeatedly. KATSINOV-Meter is a Microsoft Excel program with the following worksheets:

1. The core of the KATSINOV-Meter which contains

   The KATSINOV METER or IRL-Meter (Innovation Readiness Level) is a measurement tool used to assess the level of readiness or maturity of an innovation in a project, program, or activity. IRL-Meter uses a 6 "C" conceptual framework that includes Concept, Component, Completion, Chasm, Competition, and Changeover/ Closedown, which comprehensively divides the innovation lifecycle into 6 phases of

readiness levels (figure 14.1). This measurement provides direction to management in the implementation of innovation by assessing 7 key aspects: Technology (T), Market (M), Organization (O), Manufacturing (Mf), Partnership (P), Investment (I), and Risk (R).

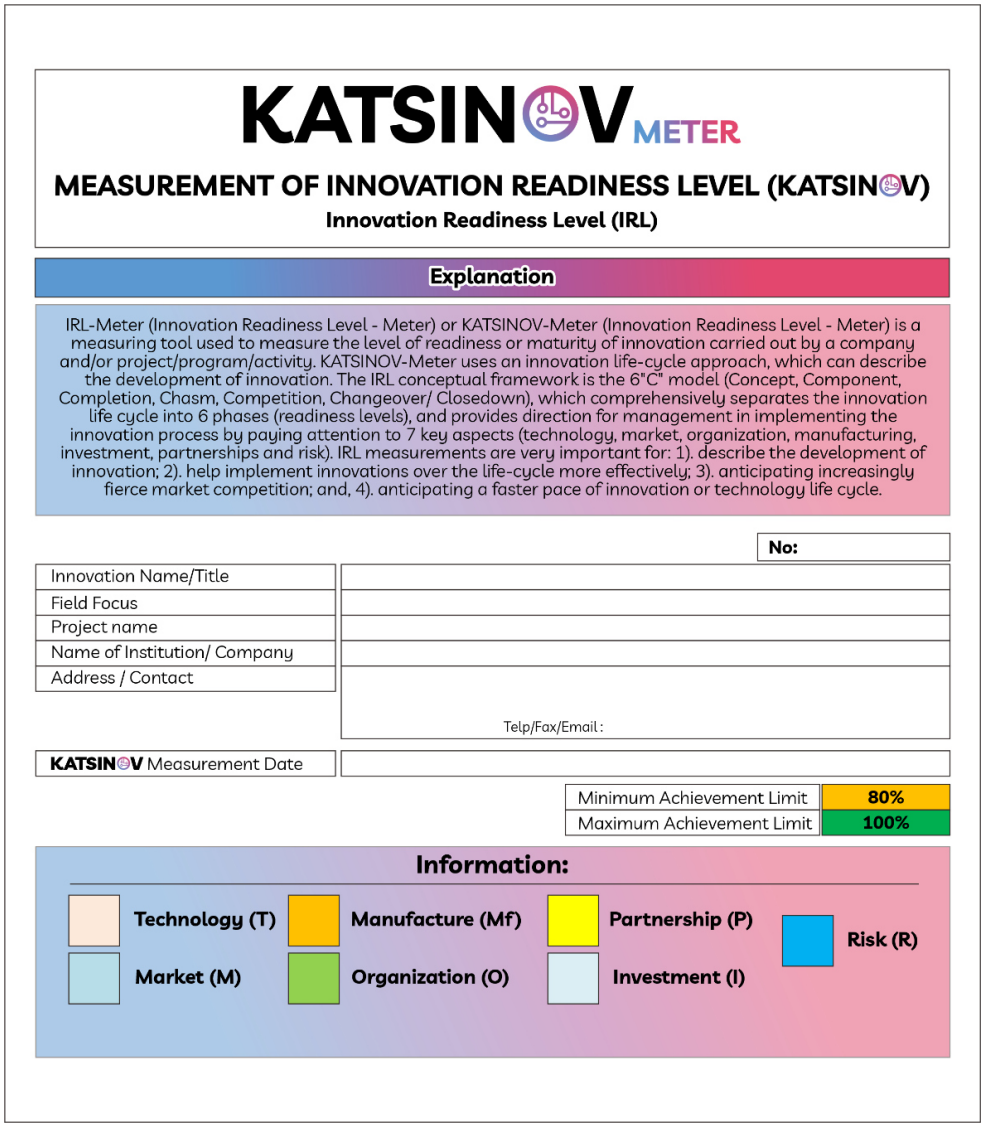


Figure 14.1. Initial entry section.

IRL-Meter is essential because it helps to describe the development of innovations, implement innovations effectively, anticipate increasingly fierce market competition, and accelerate the life cycle of technology or innovation. In its measurement, IRL sets a minimum achievement limit of 80% marked in yellow and a maximum limit of 100% marked in green. Practically, KATSINOV METER provides a table of entries to record related information, such as the name of the innovation, the focus of the field, the name of the project, the name of the institution or company, the address, and the contact. Each key aspect is also assigned a specific color code,

namely Technology with beige, Market with light blue, Organization with green, Manufacturing with dark yellow, Partnership with yellow, Investment with pink, and Risk with red. With this approach, KATSINOV-Meter can help various parties in understanding and improving innovation readiness to achieve optimal success.

2. Measuring and determining KATSINOV

Figure 14.2 shows KATSINOV 1, an indicator of innovation readiness measurement in the KATSINOV METER. This table summarizes the important aspects assessed to measure the level of innovation readiness based on seven main categories, namely Technology (T), Market (M), Organization (O), Manufacturing (Mf), Investment (I), Partnership (P), and Risk (R). Each aspect has some specific indicators that are scored between 0 and 5, where 0 means "not met" and 5 means "100% met."

KATSINOV 1

		Σ or % Fulfilled						Indicator of KATSINOV 1
		Put a cross (X) in the appropriate column						
No.	Aspect	0	1	2	3	4	5	**(0=not fulfilled; 1=20%; 2=40%; 3=60%; 4=80%; 5=100% or fulfilled)**
1.	T							New ideas that provide solutions to problems faced by society.
2.	T							Observations of basic scientific principles and scientific publications have been carried out
3.	T							Uniqueness (USP/Unique Selling Point) or novelty has been identified.
4.	T							Research stages and targets have been identified
5.	T							The technology to be developed is scientifically feasible
6.	M							Innovation is carried out based on customer requests and/or needs (as fulfillment of community needs as a solution to the problem)
7.	M							Customer needs, wants and requests have been identified
8.	M							The target market location has been identified
9.	O							Have an innovation strategy
10.	O							The project scope and tasks of the Innovation Team have been defined
11.	O							Required resources and services have been ascertained
12.	O							Seamless communication channels are available
13.	Mf							Identified the implications (consequences or direct results of the findings of a scientific research) basic manufacturing.
14.	Mf							Identified manufacturing concept
15.	Mf							There is proof of manufacturing concept through analytics or laboratory experiments.
16.	I							There is a business model concept for the idea being developed.
17.	I							There are results of customer, market and competitor analysis of the ideas developed.
18.	I							There is evidence that the idea developed has provided a solution for the customer.
19.	P							Develop a strategy to build networks and partnerships
20.	P							Potential partners have been identified
21.	R							Technology risk assessment has been a consideration in every step of the research
22.	R							Preparation of technology risk control plans at the research stage.
		0	0	0	0	0	0	
Σ		0						
%		0.00%						

KATSINOV 1

Noted

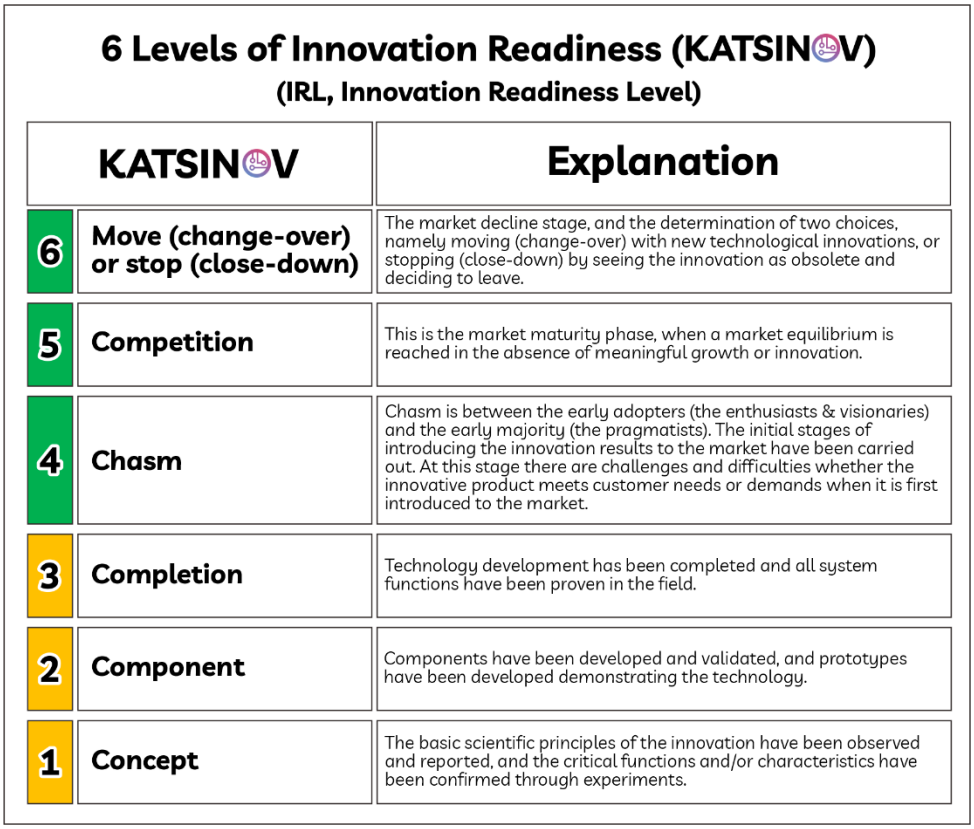
Figure 14.2. KATSINOV measurements.

The Technology Category (T) includes indicators such as the development of solution ideas for social problems, observation of basic scientific principles, identification of innovation uniqueness (USP/Unique Selling Point), determination of research targets, and scientific feasibility of the technology developed. Meanwhile, the Market (M) category assesses the extent to which innovation answers customer needs, identifies market needs, and target locations. In the Organization (O) category, indicators include the preparation of innovation strategies, definition of project scope, availability of resources and services, and the existence of smooth communication channels. The Manufacturing Category (Mf) assesses the identification of consequences of scientific research, basic manufacturing concepts, as well as proof of manufacturing concepts through analysis or laboratory experiments.

The Investment Category (I) evaluates the concept of the business model, analysis of customers, markets, and competitors, as well as evidence that the idea has provided a solution for the customer. Partnership (P) assesses networking strategies and identifies potential partners, while Risk (R) focuses on technological risk assessment and risk control planning in research. At the bottom of the table, the total score column (Σ) shows the cumulative value of all indicators, while the percentage of completion (%) is calculated based on the total value. In this figure, all indicators are still valued at 0, with a maturity rate of 0.00%, indicating that no aspect has been met or measurable yet. The notes section below the table is provided to add additional information or explanations related to the assessment. KATSINOV 1 helps map innovation readiness by compiling a detailed assessment of key indicators in various aspects, so that it can be a guide in the implementation and development of innovation.

3. KATSINOV levels

Figure 14.3. explains the 6 Levels of Innovation Readiness (KATSINOV) or Innovation Readiness Level (IRL). Each level represents the phase of innovation development from the initial conception to the stage of maturity or discontinuation. The first level is called Concept (1), where the basic scientific principles of innovation have been observed and reported. At this stage, the critical functions and/or characteristics of the innovation have been confirmed through experiments. Furthermore, in Component (2), the components of the innovation have been developed and validated. Prototypes have also been created to demonstrate the technology being developed.



6 Levels of Innovation Readiness (KATSINOV)

(IRL, Innovation Readiness Level)

KATSINOV		Explanation
6	**Move (change-over) or stop (close-down)**	The market decline stage, and the determination of two choices, namely moving (change-over) with new technological innovations, or stopping (close-down) by seeing the innovation as obsolete and deciding to leave.
5	**Competition**	This is the market maturity phase, when a market equilibrium is reached in the absence of meaningful growth or innovation.
4	**Chasm**	Chasm is between the early adopters (the enthusiasts & visionaries) and the early majority (the pragmatists). The initial stages of introducing the innovation results to the market have been carried out. At this stage there are challenges and difficulties whether the innovative product meets customer needs or demands when it is first introduced to the market.
3	**Completion**	Technology development has been completed and all system functions have been proven in the field.
2	**Component**	Components have been developed and validated, and prototypes have been developed demonstrating the technology.
1	**Concept**	The basic scientific principles of the innovation have been observed and reported, and the critical functions and/or characteristics have been confirmed through experiments.

Figure 14.3. KATSINOV level explanation.

The next stage is Completion (3), which shows that the development of the technology has been completed and all system functions have proven to be effective in the field. At the fourth level, Chasm (4), innovation is between early adoption by "early adopters" (visionary and enthusiastic) and early majority groups (pragmatic). At this stage, the main challenge is to ensure that innovative products are able to meet the needs or demands of the market when they are first introduced. The fifth level is called Competition (5), which represents the maturity phase of the market. In this phase, the market has reached equilibrium in the absence of any significant growth or innovation. Finally, in Move (change-over) or stop (close-down) (6), innovation reaches the stage of market decline. In this phase, an important decision must be made: continue the innovation with new technological changes (change-over) or stop the innovation because it is considered obsolete and leave the market (close-down). KATSINOV provides a framework for assessing the level of readiness of an innovation, from the initial concept to the final market phase, while emphasizing the stages of technology development, validation, as well as market challenges and strategic decisions. **Worksheet 3** is an explanation for each key indicator or activity at each KATSINOV level (see **Attachment 1**).

14.1. Summary of measurement results and KATSINOV determination

This figure 14.4. is a Summary of Results to measure the level of readiness of innovation in various aspects, using radar charts as the main visualization. At the top of the form, there is a space to fill in important information such as the title of the innovation, the focus of the field, the name of the project, institution or company, and the relevant contact or address.

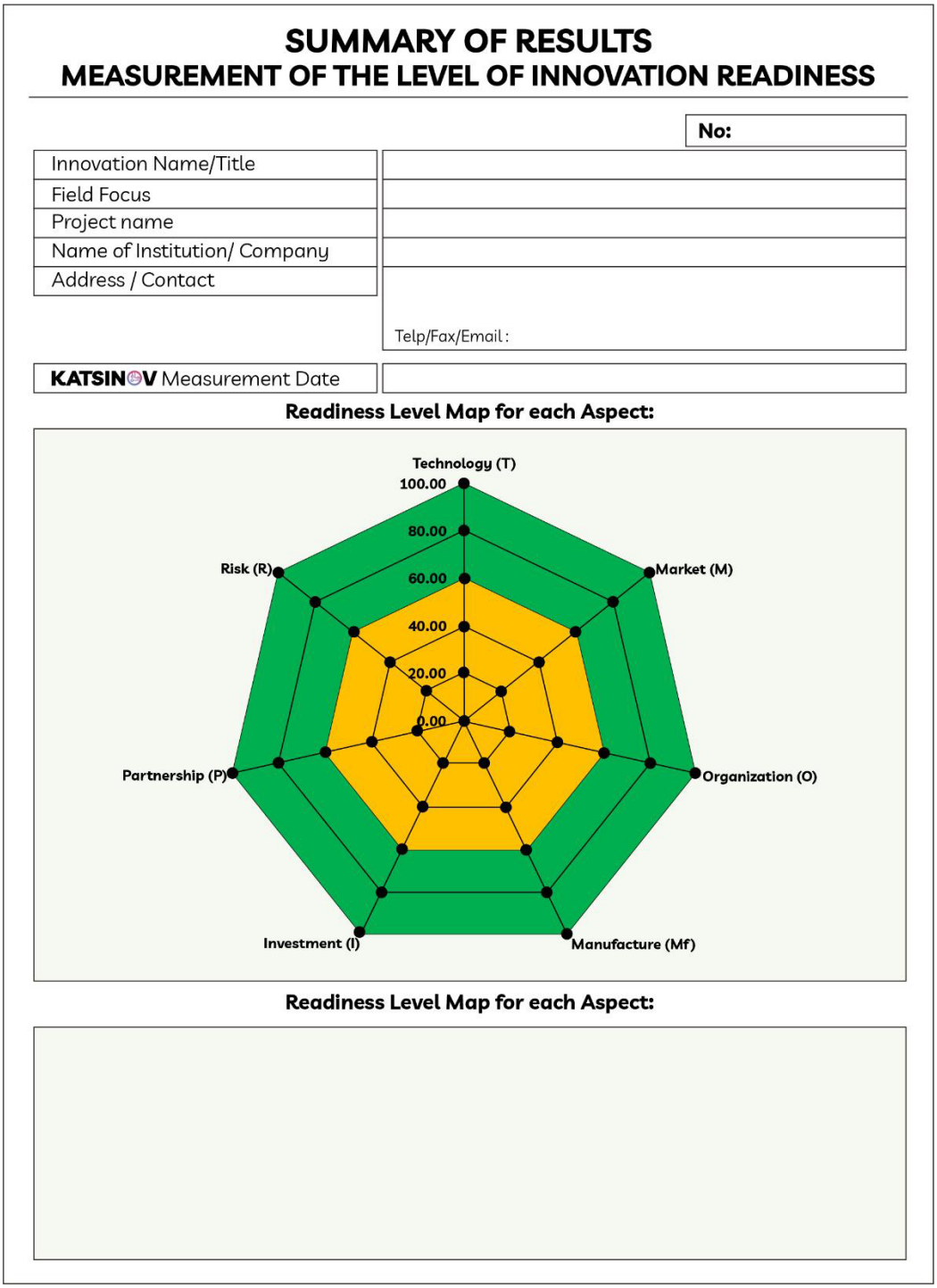


Figure 14.4. Summary of measurement results and determination of KATSINOV.

In addition, the form includes a dedicated column for the date the measurement was taken. In the center, there is a "Readiness Level Map for each Aspect" in the form of a radar chart. This radar chart is used to map the readiness of innovation from several aspects, including: Technology (T) - readiness in terms of technology, measured from 0 to 100. Market (M) - the readiness of the market to accept the resulting innovation. Organization (O) - the readiness of the organization to support the development of innovation. Manufacture (Mf) - the readiness of the manufacturing or production aspect in implementing innovation. Investment (I) - readiness in terms of funding or investment needed for innovation. Partnership (P) - readiness to establish cooperation or partnerships to support innovation. Risk (R) - readiness to deal with risks that may arise during the implementation of innovation.

This radar graph uses a scale of 0 to 100 with three levels of visualization, namely green areas indicating high readiness levels, yellow indicating medium readiness, and areas in smaller graphs indicating low readiness. Each data point on the graph represents a readiness value for each aspect. These values are linked to form a closed pattern that helps in assessing balance and which areas need further attention or improvement.

The bottom of the form also provides additional space with the title "Readiness Level Map for each Aspect". This space can be used to supplement other data or in-depth analysis of the results of measuring innovation readiness. This form is a tool used to assess the readiness of an innovation from a variety of crucial perspectives. The results of this evaluation are very important in determining the right strategy to overcome weaknesses or optimize the potential of each aspect in the innovation journey towards implementation in the market.

1. KATSINOV 1

   Figure 14.5. is the "Summary of Results Measurement of the Level of Innovation Readiness" which is arranged in a visual format with the main elements in the form of radar charts and supporting tables below. This tool is used to assess the readiness of innovations from various important aspects that support successful implementation.

   Main Section: Radar Chart, the top of the image displays the radar chart as the main visualization that shows the level of readiness for innovation in various aspects. The aspects measured include: Technology (T): The level of readiness of the technology used in innovation. Market (M): Potential for innovation acceptance in the market. Organization (O): The readiness of the organization to manage and support innovation. Manufacture (Mf): The ability of production or manufacturing to implement innovation. Investment (I): The level of readiness of available funding to

develop innovations. Partnership (P): Readiness to establish strategic cooperation or collaboration. Risk (R): Identification and preparedness to deal with risks that may arise. This radar chart uses a scale of 0 to 100, with green indicating high readiness, yellow for medium readiness, and deep areas indicating low readiness. The resulting chart patterns help visualize the balance of readiness between aspects, as well as identify which aspects need further improvement.

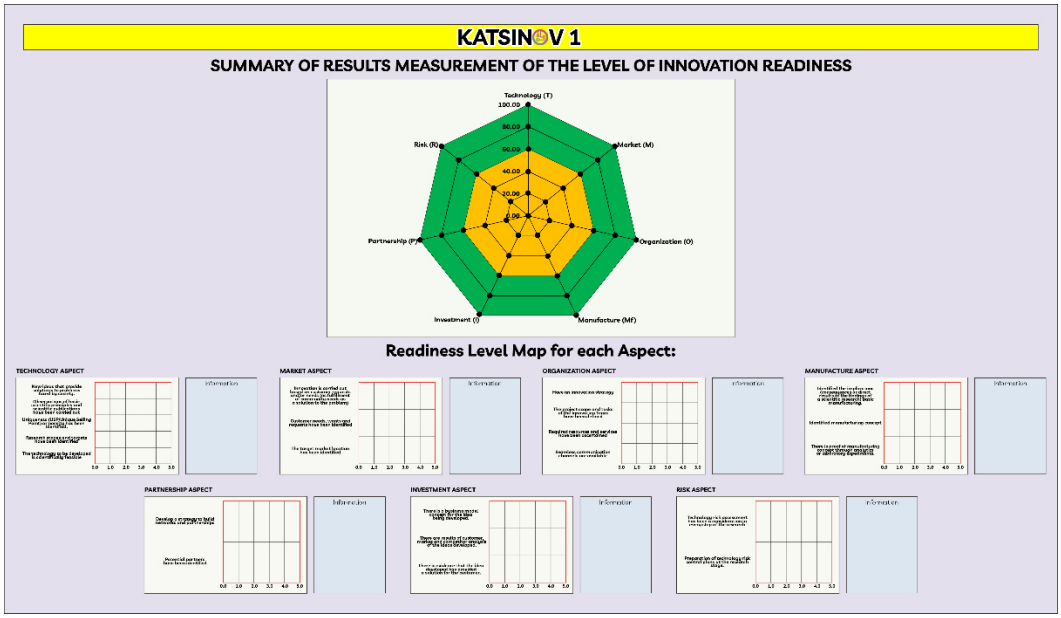


Figure 14.5. Summary of KATSINOV 1 measurement results.

Table Section: Readiness Level per Aspect, below the radar chart, there are seven tables detailing the Readiness Level for each aspect: Technology Aspect, this table contains points such as the readiness of the basic technology, supporting technologies, and the tests that have been carried out. The Market Aspect focuses on the readiness of innovations for the market, including the identification of market segments and the validation of customer needs. The Organization Aspect assesses the readiness of an organization in terms of human resources, organizational structure, and managerial capabilities. The Manufacture Aspect assesses the readiness of the production process, manufacturing capabilities, and product quality control. The Partnership Aspect contains an evaluation of the readiness of collaboration or cooperation with external parties that support innovation. The Investment Aspect assesses the readiness of funding, such as capital sources, fund allocation, and investment sustainability. The Risk Aspect focuses on identifying potential risks, risk management, and prepared mitigation measures. Each table provides quantitative and qualitative information regarding the readiness of

innovation in each aspect, with indicators or parameters that have been measured and assessed. Figure 68 provides a comprehensive overview of the level of innovation readiness through radar chart visualization and analysis of supporting tables. This evaluation aims to assist organizations or innovation developers in determining improvement priorities and preparing a more mature implementation strategy in each aspect.

2. KATSINOV 2

Figure 14.6. is the "Summary of Results Measurement of the Level of Innovation Readiness" which is arranged in a visual format with the display of radar charts as the main element. This visualization aims to assess the readiness of innovation in various key aspects that affect the success of its implementation. Figure 69 represents the second version of KATSINOV, which seems to show an improvement in the results of the measurements compared to the previous version.

Main Section: Radar Chart, the radar chart in the center of the image shows the level of innovation readiness in seven important aspects: Technology (T): Assesses the readiness of basic and supporting technologies. Market (M): Measures the potential for innovation to be accepted by the market and its segmentation. Organization (O): Assesses the readiness of the organization to support the implementation of innovation. Manufacture (Mf): Measures the readiness of a manufacturing or production process. Investment (I): Assessing the readiness of funding that supports the development of innovation. Partnership (P): Assessing readiness in strategic collaboration with external parties. Risk (R): Assesses the ability to identify risks and prepare mitigations. The radar chart uses a scale of 0 to 100, where the green area represents a high level of readiness, the yellow area indicates medium readiness, and the orange area reflects low readiness. This visualization helps in analyzing the areas that need improvement, while highlighting areas that have reached optimal readiness.

Table Section: Readiness Level by Aspects, under the radar chart there are seven tables detailing the level of innovation readiness in each aspect: Technology Aspect focuses on technology readiness with indicators such as basic technology, support, testing, and validation. The Market Aspect contains market readiness, including analysis of market segments, customer needs, and commercialization strategies. The Organization Aspect evaluates the readiness of the organization from the aspects of human resources, organizational structure, and managerial roles. Manufacture Aspect focuses on production process readiness, manufacturing technology, and product quality control. The Partnership

Aspect assesses the readiness to establish strategic cooperation and build collaboration with external partners. The Investment Aspect assesses readiness in terms of funding, sources of investment, and cost allocation for innovation development. The Risk Aspect focuses on identifying risks, potential obstacles, and mitigation strategies that have been planned. Each table is equipped with graphs and descriptive information detailing the measurement parameters in each aspect. This helps in identifying strengths and weaknesses that need to be improved to achieve optimal innovation readiness.

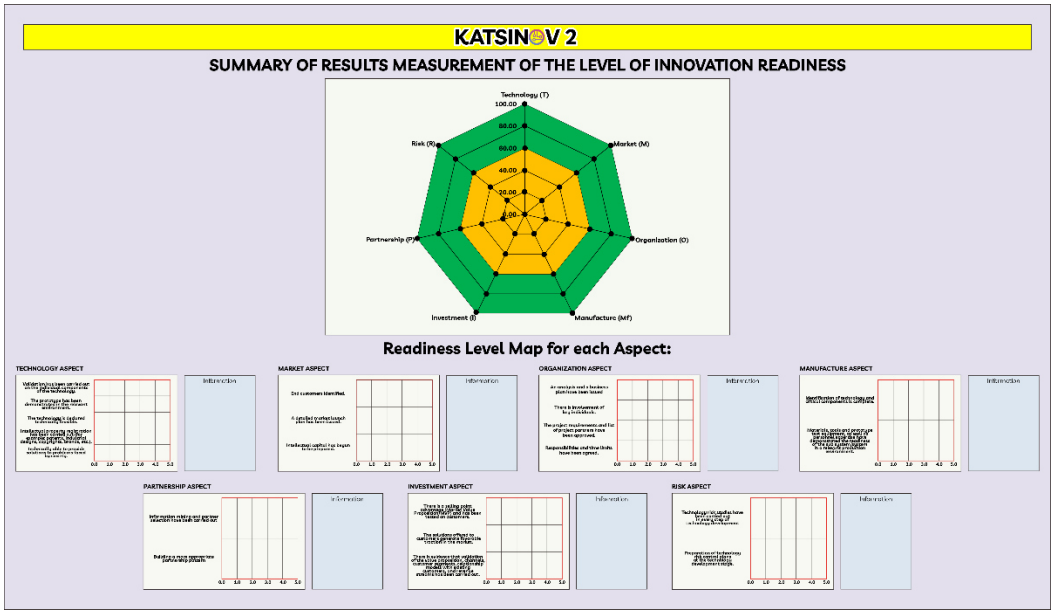


Figure 14.6. Summary of KATSINOV 2 measurement results.

Figure 14.6. presents a thorough evaluation of the level of innovation readiness in seven key aspects. Radar charts provide a clear visual representation of the balance of readiness across various aspects, while supporting tables provide in-depth explanations for each aspect. With these results, organizations can set priorities for improvement in certain aspects to support a more mature and successful implementation of innovation.

3. KATSINOV 3

Figure 70 presents the results of measuring innovation readiness using the Readiness Level Map level 3 which consists of two main parts: a radar diagram at the top and a readiness map for each aspect at the bottom. The radar diagram at the top, the radar diagram or spider chart illustrates the eight aspects of innovation readiness that have been evaluated. The scale on the axis of each aspect helps to visualize the level of readiness for innovation. These aspects are: Human Resources measures

the readiness of the workforce to support innovation, such as competence, training, and mastery of new technologies. Technology identifies the availability and readiness of the technology needed to adopt innovation. Finance assesses financial readiness, including fund allocation, budget support, and the ability to access external funding sources. Partnership measures the strength of networks and collaborations with external parties, such as research institutions, industry, or government. Infrastructure assesses the availability of physical facilities and infrastructure that support the innovation process. The market evaluates the market's readiness to receive the results of innovation, including market research and customer potential. Regulation measures the extent to which applicable regulations, policies, or standards support innovation. The organization assesses the internal readiness of the organization, such as organizational structure, innovation culture, and management support. Each aspect is assigned a value and plotted in a diagram to map the level of readiness. Green areas indicate better readiness, while yellow or orange indicate aspects that still need improvement.

Readiness level map at the bottom, below the radar diagram, there is a Readiness Level Map that explains the details of the assessment for each aspect. Here's an explanation of the indicators of each aspect: Technology Aspect, indicators: The adoption rate of the latest technology, the readiness of the technology used, the development of the in-house technology, and research and development (R&D), the table shows the current level of technology and recommendations for improvement, e.g. "The technology is already in use but needs to be improved for efficiency." Market Aspect, indicators: analysis of market readiness, customer response, market needs for innovation, and the sustainability potential of innovative products. Assess the extent to which market research has been conducted and whether the innovative product has a strong chance of being accepted. Infrastructure Aspect, indicators: physical facilities, supporting facilities, information and communication technology (ICT), and logistics infrastructure. Assess the existence of infrastructure that can support the implementation of innovation. Human Resources Aspect, indicators: team competence, workforce training, number of experts, and skills related to innovation. Demonstrate the readiness of existing human resources and the need for further skill development. Finance Aspect, indicators: allocated budget, the organization's ability to manage innovation costs, and access to external funding sources. Identify the current availability of funds and strategies for obtaining additional funding. Regulation Aspect, indicators: the suitability of innovations with

government policies, necessary permits or regulations, and administrative obstacles that may be faced. Checking whether regulatory aspects have supported the implementation of innovation. Partnership Aspect, indicator: Collaboration with external partners such as universities, industry, and government; and the role of partnerships in innovation development. Assess existing collaboration networks and recommend expansion of partnerships. Organization Aspect, indicators: Organizational structure, innovative work culture, management involvement, and internal support for innovation. Assess the organization's readiness internally to drive innovation.

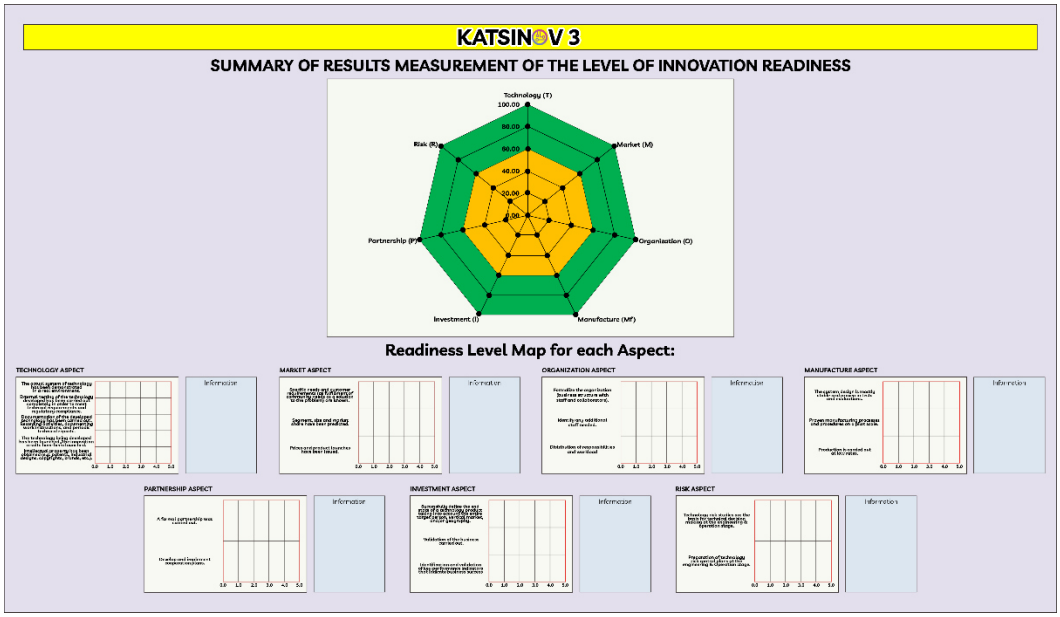


Figure 14.7. Summary of KATSINOV 3 measurement results.

Figure 14.7. provides a complete mapping of innovation readiness in eight key aspects. By using radar diagrams, weaknesses and strengths in each aspect can be visually identified. Meanwhile, the Readiness Level Map describes the indicators and details of readiness for each aspect along with recommendations for necessary improvements. This allows organizations or stakeholders to plan strategic steps to improve overall innovation readiness.

4. KATSINOV 4

The KATSINOV Level 4 (figure 14.8.) measures innovation readiness based on eight main aspects, namely Technology, Market, Organization, Manufacturing, Investment, Partnerships, Risks, and Infrastructure. Each aspect has specific indicators that are used to comprehensively assess the level of innovation readiness. The radar chart (spider chart) at the top displays the readiness score of each aspect on a scale of values from 0 to

100. The green color on the chart indicates optimal readiness, while the yellow color indicates areas that still need improvement.

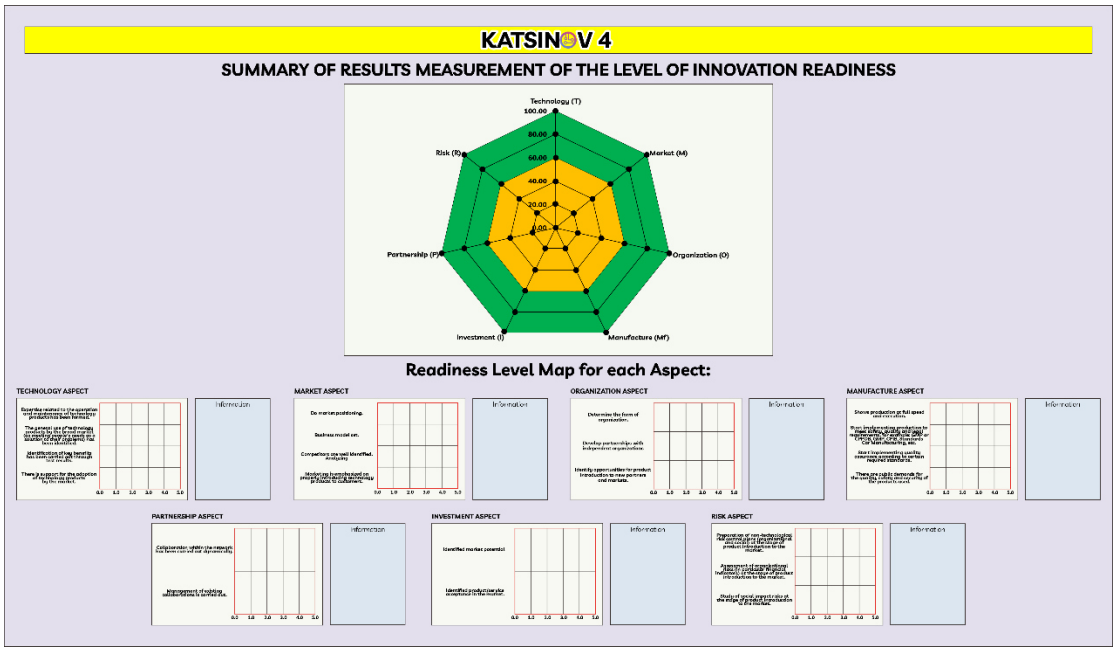


Figure 14.8. Summary of KATSINOV 4 measurement results.

In the Technology aspect, the indicators assessed include the level of technology maturity, identification of technology implementation opportunities, and support for technology adoption on a larger scale. The main focus of this aspect is technological readiness in supporting the implementation of innovations, including testing and development that has been carried out. Meanwhile, the Market aspect focuses on the readiness of products to be accepted in the market with indicators including product position in the market, clarity of business models, identification of market complexity, and opportunities for acceptance of innovation by customers. A clear marketing strategy and target market are the keys to success in this aspect. For the organizational aspect, the internal readiness of the organization is the main focus, with indicators that include establishing the organizational form, developing partnerships with related parties, and identifying product opportunities in the market through collaboration. Furthermore, the Manufacturing aspect evaluates production readiness with indicators such as production capacity that has been running, the efficiency of the manufacturing process, and public demand for innovative products. This aspect ensures large-scale production capabilities to support the sustainability of innovation. In the investment aspect, an assessment is carried out on the potential funding and product readiness in attracting investment. This is important to ensure the availability of

financial resources that support the implementation of innovation. On the other hand, the Partnership aspect measures the strength of collaboration with strategic partners, such as research institutions, governments, and industry. The main indicators are active partnerships and collaborative management that have been established. The Risk Aspect focuses on the readiness of the organization to identify and mitigate risks that arise during the innovation process. Indicators in this aspect include mitigation of technical and non-technical risks, identification of potential obstacles at various stages, and risk analysis at the production and implementation stages. Finally, the Infrastructure aspect assesses the readiness of supporting facilities and infrastructure, including the integration of information and communication technology (ICT) needed to ensure that innovation can be implemented effectively. KATSINOV Level 4 provides a clear picture of the level of readiness for innovation in each aspect, helping organizations to identify strengths as well as areas for improvement. This assessment serves as a strategic guide in preparing innovations so that they can be implemented optimally and sustainably.

5. KATSINOV 5

In the KATSINOV Level 5 (Figure 14.9.), innovation readiness is measured through eight main aspects, namely Technology, Market, Organization, Manufacturing, Investment, Partnerships, Risks, and Infrastructure. Each aspect is assessed using specific indicators that provide a comprehensive understanding of the readiness of innovation implementation. The radar graph in the center shows the readiness score of each aspect in the range of 0-100. Green indicates optimal readiness, while yellow indicates areas that still need improvement. The Technology aspect focuses on the development and maturity of technology that supports the implementation of innovation. Indicators in this aspect include an evaluation of the level of readiness of the technology, identification of opportunities for its implementation, and readiness to support the widespread adoption of the technology. Meanwhile, the Market aspect evaluates the readiness of innovations to compete and be accepted by the market. The assessment includes the determination of marketing strategies, clarity of business models, and mapping of barriers and opportunities for acceptance of innovation among customers.

In the organizational aspect, the readiness of the internal structure to support innovation is the main highlight. The assessment includes the establishment of an appropriate organization, the development of strategic collaborations with external partners, and the identification of market potential through internal and external synergies. Furthermore, the

Manufacturing aspect focuses on production readiness, including the ability to run production at full scale, operational efficiency, and meeting market demand for innovative products. The Investment aspect assesses the ability of innovation to attract funding sources. The main indicators involve the readiness of innovation to attract investors as well as the validation of market potential from the economic side. At the same time, the Partnership aspect evaluates collaboration with external parties, such as governments, industry, or research institutions. Emphasis is placed on the effectiveness of collaboration in encouraging the implementation of innovation and managing existing partnerships. For the Risk aspect, the assessment is focused on the identification, mitigation, and management of risks that may occur during the innovation implementation cycle. Indicators include technical and non-technical risk management, as well as risk mapping at the production stage to product commercialization. Finally, the infrastructure aspect assesses the readiness of facilities and infrastructure, such as the integration of information technology systems and the support of other facilities that ensure the successful implementation of innovation.

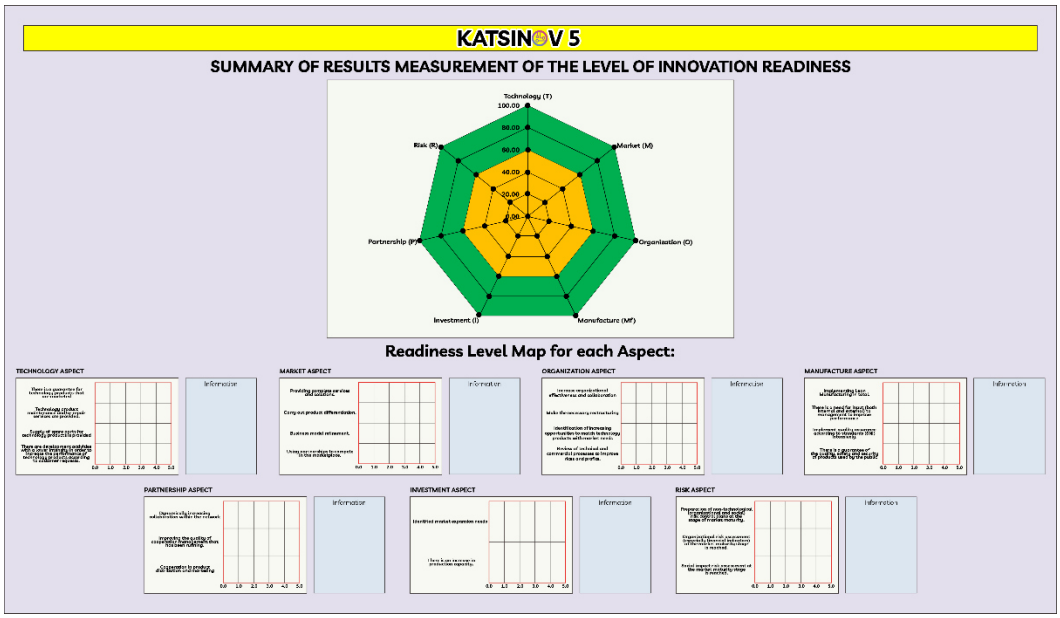


Figure 14.9. Summary of KATSINOV 5 measurement results.

KATSINOV Level 5 provides a detailed overview of the readiness of innovation from various perspectives. This assessment helps organizations to be more strategic in preparing and improving critical aspects to ensure that innovations can be implemented optimally and sustainably.

6. KATSINOV 6

Summary of Results Measurement of the Level of Innovation Readiness using KATSINOV 6 as an indicator of the level of readiness. KATSINOV 6 (Figure 14.10.) covers seven main aspects, namely Technology (T), Market (M), Organization (O), Manufacture (MF), Partnership (P), Investment (I), and Risk (R). Each aspect is evaluated using a value scale from 0 to 100, which is displayed in the form of a radar graph (spider chart). This graph divides the readiness level into zones, where the green zone indicates high readiness, the yellow zone represents medium readiness, and the orange zone indicates low readiness. In the Technology aspect, the evaluation focuses on technology adoption, technical feasibility, and technological innovation development capabilities. This aspect is important because it is the foundation in developing innovative products or services. Market Aspect assesses the readiness of organizations in understanding market needs, marketing strategies, and the potential for acceptance of innovative products in the market.

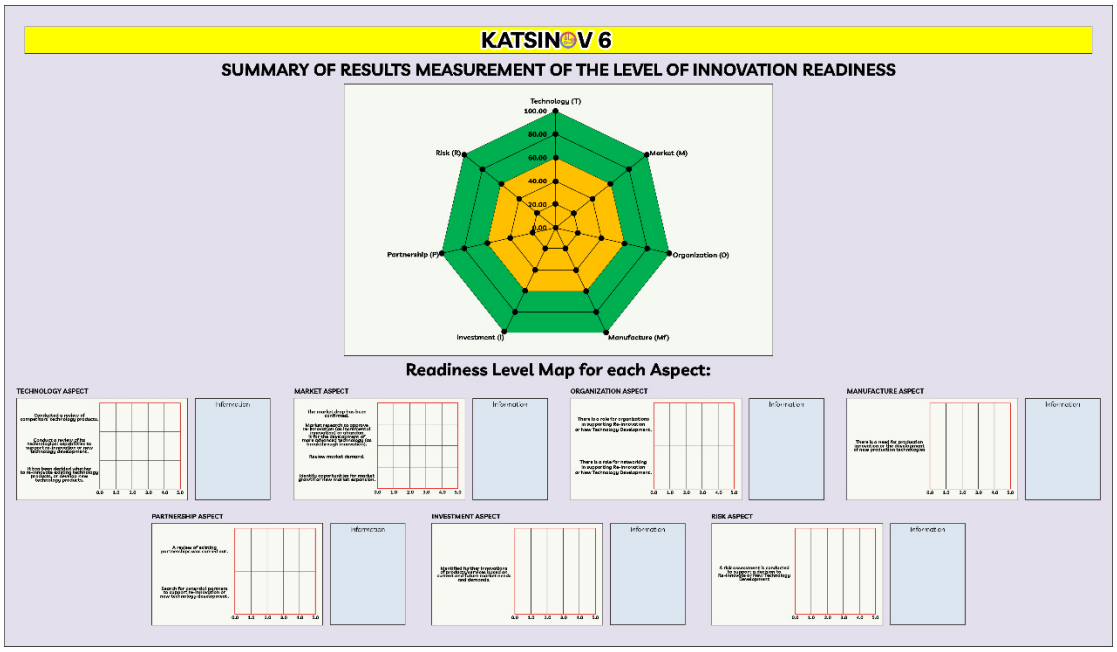


Figure 14.10. Summary of KATSINOV 6 measurement results.

The Organization Aspect includes the internal readiness of the organization, such as the management structure, supporting policies, and the readiness of human resources to encourage innovation. Meanwhile, the Manufacture Aspect evaluates production capabilities and process efficiency in creating innovative products. Furthermore, the Partnership Aspect assesses the level of collaboration with external parties, such as industry partners, academics, and research institutions, to support the

innovation ecosystem. The Investment Aspect focuses on the readiness of funding and the availability of capital needed to support the development of innovation. Finally, the Risk Aspect assesses the potential risks that arise in the innovation process as well as the organization's ability to identify and manage those risks effectively.KATSINOV 6 provides a comprehensive overview of the readiness of innovation from seven important aspects. These radar graphs help organizations to identify strengths and weaknesses in each aspect, making it easier to strategize measurably improve. With this information, organizations can plan priority steps to achieve more optimal innovation readiness and ensure every aspect is in a balanced level of readiness.

14.4. Summary of measurement results for each aspect

1. Technology Aspect

Summary of Results Measurement of the Level of Innovation Readiness" Technology Aspect using the KATSINOV method which is divided into six levels, namely KATSINOV 1 to KATSINOV 6. This graph measures the progress or level of readiness of innovation in technological aspects with a value range from 0 to 100 on the horizontal axis, while the KATSINOV level is displayed on the vertical axis. However, on this graph, the progress for each level of KATSINOV – from KATSINOV 1 to KATSINOV 6 – is 0.00, which indicates that no progress or readiness has been achieved in the technological aspect (Figure 14.11.).

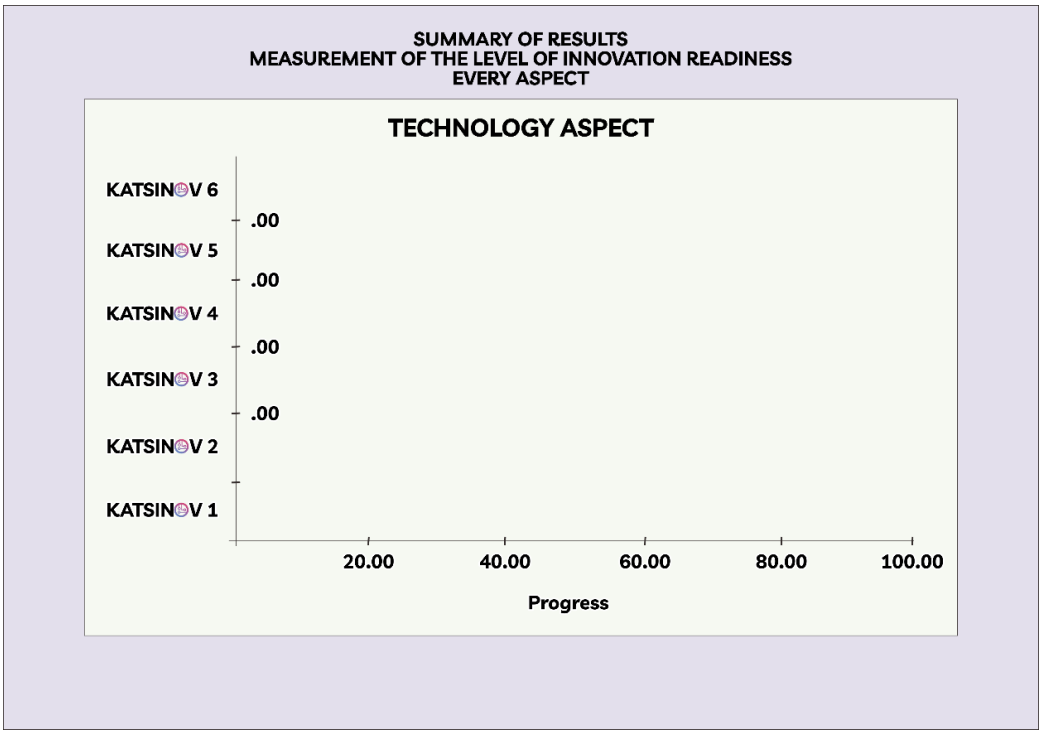


Figure 14.11. Summary of Results Measurement of the Level of Innovation Readiness" for Technology Aspect

The technological aspect of this measurement focuses on the evaluation of the application, readiness, and advancement of technology used in an innovation. Each level of KATSINOV represents the stage of technological maturity, starting from the most basic level (KATSINOV 1) to the highest level (KATSINOV 6). With a progress value of 0.00, it can be concluded that innovation in the technological aspect has not experienced significant development or is still in the early stages that require more attention in technological improvement. This information can be a guide for organizations or interested parties to immediately take strategic steps to accelerate technological development. Some of the efforts that can be made include increasing research and development, adopting new technologies, increasing the competence of human resources in technology, and collaborating with external parties who have technological advantages. With the right strategy, progress in technology aspects can increase to reach the highest level of innovation readiness.

2. Market Aspect

This image presents the "Summary of Results Measurement of the Level of Innovation Readiness" on the Market Aspect (Figure 14.12), which was evaluated using the KATSINOV framework. The framework consists of six levels, starting from KATSINOV 1 as the lowest level to KATSINOV 6 as the highest level. The horizontal axis shows the rate of progress in percentages from 0 to 100, while the vertical axis represents the KATSINOV level. Based on the results shown, all levels of KATSINOV are still at a progress value of 0.00. This means that no significant developments have been recorded in market readiness for the innovations measured. The market aspect is a crucial component in innovation readiness because it ensures that the innovations developed have the potential to be widely accepted and implemented. Key elements in this aspect include market needs analysis, target audience identification, competitiveness analysis, market opportunity validation, and commercialization strategies. Market needs analysis aims to understand the specific problems faced by target consumers and how innovation can be a relevant solution. After that, identification of the target audience is needed to determine who the most appropriate potential users or customers are, so that marketing strategies can be developed more effectively. In addition, competitiveness analysis is carried out to evaluate competitive conditions in the market and map the position of innovation compared to existing competitors.

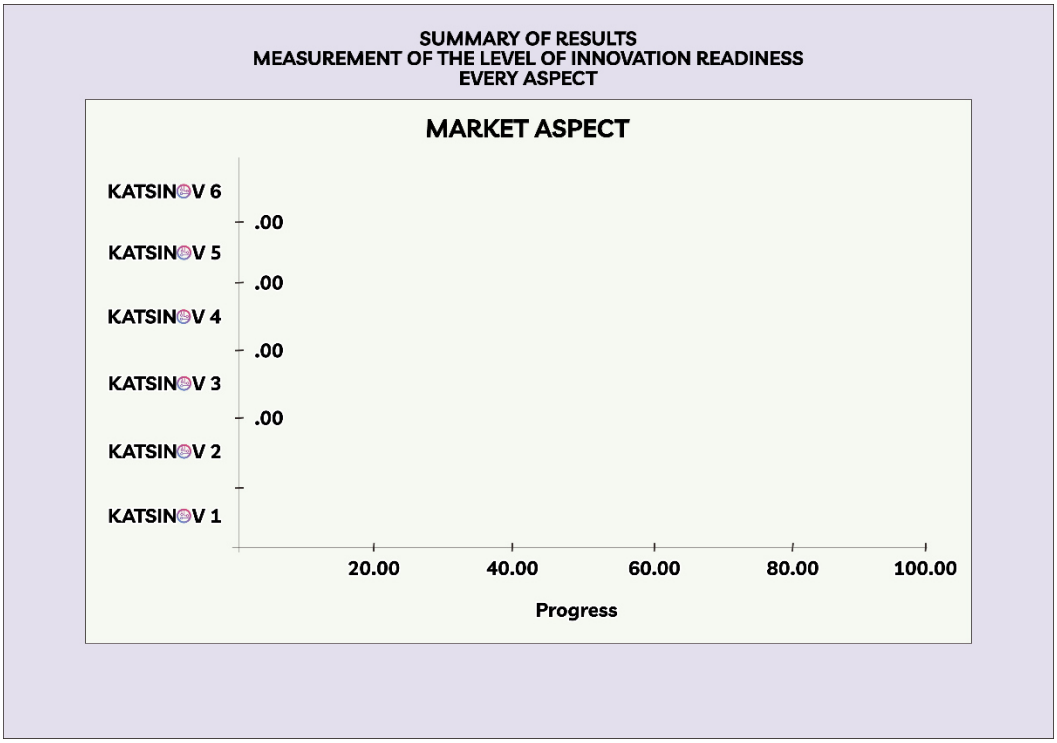


Figure 14.12. Summary of Results Measurement of the Level of Innovation Readiness" for Market Aspect

The next step is to validate market opportunities through live trials or feasibility studies involving feedback from potential users. This process is important to provide a realistic picture of the market's acceptance of innovation. After validation, the commercialization strategy must be carefully designed, including pricing planning, distribution, promotion, and product sales. All of these elements are interconnected in ensuring the readiness of innovations to enter the market successfully. However, the results of the 0.00 progress at each level of KATSINOV show that no concrete steps have been taken in developing these elements. This condition can be caused by a lack of market research, the absence of a clear strategy, or limited resources in validating market potential. To overcome this situation, systematic and structured remedial measures are needed. The first step is to conduct an in-depth market study to obtain data related to the opportunities and challenges that exist. Furthermore, collaboration with stakeholders and experts in the field of marketing can help gain broader insights. Developing innovation prototypes and conducting direct trials to market are also important steps to measure consumer acceptance. In addition, the preparation of a marketing strategy that includes promotion, distribution, and pricing must be carried out comprehensively. Finally, the identification of funding needs will support the innovation commercialization process so that it runs optimally. With

the implementation of these measures, progress in the Market Aspect is expected to increase gradually, thus helping innovation achieve higher readiness at the level of KATSINOV 4 to KATSINOV 6. Optimal market readiness will accelerate the adoption of innovations by consumers and increase the chances of success in a competitive market.

3. Organization Aspect

The figure above shows the results of measuring the level of readiness for innovation in organizational aspects (Figure14.13). This graph is titled "Summary of Results - Measurement of the Level of Innovation Readiness In Every Aspect" with a focus on Organization Aspect. The graph uses a horizontal scale as the "Progress" axis which ranges from 0 to 100, while the vertical axis displays six categories of "KATSINOV" (KATSINOV 1 to KATSINOV 6). Based on the data shown in the graph, all categories of KATSINOV have a progress value of 0.00, which means that no progress is recorded in the organizational aspect for the category. These zero values indicate that the level of readiness for innovation in organizational aspects may still be in the early stages or have not experienced significant development.

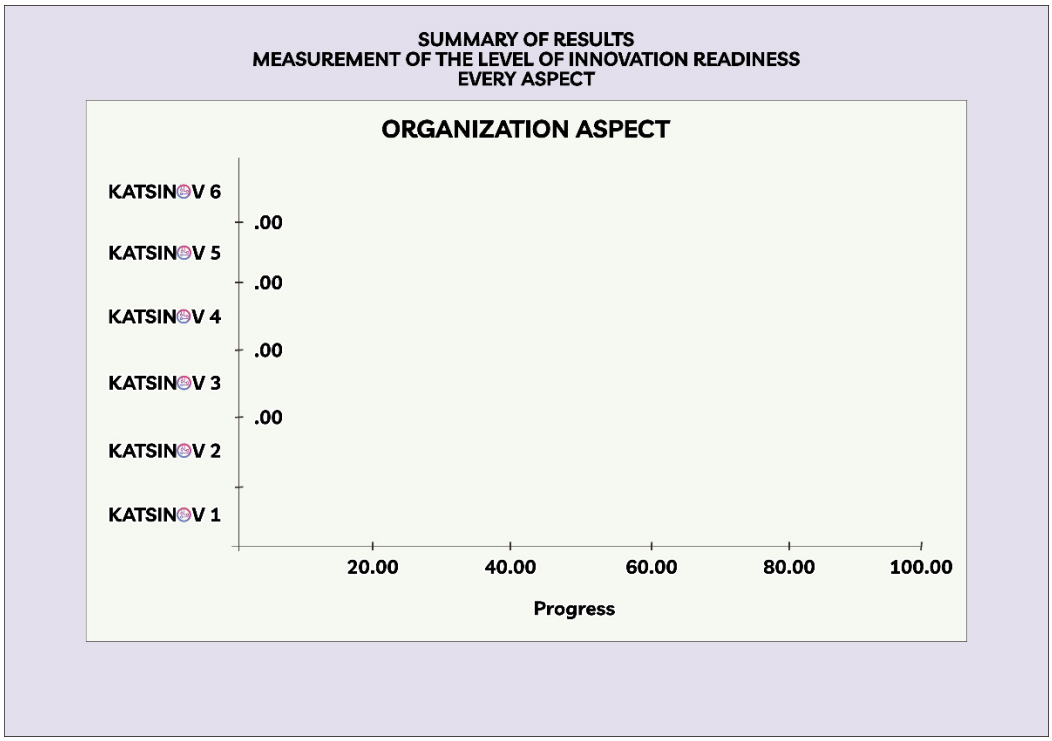


Figure 14.13. Summary of Results Measurement of the Level of Innovation Readiness" for Organization Aspect

The low level of innovation readiness in organizational aspects can be caused by several factors, such as a lack of a clear innovation strategy, lack of resource support, limitations in the application of technology, or organizational culture that does not support innovation. This indicates the need for more structured and planned improvement efforts to encourage innovation in the organization. Some concrete steps that can be taken include strengthening the culture of innovation by creating an environment that encourages creativity and risk-taking, increasing human resource training to adopt and develop innovation, and providing adequate resources and technology. In addition, visionary leadership also plays a crucial role in driving readiness for innovation at all levels of the organization. This graph provides a clear picture of the challenges faced in organizational innovation readiness. Therefore, a thorough evaluation and systematic improvement steps are needed so that organizations can be better prepared to adopt and implement innovations. Focusing on aspects of leadership, human resource skills, and technological infrastructure will be the main keys in increasing the level of innovation readiness in the future.

4. Manufacture Aspect

This figure shows the results of measuring the level of readiness for innovation in the manufacturing aspect. The graph is titled "Summary Of Results - Measurement Of The Level Of Innovation Readiness In Every Aspect" with a focus on Manufacture Aspect (Figure14.14.). On the horizontal axis is displayed the "Progress" scale which ranges from 0 to 100, while the vertical axis lists the six categories of "KATSINOV" (KATSINOV 1 to KATSINOV 6). Based on the available data, all categories of KATSINOV show a progress value of 0.00, indicating no development or readiness in the manufacturing aspect.

These results show that the manufacturing aspect in the context of innovation readiness is in a stagnant or underdeveloped condition. This may be due to several factors such as the lack of implementation of advanced technology, lack of investment in innovative production processes, and limited ability of the workforce to deal with technological changes. The low progress in this aspect may also reflect the lack of a comprehensive strategy to encourage innovation in manufacturing activities. To increase the readiness of innovation in the manufacturing aspect, steps that can be taken include the application of more advanced production technologies such as automation and digitalization, improving the competence of the workforce through training and education, and the allocation of adequate resources to support research and development in

the manufacturing sector. In addition, collaboration between organizations, governments, and other stakeholders also needs to be strengthened to encourage innovation and efficiency in the production process.

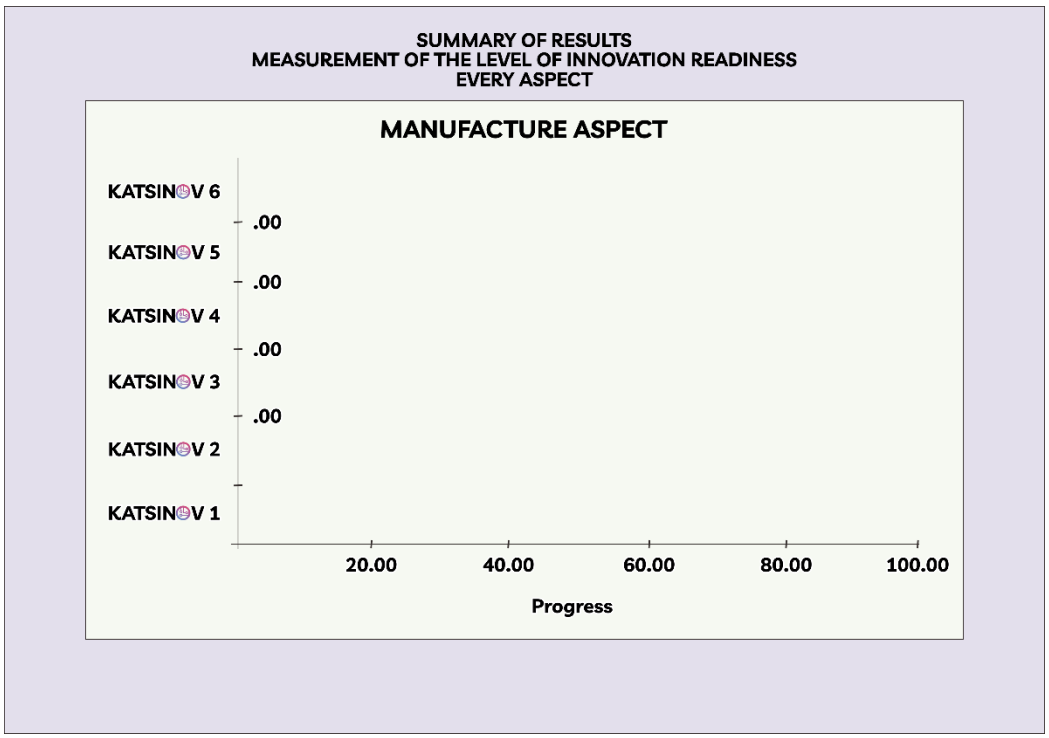


Figure 14.14. Summary of Results Measurement of the Level of Innovation Readiness" for Manufacture Aspect

This graph confirms that the manufacturing aspect requires serious attention in efforts to increase innovation readiness. Improvements in technology adoption, increased human resources, and production process efficiency will be the main keys in spurring innovation growth in this sector in the future.

5. Partnership Aspect

This figure shows the results of measuring the level of innovation readiness in the partnership aspect. The graph is titled "Summary Of Results - Measurement Of The Level Of Innovation Readiness In Every Aspect" with a focus on Partnership Aspect (Figure 14.15.). On the horizontal axis there is a "Progress" scale that ranges from 0 to 100, while on the vertical axis there are six categories of "KATSINOV" (KATSINOV 1 to KATSINOV 6). All KATSINOV categories in this chart show a value of 0.00, which means that there has been no progress in the readiness of innovation in the aspect of partnerships. These results reflect that the partnership aspect has experienced total stagnation in the context of innovation.

Partnerships play a key role in driving innovation because collaboration with external parties such as suppliers, research institutions, governments, and other business partners can increase an organization's capacity to innovate. However, this lack of progress shows that there is no effective collaborative strategy or strong synergy with external parties.

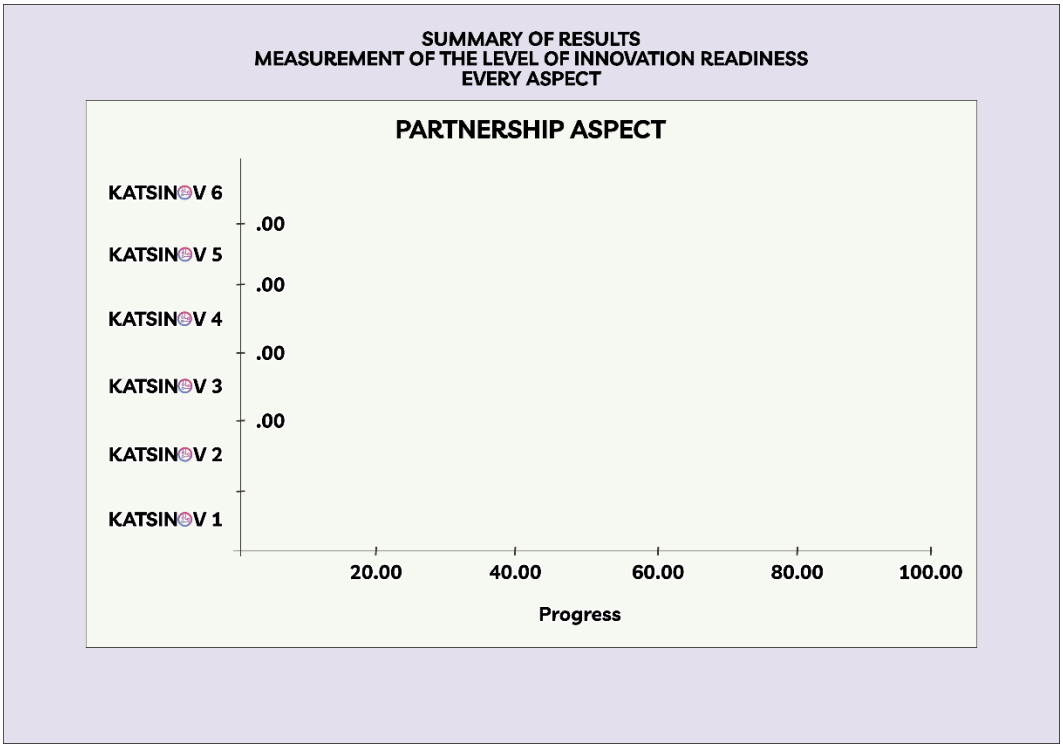


Figure 14.15. Summary of Results Measurement of the Level of Innovation Readiness" for Partnership Aspect

Some factors that may be the cause of this stagnation include a lack of collaborative initiatives, a lack of strategic partnership networks, and low trust in building long-term relationships with potential partners. In addition, the lack of communication and coordination between the organization and external stakeholders can slow down the development of innovation in this aspect of partnerships. To improve progress in the partnership aspect, organizations need to make concrete efforts such as establishing strategic collaborations with external parties, participating in business and technology forums, and building relationships with research and innovation centers. Another step is to encourage public-private partnership programs, increase engagement in the innovation ecosystem, and ensure that the results of the collaboration provide real added value. This graph shows the need for serious attention to the partnership aspect in innovation readiness. By building stronger and more structured partnerships, organizations can accelerate innovation growth and create more effective and sustainable solutions.

6. Investment Aspect

Based on the results of measuring the level of innovation readiness in the investment aspect, it can be seen that the six categories measured (KATSINOV 1 to KATSINOV 6) show a progress rate of 0.00. This shows that no significant development or contribution has been achieved in the investment aspect. Visually, the graph shows that all categories are still at zero on the horizontal axis, reflecting a very low level of readiness (Figure14.16.). These results give an idea that the investment aspect of innovation readiness still requires serious attention. Some potential factors that can cause this low progress include the lack of budget allocation for innovation, the lack of stakeholder commitment to support investment in the field of innovation, and the absence of strategic planning to support improvements in these aspects. In addition, bureaucratic obstacles, limited resources, and lack of synergy between various parties can also exacerbate this situation.

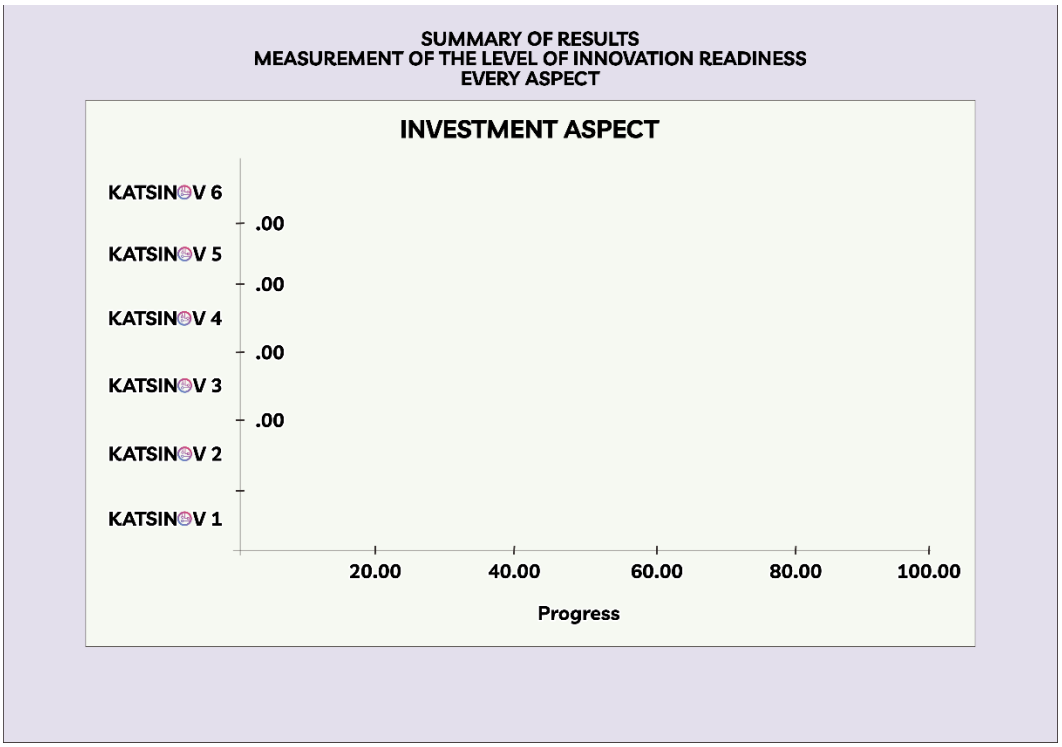


Figure 14.16. Summary of Results Measurement of the Level of Innovation Readiness" for Investment Aspect

In the context of development and innovation readiness, the investment aspect plays a very crucial role. Adequate investment can encourage research, technology development, and the application of innovation in various sectors. Therefore, collaborative efforts from the government, the private sector, and educational institutions are needed to increase investment in this area. Increasing fund allocation, formulating

policies that favor innovation, and providing incentives for parties who invest in innovation development are concrete steps that can be taken. These results show the urgency to improve and increase the readiness of innovation in the investment aspect. If improvement efforts are not carried out immediately, the level of innovation readiness will continue to stagnate, which can ultimately hinder development progress and overall competitiveness. With the right strategy, strengthening the investment aspect can be the main driver in accelerating the readiness of future innovations.

7. Risk Aspect

Based on the results of measuring the level of innovation readiness in the risk aspect, the six categories evaluated (KATSINOV 1 to KATSINOV 6) showed a value of 0.00. This illustrates the absence of progress or development in managing and mitigating risks related to innovation readiness (Figure 14.17.). These results confirm that the risk aspect has not received adequate attention in planning and implementing innovations. In the context of innovation, risk management has a very important role because innovation is often accompanied by various uncertainties and potential failures. Risks can arise in various forms, such as financial, technical, operational, and market risks. An inability to identify, analyze, and mitigate risks can lead to innovation programs not running effectively and efficiently.

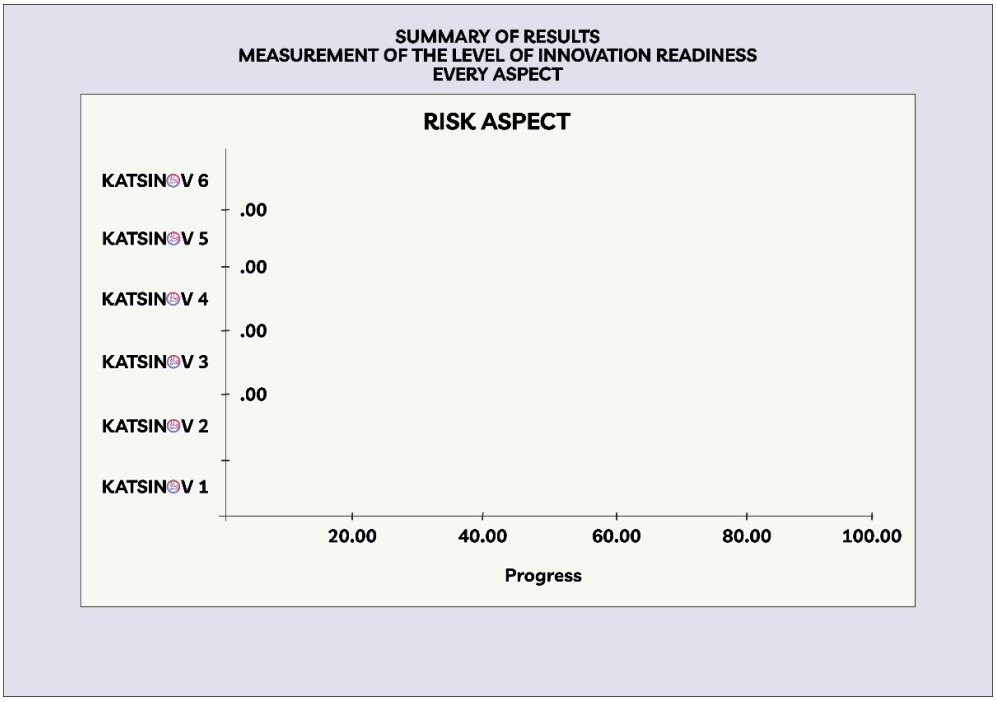


Figure 14.17. Summary of Results Measurement of the Level of Innovation Readiness" for Risk Aspect

Measurement results that show a 0.00 number can be caused by several main factors. First, the lack of awareness of risks is a significant obstacle. Many parties involved in innovation often overlook the importance of risk management and do not understand the impact of risks that are not properly managed. Second, the lack of strategic planning leads to the absence of a structured mechanism for identifying and managing risks. Third, limited resources, both in terms of funding, experts, and supporting technology, are also obstacles in the implementation of risk management. Finally, the absence of policies or regulations that support the implementation of risk management in innovation readiness further exacerbates this stagnation condition. Risk management is a key component in ensuring the success of innovation. By effectively managing risk, organizations can reduce potential failures, improve resource allocation efficiency, build trust from stakeholders, and drive long-term innovation sustainability. Therefore, some strategic efforts need to be made immediately to overcome stagnation in this aspect. First, increasing awareness and capacity of risk management through education and training related to risk identification, evaluation, and mitigation methods is a fundamental step that must be implemented. Second, developing a structured risk management strategic plan, including risk identification mechanisms, impact analysis, and appropriate mitigation measures, is a top priority. Third, the provision of adequate resources, both in the form of funding, experts, and supporting technology, must be pursued by the government, the private sector, and related institutions. In addition, policies that support the implementation of risk management in innovation need to be immediately drafted and implemented so that all parties have a clear and directed framework. The results of the risk aspect measurement with a value of 0.00 indicate the need for serious attention to risk management in innovation readiness. Without awareness, strategic planning, adequate resource provision, and supportive policies, the risk aspect will continue to be an obstacle to innovation development. Therefore, collaborative steps from all relevant parties are very important so that risk management can be improved and innovation readiness can be significantly improved in the future.

14.5. KATSINOV Measurement Procedure

Measurement and determination of KATSINOV using the KATSINOV-Meter can be carried out by following the following steps:

1. Complete the first sheet (worksheet 1) first by filling in information about the name/title of innovation, field of innovation, project name, name of

institution/company, and address/contact, number and date of measurement and KATSINOV Determination (Figure 14.18.)..

KATSINOV-Meter focuses on evaluating seven main aspects, namely technology, market, organization, manufacturing, investment, partnerships, and risk. This measurement is important because it provides significant benefits, including describing the progress of innovations, helping to implement innovations more effectively throughout their lifecycle, and preparing organizations to face increasingly fierce competition and rapid changes in technological developments. The top of the KATSINOV-Meter form displays a general explanation of this measuring tool, including the purpose and methodology used. Furthermore, in the core part, there are important fields that must be filled in by users to document information related to innovation measurement. The first column contains the Innovation Name (Innovation Name/Title) which is the main identity of the project or innovation activity being measured. The next column contains Field Focus and Project Name, which help identify the scope and purpose of the innovation being developed. The next information includes the Name of Institution/ Company along with the Address/Contact, which records the institution or organization responsible for the innovation.

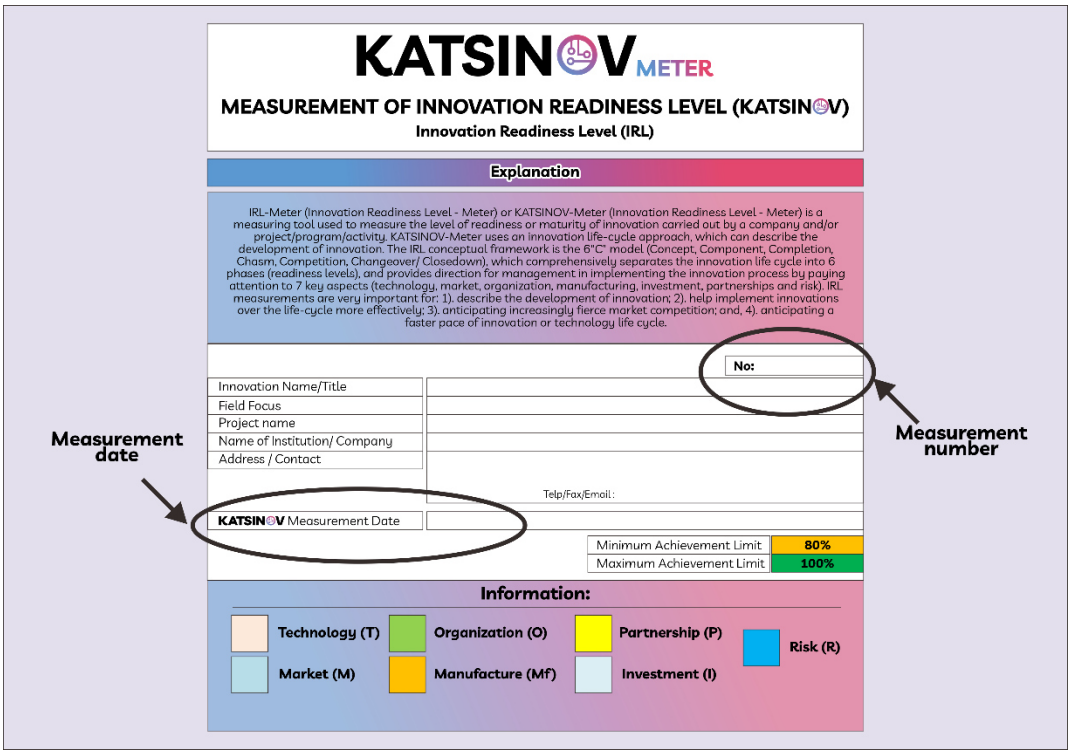


Figure 14.18. Fill in the innovation product information.

There are two key elements in this form that are indicated by a special marker, namely the Measurement Date and the Measurement Number. The measurement date is recorded under the KATSINOV-Meter Measurement Date label which serves to document when the evaluation of the level of readiness of the innovation is carried out. This is important for tracking the progress of innovations over time, especially if measurements are made at regular intervals. Meanwhile, the measurement number (No) is placed on the right side of the form and serves to provide a unique identification in each measurement process carried out, making it easier to prepare reports and archives. At the bottom of the form, there are minimum and maximum achievement limits that provide an indication of innovation performance. The minimum limit is set at 80%, while the maximum limit is 100%, which reflects the ideal level of readiness in the implementation of innovations. In addition, the form comes with additional information in the form of legends that use color coding to map out the seven main aspects of innovation. The Technology aspect (T) is represented in light blue, while Organization (O) uses purple. Furthermore, Partnership (P) is represented by yellow, Risk (R) is pink, Market (M) is green, Manufacturing (Mf) is orange, and Investment (I) is dark blue. This legend helps to visualize the results of innovation measurement in a more systematic and structured way.KATSINOV-Meter is a comprehensive and systematic tool in measuring innovation readiness. With a lifecycle-based approach and a focus on seven key aspects, the tool not only provides a quantitative overview of the progress of innovation, but also assists organizations in identifying areas that need improvement or improvement. Through planned and regular measurements, KATSINOV-Meter can be a strategic guide for companies or institutions in managing and implementing innovations to achieve more optimal and sustainable results.

2. Perform a quick KATSINOV or KATSINOV -Quick measurement based on the results of the available quick-assessment data

One of the advantages of the KATSINOV Meter is its focus on seven key aspects that support the success of innovation, namely: Technology (T), Market (M), Organization (O), Manufacturing (Mf), Partnership (P), Investment (I), and Risk (R). Each of these aspects has an important role in ensuring innovation readiness at every stage of its life cycle. For example, the Technology (T) aspect assesses the readiness of the technology used in innovation, while the Market (M) focuses on market acceptance and the economic potential of the innovation (Figure 14.19.). Meanwhile, the

Organization (O) emphasizes the internal structure and readiness of the organization in supporting the implementation of innovation. The Manufacturing Aspect (Mf) evaluates production capabilities, while Partnerships (P) are concerned with the strategic collaboration required to accelerate implementation. The Investment aspect (I) assesses the financial support available, and Risk (R) focuses on managing the risks that may be encountered during the innovation process. The KATSINOV Meter has significant benefits for various interested parties, including company management, policymakers, as well as the innovation team itself. First, it helps describe the development of innovation from the initial stage to the final implementation stage. Thus, management can understand where their innovation is in the life cycle and take appropriate steps to overcome any obstacles or challenges that arise. Second, the KATSINOV Meter allows management to be more effective in helping innovations move through their life cycles quickly and efficiently. This is very important in the face of increasingly fierce competition in the global market. Third, the use of these tools allows organizations to anticipate changes and increasingly fierce market competition, and respond to them with more mature and adaptive innovation strategies.

Figure 14.19. Limits (percentage of indicators met) for the achievement of KATSINOV indicators at each level.

The bottom of this measurement tool includes an achievement limit percentage indicator that is used as a benchmark in evaluating innovation

readiness. There are two main achievement levels, namely the Minimum Achievement Limit of 80%, which is marked in yellow, and the Maximum Achievement Limit of 100%, which is marked in green. This percentage reflects how many indicators have been met in the aspects assessed. If the readiness indicator has reached 80%, innovation is considered to be in the early stages of adequate readiness, while achieving 100% indicates full and optimal readiness. In addition, the legend of the colors shown in the image makes it easy to understand the seven aspects measured by the KATSINOV Meter. Each aspect is marked with a different color for easy identification: Technology (T) is light blue, Market (M) is dark blue, Organization (O) is green, Manufacturing (Mf) is orange, Partnership (P) is purple, Investment (I) is pink, and Risk (R) is red. With the use of these colors, the results of the evaluation can be visualized more clearly and easily understood by various interested parties. The KATSINOV Meter is a very useful and comprehensive tool in measuring innovation readiness through a systematic approach based on the innovation life cycle. This tool not only assists organizations in evaluating the status of their innovations, but also provides clear direction to address challenges, maximize opportunities, and ensure successful innovation implementation. With an emphasis on seven key interrelated aspects, the KATSINOV Meter is an effective tool for planning and managing innovations, especially in a rapidly evolving business and technological environment. The use of this tool is very relevant in today's era of global competition, where the ability to innovate effectively can be the determinant of the success of an organization or company in a dynamic and competitive market.

In order to provide a fast and accurate measurement of the level of innovation readiness, KATSINOV Quick comes as a simpler but still effective alternative approach. While the KATSINOV Meter uses a six-phase approach to innovation readiness with more complex indicators, the KATSINOV Quick focuses more on measurements in the form of direct assessments using colored scales (green, yellow, orange, and red) each representing the level of innovation readiness. This system is designed to identify how far an innovation is ready through rapid assessment, especially in decision-making processes that are urgent or require results in a short period of time. The schematic shown in the image shows four levels of readiness that can be selected. The green color indicates maximum readiness or optimal innovation readiness; This means that the innovation is mature, ready to be implemented, and the probability of successful implementation is high. The yellow color reflects partial readiness or innovation that is in the middle stage; Although it is not perfect,

the innovation still has opportunities to be further developed with certain improvements. Furthermore, orange indicates low readiness; Innovation at this level still requires serious attention for further development, whether in terms of technology, market, or other related aspects. Finally, red depicts very low readiness or even not at all ready; At this stage, innovation requires a fundamental overhaul and re-assessment of all aspects before it can be said to be ready.

In the context of measuring innovation readiness, KATSINOV Quick also allows users to provide a circle sign (●) as an indicator of the selection that best suits the conditions of the innovation being measured. This makes the KATSINOV Quick a more practical measuring tool compared to the in-depth version of the KATSINOV Meter. The user only needs to make a direct identification of the indicators that best describe the readiness of the innovation, which further provides the results in the form of a KATSINOV Quick score. As shown in the figure, if no indicators are selected or the innovation is declared "no suitable option," then the condition reflects a very low readiness of the innovation or less support for further development. In this quick measurement, the resulting value is expressed in symbol <1 to illustrate that the innovation is still in the early stages of readiness.

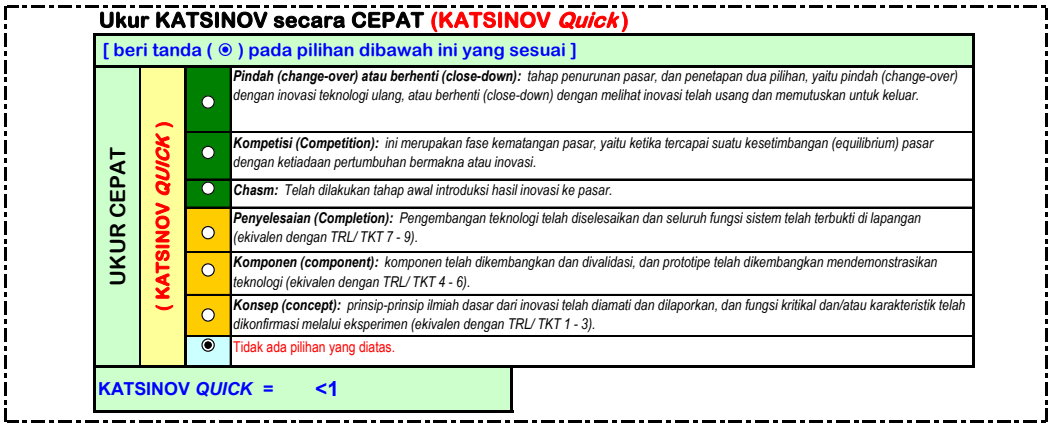


Figure 14.20. Quick measure KATSINOV.

With this measurement method, management or those in charge of innovation can make faster decisions related to the development of certain products, technologies, or programs. KATSINOV Quick acts as a screening tool or an initial screening tool that can be used in short-term strategic planning (Figure 14.20.). For example, if the measurement results show a low level of readiness (red), then strategic decisions can be directed to delay the implementation of the innovation and focus on comprehensive

improvements before proceeding to the next stage. On the other hand, if the innovation is assessed to be at an intermediate readiness level (yellow or orange), management can consider advanced investment options to ensure increased readiness towards an optimal level. As part of the innovation measurement framework, KATSINOV Quick provides advantages in terms of time efficiency and ease of use. This makes it an ideal solution for companies, organizations, or research institutes that require short and effective evaluations for various innovation projects. The tool can also be integrated with other approaches such as the KATSINOV Meter to provide more in-depth results if needed. Often, the results of the initial measurement through the KATSINOV Quick are an important reference to determine whether an innovation is worthy of further development or needs to be restructured.

In addition, the use of color in KATSINOV Quick creates an intuitive visual approach that makes it easier for all interested parties, including non-technical parties, to understand the results of innovation evaluations. In its implementation, the combination of this approach with in-depth measurements such as the KATSINOV Meter will provide a more holistic picture of the overall state of innovation. The visual and structured approach offered by KATSINOV Quick ultimately supports companies or institutions in faster and more informed strategic decision-making. Simply put, although KATSINOV Quick aims to provide more instant results, it remains in line with the basic principles of measuring the readiness of complex innovations. This method allows users to easily make an initial assessment of the potential implementation of innovations. Further decisions can be based on these initial results, thus allowing alignment between the organization's strategy and the real conditions of the innovation being assessed. As such, KATSINOV Quick serves as an integral part of the innovation measurement ecosystem, supporting the efficiency of time, resources, and optimal results-oriented policymaking.

3. Measurement and Determination of KATSINOV

Begins by placing a cross (x) at the lowest KATSINOV statement (KATSINOV 1), continuing to the statement at KATSINOV 2 and so on to the higher KATSINOV (Figure 14.21). The KATSINOV level achieved is the KATSINOV level whose indicator or statement "can be met". If the indicator of a KATSINOV level is "not met", the measurement and determination is completed (stopped) and the KATSINOV achieved is the KATSINOV level below which is fulfilled.

After discussing the KATSINOV Quick as a fast measurement instrument, it is important to understand how the KATSINOV Meter system

works in evaluating the readiness of innovation in a more in-depth and structured manner. The schema shown in the flow chart provides a clear picture of the measurement stages, decision-making, and the role of supporting documents in the assessment process. Measurements with the KATSINOV Meter begin with the collection of data through relevant supporting documents. This document serves as the main reference in the KATSINOV measurement process to ensure that each criterion can be measured accurately and objectively. The data obtained will be used as a basis in determining the level of fulfillment of the criteria that have been set in the KATSINOV Meter.

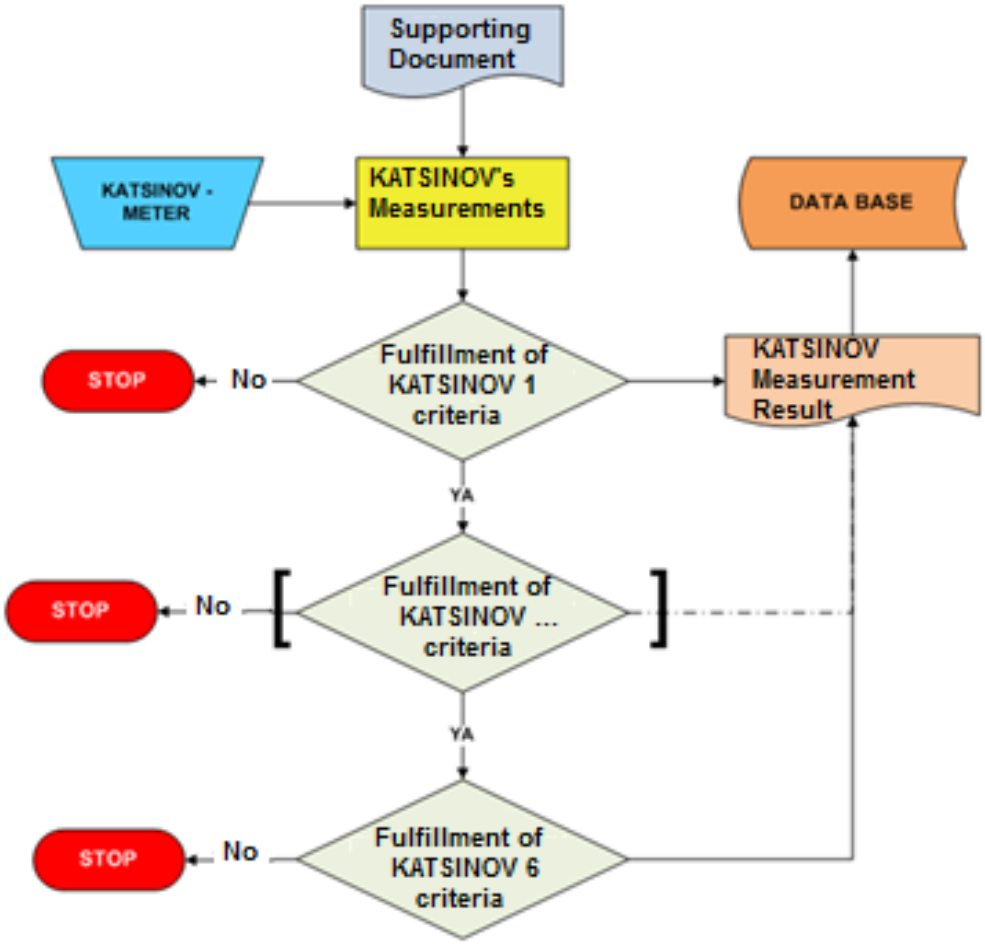


Figure 14.21. Measurement steps and determination with KATSINOV-Meter.

The first stage begins with the fulfillment of the first criteria from KATSINOV. If at this stage the innovation is judged not to meet the required criteria, the evaluation process will stop as indicated by the "STOP" symbol on the diagram. This gives a signal that innovation is not ready to proceed to the next stage and needs to be improved or re-assessed on the aspects

assessed. On the other hand, if the innovation meets the first criterion, then the evaluation process will continue to the next criterion. This phased approach aims to ensure that each stage of innovation readiness has been met before it is declared feasible or ready to be implemented. Each criterion in the KATSINOV Meter has specific indicators, including technical, economic, institutional, and sustainability aspects of innovation. This measurement aims to ensure that innovations are not only technically ready, but also have the potential for long-term sustainability. The diagram shows that if an innovation does not meet any of these criteria, the process will stop automatically. This mechanism provides certainty that innovations that are continued to the next stage have an adequate level of readiness in accordance with the standards that have been set. These stages are carried out sequentially until all criteria, including the sixth criterion, are successfully met. This process ends when the innovation is declared to meet all the criteria contained in the KATSINOV Meter. The final results of these measurements will be recapitulated and stored in a database, which will then become a reference for strategic decision-making related to innovation implementation. This database plays an important role as an archive that records the measurement results of various innovations that have been tested, so that it can be used as a reference for further evaluation or development of new innovations in the future. In other words, this system not only helps in assessing innovation readiness, but also supports more systematic and sustainable management of innovation-related knowledge.

The integration between the stages of the KATSINOV Meter and the decision-making process makes it a more comprehensive instrument than the KATSINOV Quick. If KATSINOV Quick focuses on quick assessment, the KATSINOV Meter provides more in-depth and detailed results, so that it can identify weaknesses and potential that need to be developed from an innovation. This approach is particularly suitable for innovations that are complex or require a more comprehensive assessment before they can be implemented. In field implementation, the use of the KATSINOV Meter can help organizations or institutions in prioritizing which innovations are worthy of further development. For example, if the measurement results show that the innovation fails to meet the second or third criteria, then the organization may decide to pause the development of the innovation and allocate resources to other, more promising innovations. On the other hand, innovations that meet all criteria can be directly directed to the implementation or commercialization stage in accordance with the strategic plan that has been set. Thus, the KATSINOV Meter plays an

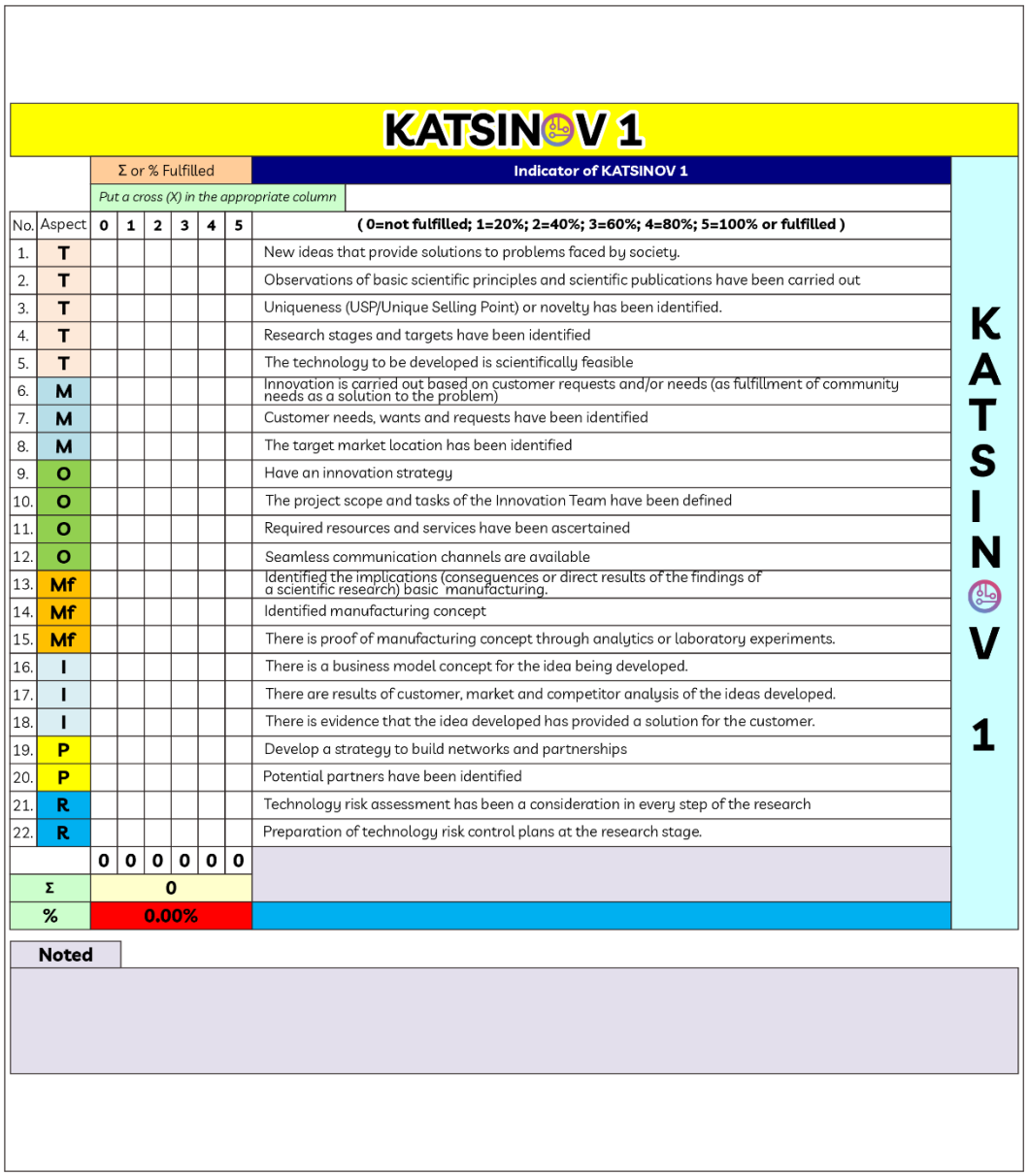
important role in ensuring that the available resources are used efficiently and on target. Another advantage of the phased approach shown in the flowchart is its ability to minimize the risk of failure in the development and implementation of innovations. The tiered evaluation process allows each stage to be thoroughly tested before moving on to the next stage. This provides an opportunity for organizations to identify potential bottlenecks early, so mitigation measures can be taken quickly. This approach also ensures that the resulting innovations have a high level of readiness and are reliable when applied in a real environment.

By combining the KATSINOV Meter and KATSINOV Quick approaches, organizations or institutions can get a more holistic picture of their innovation readiness. KATSINOV Quick can be used as an initial evaluation tool to provide a brief overview of the state of innovation, while KATSINOV Meter serves as an in-depth evaluation tool that provides more structured and comprehensive results. The combination of these two approaches ensures that innovations are assessed effectively and efficiently, which can support more accurate and strategic decision-making. Ultimately, the overall use of the KATSINOV system contributes significantly to increasing the effectiveness of innovation development in various sectors. With systematic measurement, organizations can ensure that the innovations developed have a high potential for success and are in accordance with the needs of the market or set targets. Therefore, KATSINOV serves not only as a measuring tool, but also as a management instrument that supports the innovation process from the initial stage to the implementation stage.

The KATSINOV 1 indicator (Figure 14.22.) is a measuring tool used to evaluate the stages and readiness of innovations in meeting certain criteria. This table consists of 22 aspects classified into several categories, namely T (Technology), M (Market), O (Organization), Mf (Manufacturing), I (Idea), P (Partnership), and R (Risk). Each aspect is assigned a value on a scale of 0 to 5, with 0 marking "not yet met" and 5 marking "fully met". However, based on the data displayed in the table, all aspects have not been assessed, with a total of $\Sigma = 0$ and a percentage of 0.00%. Here is a more detailed breakdown of each aspect in the table:

Technology Category (T), Aspect 1: New Ideas that Provide Solutions to Community ProblemsTechnological innovation must have a clear added value in solving real problems faced by society. Without relevant ideas and solutions, it is difficult for innovation to develop into a product or solution that is accepted by the market. Aspect 2: Observation of Scientific Principles and Scientific PublicationsObservations made based on scientific

principles and accompanied by important publications are evidence of the validity of the research process. This step ensures that the approach used is accountable. Aspect 3: Unique or Has a Selling Value (USP)The uniqueness of a product or innovation is one of the determinants of success in the market. The Unique Selling Point (USP) concept creates an attraction that differentiates innovation from other existing solutions. Aspect 4: Setting Research Goals and TargetsClear goals and targets allow the innovation development process to run more structured and measurable. Aspect 5: Scientific Feasibility of TechnologyThe technology developed must be proven to be scientifically feasible and empirically testable. This is related to the feasibility of implementation on a larger scale.



KATSINOV 1

		Σ or % Fulfilled						Indicator of KATSINOV 1
		Put a cross (X) in the appropriate column						
No.	Aspect	0	1	2	3	4	5	(0=not fulfilled; 1=20%; 2=40%; 3=60%; 4=80%; 5=100% or fulfilled)
1.	T							New ideas that provide solutions to problems faced by society.
2.	T							Observations of basic scientific principles and scientific publications have been carried out
3.	T							Uniqueness (USP/Unique Selling Point) or novelty has been identified.
4.	T							Research stages and targets have been identified
5.	T							The technology to be developed is scientifically feasible
6.	M							Innovation is carried out based on customer requests and/or needs (as fulfillment of community needs as a solution to the problem)
7.	M							Customer needs, wants and requests have been identified
8.	M							The target market location has been identified
9.	O							Have an innovation strategy
10.	O							The project scope and tasks of the Innovation Team have been defined
11.	O							Required resources and services have been ascertained
12.	O							Seamless communication channels are available
13.	Mf							Identified the implications (consequences or direct results of the findings of a scientific research) basic manufacturing.
14.	Mf							Identified manufacturing concept
15.	Mf							There is proof of manufacturing concept through analytics or laboratory experiments.
16.	I							There is a business model concept for the idea being developed.
17.	I							There are results of customer, market and competitor analysis of the ideas developed.
18.	I							There is evidence that the idea developed has provided a solution for the customer.
19.	P							Develop a strategy to build networks and partnerships
20.	P							Potential partners have been identified
21.	R							Technology risk assessment has been a consideration in every step of the research
22.	R							Preparation of technology risk control plans at the research stage.
		0	0	0	0	0	0	
Σ		0						
%		0.00%						

KATSINOV 1

Noted

Figure 14.22. Indicators at each level KATSINOV.

Market Category (M), Aspect 6: Innovation Based on Demand and Community Needs Successful innovation is usually based on specific needs put forward by the community or customers, making it more relevant and easy to accept. Aspect 7: Identification of Customer NeedsThe process of identifying customer needs is a key stage in creating innovations that meet market expectations. Aspect 8: Identify the Target Market LocationThe target market location must be clearly defined, so that marketing and distribution strategies can be well planned.

Organizational Category (O), Aspect 9: Innovation StrategyThe right innovation strategy will guide product development more efficiently and effectively. This stage includes planning innovation measures. Aspect 10: Project Scope and Tasks of the Innovation TeamThe scope of work and the division of tasks within the innovation team must be defined to ensure each member understands their roles and responsibilities. Aspect 11: Identify Resources and Services NeededDetermining resources, whether in the form of labor, equipment, or infrastructure, is the first step to support the innovation process. Aspect 12: Communication ChannelsA smooth communication channel facilitates coordination within the innovation team and ensures everyone has the same understanding of the project objectives.

Category Manufacturing (Mf), Aspect 13: Implications of ResearchResearch must produce clear implications, both conceptually and practically. These implications include significant findings that can be used in product development. Aspect 14: Manufacturing ConceptsIdentification of manufacturing concepts is important to understand the production process to be applied. Aspect 15: Proof of Manufacturing Concept Through ExperimentsProof that manufacturing concepts can be tested through analysis and experimentation is an indicator of the readiness of the production process.

Idea Category (I), Aspect 16: Business Model ConceptA clear business model provides an overview of how an idea will be developed into a product or service that has economic value. Aspect 17: Market and Competitor AnalysisThe results of the analysis of customers, markets, and competitors ensure that the ideas developed have the potential to succeed in the market. Aspect 18: Proof of Solutions for CustomersInnovation must provide concrete evidence that the developed solution is effective in solving customer problems.

Category Partnership (P), Aspect 19: Network Building Strategies and PartnershipsBuilding a strategic partnership network is an important step in expanding the reach of innovation. Aspect 20: Identify Potential

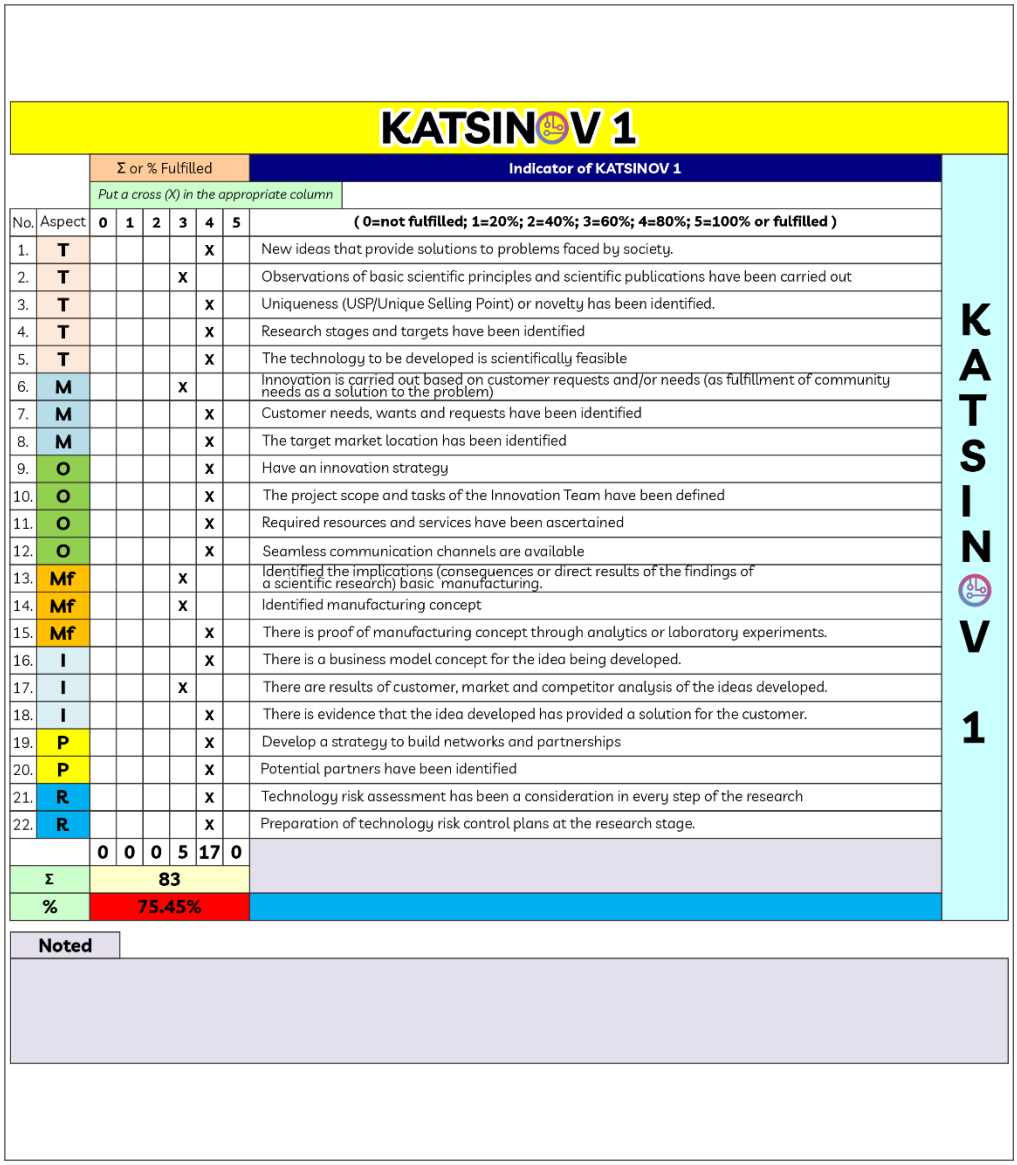
PartnersPotential partners must be identified to support the development, production, and marketing of innovations.

Risk Category (R), Aspect 21: Technology Risk EvaluationTechnology risk evaluation must be a consideration in every stage of development so that innovation can run smoothly. Aspect 22: Risk Control PlanRisk control planning is important to minimize possible obstacles or failures at the research and development stages.

Based on the KATSINOV 1 indicator table, all aspects have not been assessed, as can be seen from the total value of $\Sigma = 0$ and a percentage of 0.00%. This shows that there has not been the fulfillment of indicators from every aspect. To achieve the ideal stage of innovation, a thorough evaluation and concrete steps are needed in meeting each of the above criteria. Every aspect must be fulfilled gradually, starting from the observation stage, scientific validation, to business concept development, manufacturing, partnerships, and risk management. With a systematic and collaborative approach, the KATSINOV 1 indicator can be used as an effective guide in measuring the readiness of innovation at various stages (Figure 14.23.).

Based on the assessment on the table, the total score achieved was 83 of the total maximum weight, with an aspect fulfillment rate of 75.45%. This shows that the majority of indicators have been well met, although there are some aspects that still require further attention to ensure innovation readiness at the conceptual stage. This assessment includes 22 main aspects categorized based on various dimensions such as technical (T), management (M), organization (O), manufacturing (Mf), innovation (I), market (P), and risk (R). Each aspect has a crucial role in measuring the readiness of innovation in the early stages of development. Several indicators in the technical category (T) show that the innovations being developed already have a solid scientific basis. Aspects such as understanding of basic scientific principles, identification of uniqueness (USP), as well as the scientific feasibility of the developed technology, all scored in full. This shows that the innovation idea has a solid theoretical foundation, which is the main requirement to proceed to the next stage.

However, from the technical aspect, there are several challenges that still need to be resolved, such as determining research targets and setting research targets. Some aspects that received low scores indicate the need for improvements in more mature and structured research planning. Determining the right research targets can help align research goals with the needs of the market or society that is the target of the development of the innovation.



KATSINOV 1

No.	Aspect	0	1	2	3	4	5	Indicator of KATSINOV 1 (0=not fulfilled; 1=20%; 2=40%; 3=60%; 4=80%; 5=100% or fulfilled)
		Σ or % Fulfilled						
		Put a cross (X) in the appropriate column						
1.	T					X		New ideas that provide solutions to problems faced by society.
2.	T				X			Observations of basic scientific principles and scientific publications have been carried out
3.	T					X		Uniqueness (USP/Unique Selling Point) or novelty has been identified.
4.	T					X		Research stages and targets have been identified
5.	T					X		The technology to be developed is scientifically feasible
6.	M				X			Innovation is carried out based on customer requests and/or needs (as fulfillment of community needs as a solution to the problem)
7.	M					X		Customer needs, wants and requests have been identified
8.	M					X		The target market location has been identified
9.	O					X		Have an innovation strategy
10.	O					X		The project scope and tasks of the Innovation Team have been defined
11.	O					X		Required resources and services have been ascertained
12.	O					X		Seamless communication channels are available
13.	Mf				X			Identified the implications (consequences or direct results of the findings of a scientific research) basic manufacturing.
14.	Mf				X			Identified manufacturing concept
15.	Mf					X		There is proof of manufacturing concept through analytics or laboratory experiments.
16.	I					X		There is a business model concept for the idea being developed.
17.	I				X			There are results of customer, market and competitor analysis of the ideas developed.
18.	I					X		There is evidence that the idea developed has provided a solution for the customer.
19.	P					X		Develop a strategy to build networks and partnerships
20.	P					X		Potential partners have been identified
21.	R					X		Technology risk assessment has been a consideration in every step of the research
22.	R					X		Preparation of technology risk control plans at the research stage.
		0	0	0	5	17	0	
Σ		83						
%		75.45%						

KATSINOV 1

Noted

Figure 14.23. The KATSINOV indicator does not meet its limit value.

In the management (M) category, the indicators assessed include the innovation process based on customer demand or market needs as well as the identification of specific needs of users. The results of the assessment show that these aspects have not been fully met, as evidenced by the low scores on the indicators of customer needs, market demand, and innovation target locations. In fact, identifying market demand is a crucial step in ensuring that the innovations developed have useful value and attractiveness for society or industry. If this aspect is not corrected immediately, the risk of misalignment between the innovations developed and the actual needs of the market will be even greater.

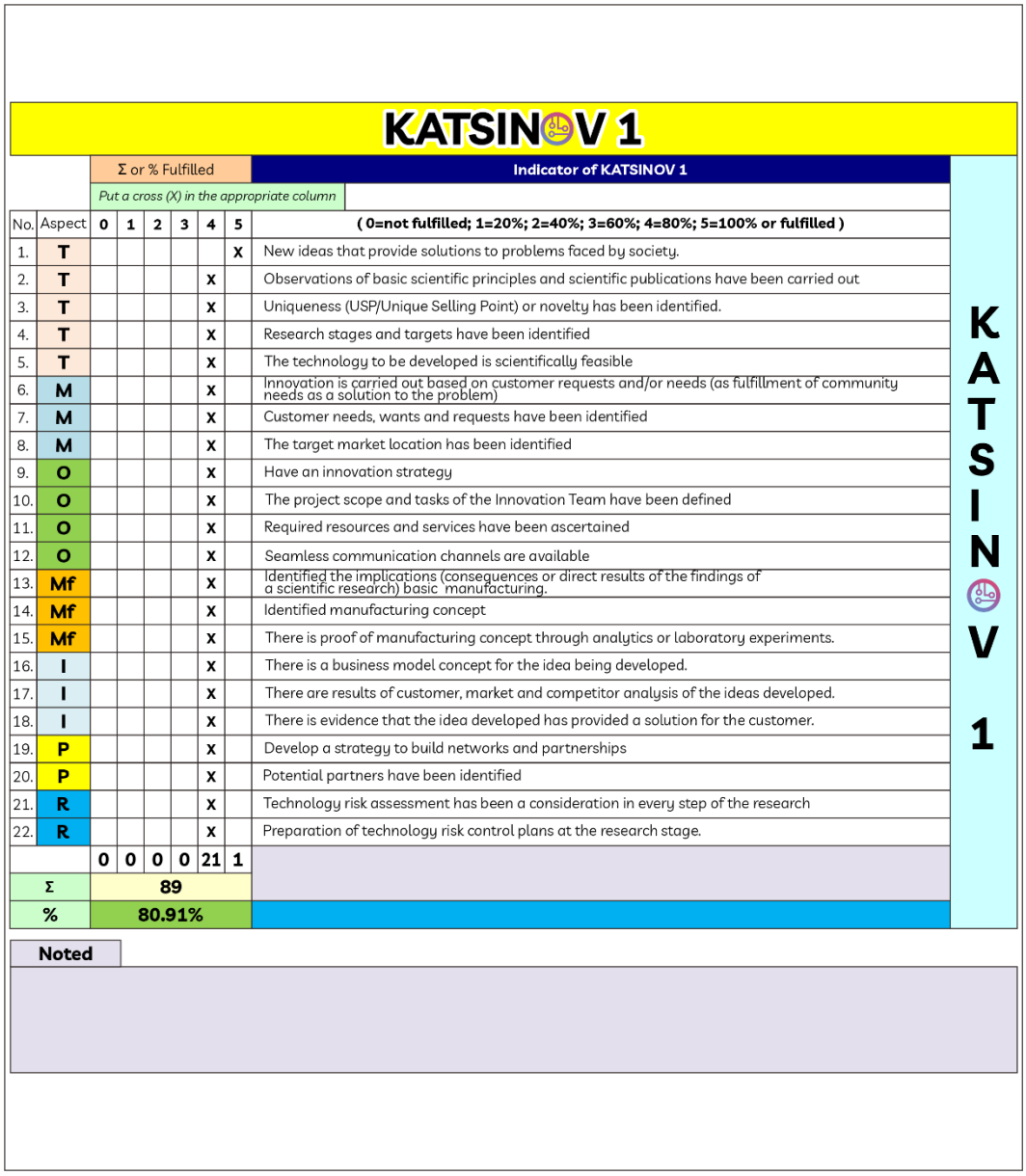
In addition, indicators related to the organization (O) show quite good results. Several aspects such as innovation strategy, project scope, and resource availability have received high scores, indicating that the

innovation team has a clear picture of the work structure and tasks that must be completed. However, there is still room for improvement, especially in ensuring smooth and effective communication within the team. An optimal communication process is essential to encourage synergy between team members and minimize the risk of miscommunication that can hinder the smooth running of innovation. In the manufacturing aspect (Mf), there are indicators that evaluate the readiness of manufacturing concepts and proof through analysis or laboratory experiments. Unfortunately, this indicator still gets a low score, which indicates the need for further efforts to ensure the readiness of the manufacturing aspect. Identification of mature manufacturing concepts will be an important foundation in future large-scale production processes. Thus, innovation teams need to increase collaboration between research teams and production teams to find the best solutions in prototype development.

Furthermore, the innovation aspect (I) includes an assessment of business models that support the development of innovations, analysis of markets and competitors, and proof that the innovations developed provide real solutions for customers. Some aspects in this category show positive results, but other aspects still need attention. For example, concrete evidence that innovation provides solutions to customers should be further clarified through case studies or real trials in the field. This is important to convince potential users or potential partners about the advantages of the innovations offered. From the market side (P), this evaluation focuses on developing strategies to build a partnership network as well as identifying potential partners who can support innovation. The assessment shows that this aspect has received serious attention from the innovation team, but needs to be strengthened in terms of collaboration strategies and broader network development. Identified potential partners can be the key to accelerating the innovation development process and expanding market access. The last category is risk (R), which includes an assessment of technological risk management and risk mitigation planning at the research stage. The results of the evaluation show that this aspect has been considered by the team, although more detailed planning is still needed. Systematic risk identification and mitigation plan development will help minimize obstacles that may arise in the future.

The results of the KATSINOV 1 assessment show that the level of innovation readiness is in the middle category, with a fulfillment score of 75.45%. Although the technical and management aspects have a fairly strong foundation, there are still some aspects in the manufacturing,

innovation, and market categories that need to be improved. To achieve optimal innovation readiness, the development team needs to focus on improving communication strategies, meeting market needs, developing manufacturing concepts, and more mature risk management. With more comprehensive planning, this innovation has the potential to develop and provide real solutions to problems in society. If all indicators at each level do not meet their limit values, the KATSINOV Indicator will turn red with the statement "Not Fulfilled", see Figure 14.23.. Meanwhile, if the indicators at each level meet their limit values, then the KATSINOV Indicator will turn green with the statement "Fulfilled ", (Figure 14.24.).



KATSINOV 1

		Σ or % Fulfilled						Indicator of KATSINOV 1
		Put a cross (X) in the appropriate column						
No.	Aspect	0	1	2	3	4	5	**(0=not fulfilled; 1=20%; 2=40%; 3=60%; 4=80%; 5=100% or fulfilled)**
1.	T						X	New ideas that provide solutions to problems faced by society.
2.	T					X		Observations of basic scientific principles and scientific publications have been carried out
3.	T					X		Uniqueness (USP/Unique Selling Point) or novelty has been identified.
4.	T					X		Research stages and targets have been identified
5.	T					X		The technology to be developed is scientifically feasible
6.	M					X		Innovation is carried out based on customer requests and/or needs (as fulfillment of community needs as a solution to the problem)
7.	M					X		Customer needs, wants and requests have been identified
8.	M					X		The target market location has been identified
9.	O					X		Have an innovation strategy
10.	O					X		The project scope and tasks of the Innovation Team have been defined
11.	O					X		Required resources and services have been ascertained
12.	O					X		Seamless communication channels are available
13.	Mf					X		Identified the implications (consequences or direct results of the findings of a scientific research) basic manufacturing.
14.	Mf					X		Identified manufacturing concept
15.	Mf					X		There is proof of manufacturing concept through analytics or laboratory experiments.
16.	I					X		There is a business model concept for the idea being developed.
17.	I					X		There are results of customer, market and competitor analysis of the ideas developed.
18.	I					X		There is evidence that the idea developed has provided a solution for the customer.
19.	P					X		Develop a strategy to build networks and partnerships
20.	P					X		Potential partners have been identified
21.	R					X		Technology risk assessment has been a consideration in every step of the research
22.	R					X		Preparation of technology risk control plans at the research stage.
		0	0	0	0	21	1	
Σ		89						
%		80.91%						

KATSINOV 1

Noted

Figure 14.24. KATSINOV indicator that meets its limit value.

The display for a summary of the measurement results and determination of KATSINOV achieved will automatically be seen in Worksheet 4, namely Summary of Measurement Results and Determination of Innovation Readiness Level, (Figure 14.25.). Summary of measurement results and Determination of KATSINOV 1 for each aspect the key can be seen in Figure 14.26.

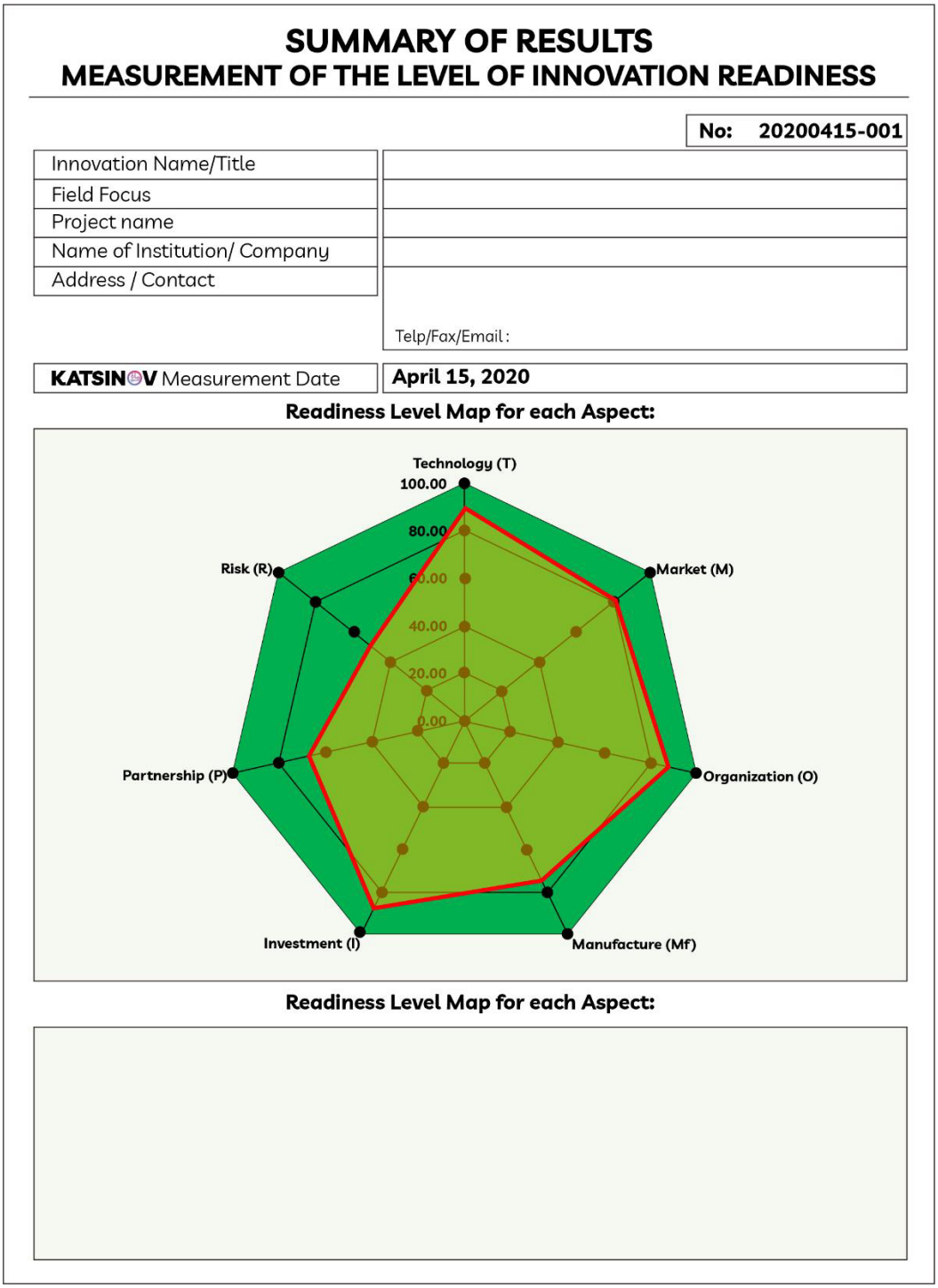


Figure 14.25. Summary of Measurement and Determination Results.

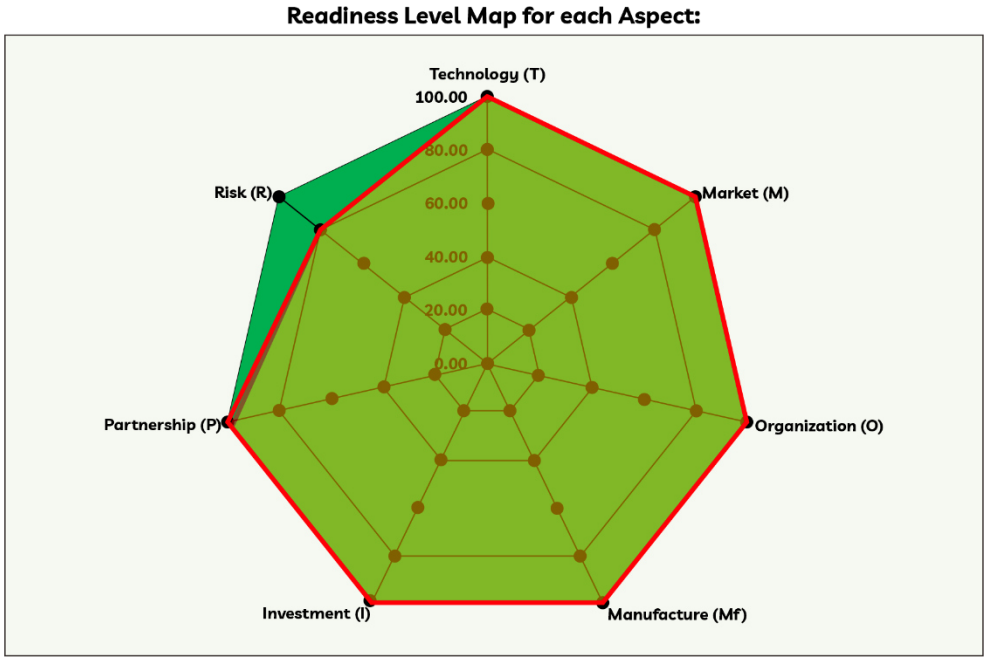


Figure 14.26. Summary of measurement results and determination of KATSINOV 1.

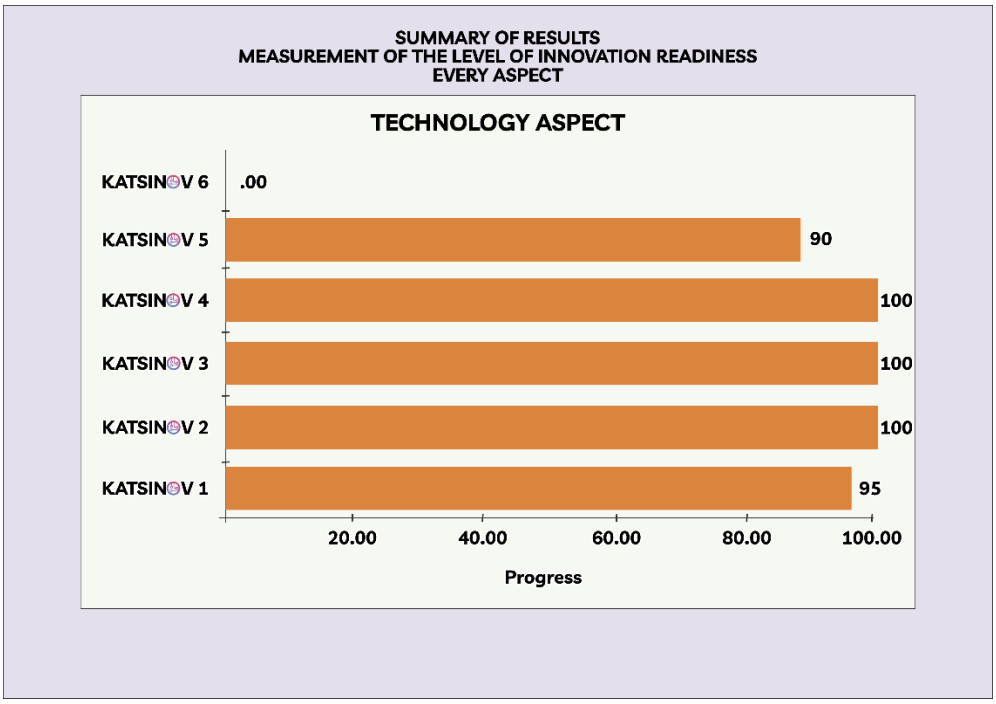
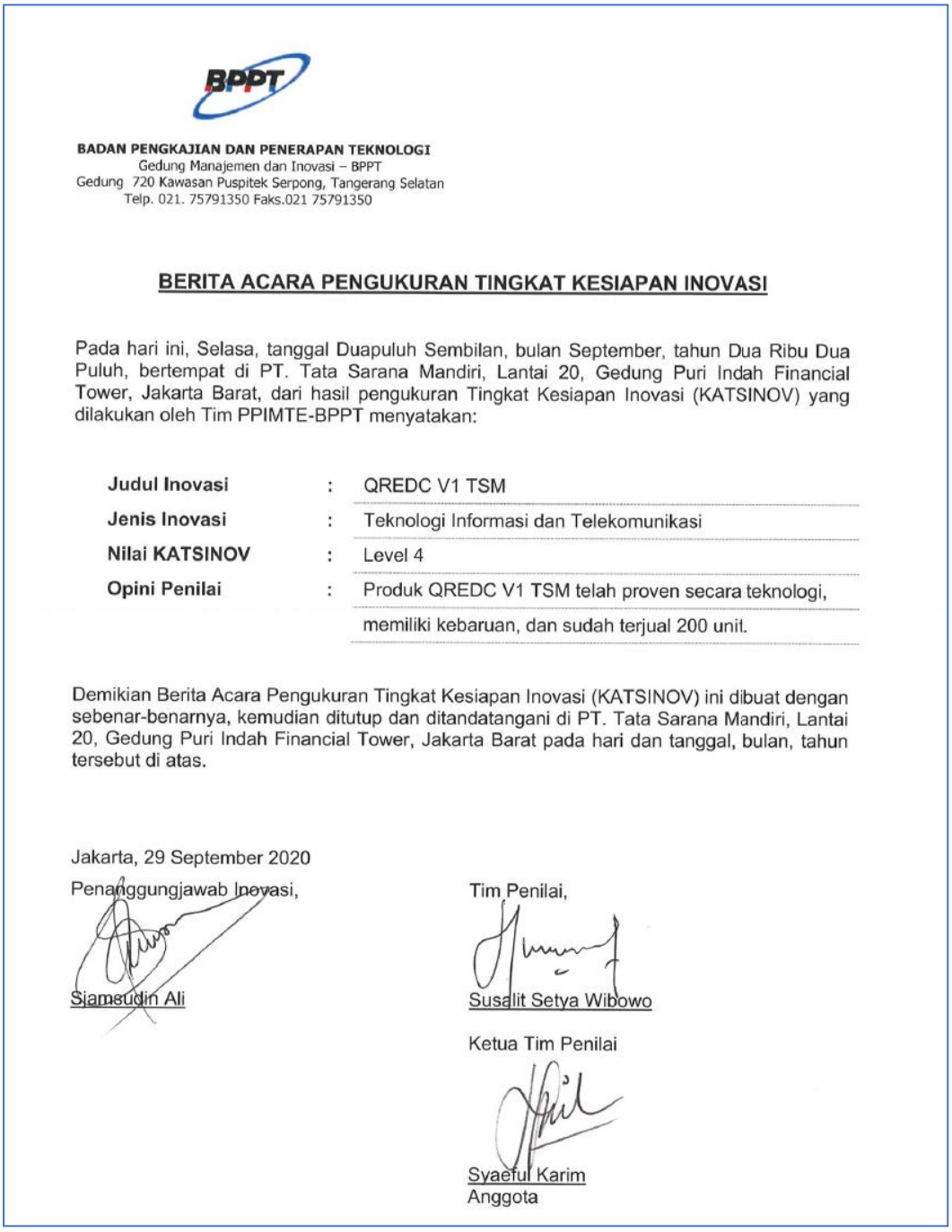


Figure 14.27. Summary for technological aspects of each KATSINOV level.

Meanwhile, a summary for each aspect of each level can be obtained from the KATSINOV measurement results, as an example shown in figure 14.27. After the measurements have been completed, the final stage is the preparation of the Official Report on Acceptance of KATSINOV measurement results which are signed by all parties, namely Reviewers

and Innovation Product Owners. An example of a KATSINOV Measurement Report is shown in figure 14.28.



BADAN PENGKAJIAN DAN PENERAPAN TEKNOLOGI
Gedung Manajemen dan Inovasi – BPPT
Gedung 720 Kawasan Puspitek Serpong, Tangerang Selatan
Telp. 021. 75791350 Faks.021 75791350

BERITA ACARA PENGUKURAN TINGKAT KESIAPAN INOVASI

Pada hari ini, Selasa, tanggal Duapuluh Sembilan, bulan September, tahun Dua Ribu Dua Puluh, bertempat di PT. Tata Sarana Mandiri, Lantai 20, Gedung Puri Indah Financial Tower, Jakarta Barat, dari hasil pengukuran Tingkat Kesiapan Inovasi (KATSINOV) yang dilakukan oleh Tim PPIMTE-BPPT menyatakan:

Judul Inovasi	:	QREDC V1 TSM
Jenis Inovasi	:	Teknologi Informasi dan Telekomunikasi
Nilai KATSINOV	:	Level 4
Opini Penilai	:	Produk QREDC V1 TSM telah proven secara teknologi, memiliki kebaruan, dan sudah terjual 200 unit.

Demikian Berita Acara Pengukuran Tingkat Kesiapan Inovasi (KATSINOV) ini dibuat dengan sebenar-benarnya, kemudian ditutup dan ditandatangani di PT. Tata Sarana Mandiri, Lantai 20, Gedung Puri Indah Financial Tower, Jakarta Barat pada hari dan tanggal, bulan, tahun tersebut di atas.

Jakarta, 29 September 2020

Penanggungjawab Inovasi,

Syamsudin Ali

Tim Penilai,

Susalit Setya Wibowo

Ketua Tim Penilai

Syaeful Karim
Anggota

Figure 14.28. Official Report on Acceptance of KATSINOV measurement results.

Chapter 15
KATSINOV MEASUREMENT REPORTING AND CASE STUDIES

Irshan Zainuddin, Sudono

15.1. Reporting Of Katsinov Measurement Results

After taking the KATSINOV measurements, the team was then required to prepare a report on the measurement results. In reporting the results of KATSINOV measurements, it must at least contain:

1. The complete identity of the inventor or innovator, as well as the institution that organizes it.

   This section contains the complete identity of the inventor or innovator as well as the institution that organizes the KATSINOV measurement. This identity includes the name of the inventor or innovator, the origin of the inventor's institution, and the institution that organizes the measurement. The inventor or innovator responsible for this innovation lists his full name, such as Dr. Ahmad Setiawan, M.Eng, who comes from the ABC Technology Research Center. The institution that organizes the KATSINOV measurement is the National Research and Innovation Agency (BRIN) which acts as an independent team to assess innovation objectively. In addition, contact details, such as the institution's address, phone number, and email, are included as additional information. These details serve to facilitate communication between the measurement organizing team and the innovator regarding the product or technology being measured.

LAPORAN

PENGUKURAN TINGKAT KESIAPAN INOVASI

JUDUL INOVASI	:	Mobil Pedesaan
BIDANG INOVASI	:	Teknologi Transportasi
LEMBAGA/ INSTANSI	:	Universitas Negeri Semarang (Unnes)
ALAMAT/ KONTAK	:	Jalan Sekaran, Sekaran, Gunung Pati, Kota Semarang, Jawa Tengah 50229 Phone: (024) 8508092

2. Endorsement sheet signed by the Reviewer Team and the Inventor/Innovator.

   The endorsement sheet is an important document in this report because it serves as evidence of validation of the results of the KATSINOV measurement. This section includes the official title of the report, the name of the inventor or innovator, and the signatures of the entire team of reviewers and innovators. Each member of the reviewer team includes their full name, title, and signature as a form of approval of the measurement results. For example, Prof. Budi Raharjo as the Chairman of the Reviewer Team, Dr. Ani Susanti, and Ir. Agus Prasetyo, M.Sc as a member of the reviewer also affixed their signatures. In addition, inventors or innovators also give signatures as a form of approval for the results that have been obtained. The date of preparation of the report is also included as a reference for the time of completion of the measurement, so that this report has a clear and formal legality.

LEMBAR PENGESAHAN

LAPORAN

PENGUKURAN TINGKAT KESIAPAN INOVASI

JUDUL INOVASI	:	Mobil Pedesaan
BIDANG INOVASI	:	Teknologi Transportasi
LEMBAGA/ INSTANSI	:	Universitas Negeri Semarang (Unnes)
ALAMAT/ KONTAK	:	Jalan Sekaran, Sekaran, Gunung Pati, Kota Semarang, Jawa Tengah 50229 Phone: (024) 8508092

Jakarta, Oktober 2017

Penanggung Jawab pengukuran,

NIP.

Ketua Tim Pelaksana Pengukuran,

NIP.

Tim Pengendali Pengukuran,

NIP.

3. A brief description of the object of measurement of KATSINOV.
   The description of the measurement object provides an overview of the innovative product or technology being measured. The information in this section includes the name of the innovation product, the development background, the development objectives, and the scope of the innovation. For example, the innovation product measured is "IoT Integrated Solar Panel-Based Renewable Energy System". The background of the development of this product is based on the need for renewable energy solutions in remote areas, with the integration of Internet of Things (IoT) technology for real-time performance monitoring. The goal of developing this innovation is to provide self-sustaining energy solutions that are environmentally friendly, efficient, and reliable. The scope of innovation includes the design of a 2 kW solar panel system, inverters, energy storage batteries, as well as IoT modules that enable accurate monitoring of energy performance.

1. PROFIL PRODUK INOVASI

Pengembangan mobil pedesaan oleh Universitas Negeri Semarang (Unnes) dimulai pada tahun 2012 melalui kerjasama dengan Kementerian Perindustrian. Mobil pedesaan yang dikembangkan merupakan mobil tipe *pick up,* bermesin 970 cc, 4 silinder injeksi, dengan transmisi 5 *speed plus transfer case,* dilengkapi gardan ganda atau berpenggerak 4×4, suspensinya menggunakan 3 *link* dengan *coil spring*, *rigid axel,* dan kapasitas angkut sekitar 900 kg beban (lihat Gambar 1). Pengembangan mobil pedesaan kerjasama dengan Kementerian Perindustrian ini sudah melewati sejumlah tahap, antara lain pembuatan purwarupa (*prototype*) dan telah lolos uji emisi Euro 2. Mobil itu bahkan telah menjalani uji coba jalan sejauh 100.000 kilometer di berbagai medan berat, yaitu keliling Jawa dan Jawa – Aceh.

(a) (b)

Gambar 1. (a). Prototipe mobil pedesaan Unnes; (b). Mesin mobil pedesaan dengan spesifikasi 970 cc, 4 silinder injeksi dengan transmisi 5 *speed plus transfer case.*

Mobil jenis ini dinilai cocok digunakan untuk daerah pedesaan, dataran tinggi, dan pelosok wilayah terluar terdalam dan tertinggal. Selain itu, harganya jauh lebih murah dengan mobil *pick up* yang sudah ada di pasaran. Mobil jenis ini didesain sesuai dengan karakteristik daerah di Jawa Tengah dan sekitarnya, mengingat masyarakat saat ini lebih membutuhkan mobil yang handal yang cocok disegala medan. Mobil pedesaan ini bisa diproduksi dengan variasi yang sesuai dengan kebutuhan pemesan. Variasi demikian diperlukan karena medan di tiap-tiap daerah memiliki karakteristik yang unik.

Kementerian Riset, Teknologi, dan Pendidikan Tinggi (Kemristekdikti) memberikan perhatian pada mobil pedesaan ini sebagai suatu produk inovasi unggul, serta sebagai inisiasi pengembangan Klaster Inovasi Platform Mobil Pedesaan. Melalui pembiayaan dari Kemenristekdikti, Unnes menggandeng PT. PT. Viar Motor dan PT. PT. New Armada akan mengembangkan mobil pedesaan jenis *pick-up*, niaga (4x4) MT, mesin 1000 cc, motor penggerak tipe SOHC/ penggerak belakang 3 silinder, sistem penggerak injeksi, bahan bakar bensin, sistem suspensinya depan dengan *coil-spring-absorber-stabilizer* dan belakang dengan *coil spring-absorber*, *rigid axel,* massa kendaraan kosong 742 kg, dan massa muatan maksimum 1.200 kg.

2. HASIL PENGUKURAN

Berdasar pengukuran dengan alat ukur Katsinov-Meter®, produk mobil pedesaan yang dikembangkan oleh Universitas Negeri Semarang (Unnes), yang bekerjasama dengan PT. Viar Motor dan karoseri PT. New Armada, berada pada **Tingkat Kesiapan Inovasi (Katsinov) 2**. Tingkat kesiapan ini mengindikasikan bahwa inovasi produk mobil pedesaan

4. The results of the KATSINOV measurements for the Research and Development object, which provides a summary of each level of KATSINOV; The results of KATSINOV measurements are compiled based on predetermined levels, ranging from the basic level to commercial implementation. At Level 1, the innovation product was successfully identified as a potential technology that could be further developed. Furthermore, at Level 2, the concept of innovation has been validated through initial prototypes and shows promising results. At Level 3, functional testing on a laboratory scale was successfully carried out and showed a system efficiency of 95%. At Level 4, the implementation of innovative products in a real environment is carried out in two remote villages. The implementation results show an increase in energy use efficiency of up to 30% compared to conventional methods. At Level 5, innovative products begin to be commercialized in collaboration with energy industry partners, which allows for wider dissemination of products to the community. These results show that this innovation has significant potential to be developed into sustainable energy solutions.

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Gambar 1. (a). Prototipe mobil pedesaan Unnes; (b). Mesin mobil pedesaan dengan spesifikasi 970 cc, 4 silinder injeksi dengan transmisi 5 *speed plus transfer case.*

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Kementerian Riset, Teknologi, dan Pendidikan Tinggi (Kemristekdikti) memberikan perhatian pada mobil pedesaan ini sebagai suatu produk inovasi unggul, serta sebagai inisiasi pengembangan Klaster Inovasi Platform Mobil Pedesaan. Melalui pembiayaan dari Kemenristekdikti, Unnes menggandeng PT. PT. Viar Motor dan PT. PT. New Armada akan mengembangkan mobil pedesaan jenis *pick-up*, niaga (4x4) MT, mesin 1000 cc, motor penggerak tipe SOHC/ penggerak belakang 3 silinder, sistem penggerak injeksi, bahan bakar bensin, sistem suspensinya depan dengan *coil-spring-absorber-stabilizer* dan belakang dengan *coil spring-absorber*, *rigid axel,* massa kendaraan kosong 742 kg, dan massa muatan maksimum 1.200 kg.

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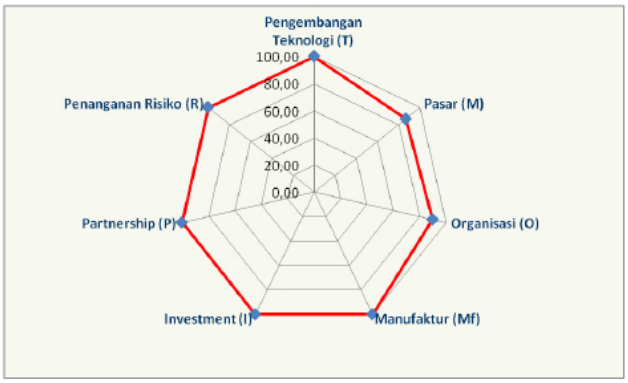
berada pada tahap pengembangan dan validasi komponen (mesin 1000 cc, *body*, sasis, suspensi, dll), serta prototipe yang didemonstrasikan pada lingkungan yang relevan.

Untuk melihat secara detail hasil pengukuran Katsinov dilakukan dengan melihat tingkat capaian atribut atau indikator dan tingkat capaian setiap aspek per Level Katsinov. Berikut ini hasil pengukuran secara detail untuk setiap Level Katsinov:

A. Level Katsinov 1

Level Katsinov 1 merupakan Tahap Konsep, yaitu prinsip-prinsip ilmiah dasar dari inovasi telah diamati dan dilaporkan, dan fungsi kritikal dan/atau karakteristik telah dikonfirmasi melalui kegiatan eksperimen di laboratorium. Dari hasil pengukuran pada Katsinov 1 diperoleh tingkat kesiapan sebesar 96,36%, artinya **memenuhi** tingkat kesiapan inovasi atau Katsinov 1 karena diatas batas tingkat kesiapan yang ditetapkan, yaitu ≥80%.

Apabila melihat tingkat kesiapan yang mencapai 96,36%, maka ini menunjukkan bahwa pada konsep pengembangan mobil pedesaan hampir mencapai sempurna. Aspek teknologi, manufaktur, *investment*, penanganan risiko, dan *partnership* pada tahap konsep ini telah mencapai kematangan optimalnya, sedangkan pada aspek pasar dan organisasi belum tercapai kematangan optimalnya.



Gambar 2. Ringkasan hasil pengukuran Katsinov 1.

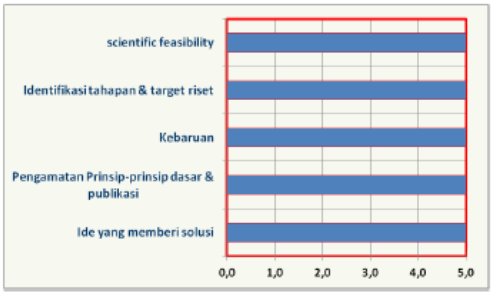
Peta capaian kesiapan untuk setiap aspek (teknologi, pasar, organisasi, partnership, manufaktur, risiko, dan investment) pada Level Katsinov 1 tersaji dalam Gambar 2. Capaian indikator atau atribut pada masing-masing aspek rata-rata diatas 80%, tercatat aspek penanganan risiko, *partnership, investment,* manufaktur, dan teknologi telah mencapai 100%, sedangkan indikator atau atribut pada aspek organisasi dan pasar belum tercapai 100%. Penjelasan rinci terkait dengan atribut atau indikator untuk setiap aspek disajikan dalam Tabel 1.

5. Discussion of the results of KATSINOV measurements.

   The discussion of the results of the KATSINOV measurement involves an in-depth analysis of the potential, challenges, and impacts of innovative products. The measurement results show that this innovation has high technical efficiency and is relevant to answer energy needs in remote areas. However, the challenge faced is that production costs are still relatively high, so steps are needed to increase the scale of production to reduce costs. In addition, this innovation has proven to be able to answer the problem of dependence on conventional energy, by utilizing environmentally friendly renewable energy sources. The technical feasibility of these products has been tested through initial implementation, while economic feasibility can be achieved through

cooperation with industry partners and government policy support. The positive impact of this innovation includes improved energy efficiency, cost savings, and contribution to efforts to reduce carbon emissions.

Tabel 1. Pendetailan tingkat capaian atribut atau indikator untuk setiap aspek pada Level Katsinov 1.

Capaian Atribut/ Indikator	Keterangan
Aspek Teknologi: 	– Indikator kelayakan ilmiah (*scientific feasibility)* tercapai 100%. o Melalui pelaksanaan penelitian telah dapat diperoleh kelayakan ilmiah terkait dengan konsep pengembangan mobil pedesaan. o Dilakukan pemodelan dan simulasi menggunakan software *Siemen grafik NX-10* (bantuan Kemenperin, tahun 2016). – Indikator identifikasi tahapan dan target riset tercapai 100%. o Perencanaan telah dibuat dalam rangka menghasilkan prototipe. o PT. Viar Motor untuk perakitan, PT. New Armada untuk body, dan Unnes untuk penelitian dan pengembangan (desain dan perancangan). o Integrator manajemen oleh Unnes dan integrator produk oleh PT. Viar Motor. PT. Viar Motor telah mendapatkan NIK (diperoleh tahun 2005). o Untuk sasis (ke depan Unnes akan produksi sasis), membina UMKM di bidang sasis. – Indikator USP *(unique selling Point)* atau kebaruan *(novelty)* tercapai 100%. o Kebaruan yang ditonjolkan bersifat inkremental, yaitu harganya lebih murah dari mobil sejenisnya, sekitar 70 juta. o Kelebihan mobdes ini adalah lebih murah, rigid axle, tidak monokop. o Dalam perancangannya, desain body dan sasis terpisah, sehingga bisa dikerjakan industri secara customize. o Sasis terpisah dengan bodi dan berbentuk mirip seperti anak tangga. Desain sasis seperti ini lebih mudah diganti *(facelift)* karena tak harus mengubah rangka. Konstruksi sasis tangga mempunyai keunggulan dalam membawa beban lebih.

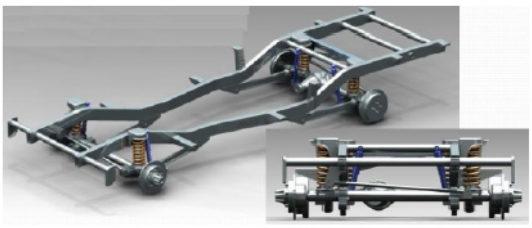
Capaian Atribut/ Indikator	Keterangan
	– Indikator kajian risiko teknologi pada tahap penelitian capaiannya 100%. o Melalui kajian risiko investasi, dimana seluruh mitra telah berinvestasi. o Untuk PT. Viar Motor dan Karoseri PT. New Armada telah memiliki pengalaman. o Untuk IKM perla ada bantuan teknis dari Unnes

Summary Level Katsinov 1:

Level Katsinov 1 merupakan Tahap Konsep, yaitu prinsip-prinsip ilmiah dasar dari inovasi telah diamati dan dilaporkan, dan fungsi kritikal dan/atau karakteristik telah dikonfirmasi melalui kegiatan eksperimen di laboratorium. Berikut ini *summary* terkait capaian dari 7 (tujuh) aspek:

1) Aspek Teknologi

- Telah dilakukan penelitian dan pengembangan mobil pedesaan dengan pengamatan prinsip-prinsip ilmiah dasar dan publikasi ilmiah melalui kajian dan desain oleh Universitas Negeri Semarang (Unnes), yaitu:
  a) Dilakukan pemodelan dan simulasi menggunakan software *Siemen grafik NX-10* (bantuan Kemenperin, tahun 2016).
  b) Telah diperoleh 8 skripsi, 1 desain industri terkait sasis, 1 paten terkait alat uji, dan beberapa publikasi.
- Telah berhasil ditetapkan spesifikasi mobil pedesaan dengan mempertimbangkan karakteristik lingkungan, yaitu: *pick-up*, niaga (4x4) MT, mesin 1000 cc, motor penggerak tipe SOHC/ penggerak belakang 3 silinder, sistem penggerak injeksi, bahan bakar bensin, sistem suspensinya depan dengan *coil-spring-absorber-stabilizer* dan belakang dengan *coil spring-absorber*, *rigid axel,* massa kendaraan kosong 742 kg, dan massa muatan maksimum 1.200 kg.



Gambar 4. Desain sasis oleh Unnes.

6. The final part of the report is in the form of conclusions and recommendations. The conclusions are compiled based on several facts in the innovation program and the innovation products measured. Meanwhile, recommendations are in the form of technical and policy recommendations. It is hoped that this recommendation can be a reference for the preparation of an Action Plan related to further Research and Development.

3. REKOMENDASI

A. Kesimpulan

Berdasar pembahasan hasil pengukuran Tingkat Kesiapan Inovasi dapat disimpulkan sebagai berikut:

1) Spesifikasi teknis mobil pedesaan: jenis *pick-up*, niaga (4x4) MT, mesin 1000 cc, motor penggerak tipe SOHC/ penggerak belakang 3 silinder, sistem penggerak injeksi, bahan bakar bensin, sistem suspensinya depan dengan *coil-spring-absorber-stabilizer* dan belakang dengan *coil spring-absorber*, *rigid axel,* massa kendaraan kosong 742 kg, dan massa muatan maksimum 1.200 kg.

2) Kebaruan *(novelty)* dari mobil pedesaan yang dikembangkan oleh Unnes, PT. Viar Motor dan PT. New Armada ini bersifat inkremental, yaitu pada harga jual yang lebih murah dibanding dengan mobil sejenis yang beredar di pasar.

3) *Market Value Proposition* (MVP) mobil pedesaan adalah *low cost car*. Hal ini dibuktikan dengan harga jual mobil pedesaan dibandingkan dengan mobil sejenis di pasar, mobil pedesaan ini harganya Rp. 70-75 juta, sedangkan mobil sejenis yang beredar di pasar rata-rata berharga diatas Rp. 100 juta, misalnya Suzuki Carry 4x2, Daihatsu G-Max 4x2, dan Mitsubishi T120ss masing-masing harganya Rp. 105 juta.

4) Keunggulan lain dari mobil pedesaan ini antara lain:

   a. Penggunaan *coil spring* akan memberikan tahanan atau redaman kejutan yang lebih baik dan tidak terjadi gesekan antara pegas (defleksi) yang menyebabkan getaran pada *body*. Sebaliknya *coil spring* memiliki kekurangan saat menerima kejutan, maka secara langsung kejutan tersebut dilendutkan sehingga menyebabkan kejutan balik yang cepat pada *body*. Oleh karena pada umumnya pegas koil di kombinasikan dengan *shock absorber*.

   b. PTO *(Power Take Off)* adalah beberapa metode untuk mengambil alih daya dari sumber listrik, seperti mesin yang sedang berjalan, dan mentransmisikannya ke aplikasi seperti alat yang terpasang atau mesin terpisah. Jadi PTO memungkinkan alat untuk menarik energi dari mesin.

   c. Sasis terpisah dengan bodi dan berbentuk mirip seperti anak tangga. Desain sasis seperti ini lebih mudah diganti *(facelift)* karena tak harus mengubah rangka. Konstruksi sasis tangga mempunyai keunggulan dalam membawa beban lebih.

   d. *Rigid axle* sering digunakan pada kendaraan berskala menengah keatas dengan muatan yang besar, juga pada kendaraan yang dirancang untuk medan-medan berat karena mampu menahan beban yang berat

5) Konsep model bisnis yang dikembangkan adalah:

   a) PT. IKI sebagai prinsipal, yaitu entitas yang memberikan amanat kepada pihak lain (Unnes, PT. Viar Motor, PT. New Armada, dan Askarindo) untuk melaksanakan suatu pekerjaan terkait R&D, produksi, dan distribusi.

The conclusion of this report shows that the measured innovations have great potential to be developed into sustainable energy technology solutions. The results of the KATSINOV measurements show a high level of efficiency, both in laboratory testing and in the initial implementation in the field. This innovation can be the answer to the need for renewable energy in remote areas with better efficiency than conventional methods. Based on these results, several recommendations were compiled to encourage further development. First, technical recommendations include improving

product design and efficiency through advanced research. Second, policy recommendations include government support in the form of incentives, funding, and policies that support the development of renewable energy. Third, an action plan is needed to develop the scale of mass production through collaboration with industry partners, so that these innovations can be implemented widely and sustainably. With the support of various parties, this innovation is expected to be able to make a significant contribution in meeting the needs of environmentally friendly and sustainable energy in Indonesia.

Tabel 4. Rekomendasi teknis.

No.	Aspek	Pihak Yang Diberikan Rekomendasi		
		Universitas Negeri Semarang (Unnes)	PT. Viar Motor	PT. New Armada
1	Teknologi	▪ Segera didaftarkan desain industri untuk sasis dan paten untuk sistem suspensi. ▪ Dalam rangka dapat dilaksanakan launching produk inovasi maka segera dilakukan uji dalam rangka memenuhi persyaratan teknis dan kesesuaian regulasi (uji emisi, uji tipe, uji *endurance* dan uji lainnya sesuai regulasi).	▪ Segera menyelesaikan prototipe mobil pedesaan yang baru (yang menggunakan pendanaan dari Kemenristekdikti).	▪ Segera menyelesaikan prototipe mobil pedesaan yang baru (yang menggunakan pendanaan dari Kemenristekdikti).
2	Pasar	▪ Memperkuat analisis pasar melalui riset pasar, dimana dapat mengidentifikasikan kebutuhan dan permintaan pengguna, terutama kalangan petani, nelayan, dan perkebunan.	▪ Mendukung analisis pasar yang dilakukan oleh Unnes melalui dukungan data pasar yang dimiliki.	▪ Mendukung analisis pasar yang dilakukan oleh Unnes melalui dukungan data pasar yang dimiliki.
3	Organisasi	▪ Pada level pengembangan produk perlu dibuat struktur organisasi WBS *(Work Breakdown Structure)* atau PBS *(Product Breakdown Structure)*, dimana lingkup pekerjaan, tanggungjawab dan output	▪ Melaksanakan lingkup pekerjaan, tanggungjawab dan output sesuai organisasi WBS *(Work Breakdown Structure)* atau PBS *(Product Breakdown Structure)*.	▪ Melaksanakan lingkup pekerjaan, tanggungjawab dan output sesuai organisasi WBS *(Work Breakdown Structure)* atau PBS *(Product Breakdown Structure)*.

15.2. Case Examples Of Measurement Katsinov

After being promulgated through the Minister of Research, Technology and Higher Education Regulation Number 29 of 2019, this measurement tool is official and must be used in Research and Development Institutes, as well as Universities in Indonesia. In fact, this measuring tool is used as an evaluation tool for research and innovation grant programs funded by the Indonesian government.

In measuring the level of innovation readiness with the KATSINOV measuring tool, reviewers are needed who have knowledge in the field of Innovation and Technology Management, and have sufficient business intuition. Therefore, the analytical thinking and intuitive thinking capacities of a KATSINOV reviewer are needed in making assessments and providing recommendations.

The case examples presented in this chapter are an attempt to provide knowledge and insight to readers regarding the level of innovation readiness with this KATSINOV measurement tool. It is hoped that the readers will be able to examine these case examples for further thorough understanding, especially in relation to the KATSINOV aspects and indicators, as well as how the transition from the low KATSINOV level to the higher KATSINOV level occurs. It is hoped that this case example will give readers an overview of the application of the KATSINOV measurement tool to various research and innovation fields. The following is an explanation of several examples of KATSINOV measurement cases:

1. Case Example 1: Digicoop

a. Person Contact

Responsible for innovation activities:

The Microelectronics Center (PME) of the Bandung Institute of Technology (ITB)
Address: 4th Floor, Gd. Litbang Integrasi dan Aplikasi (PAU), JL. Tamansari, No. 126, Bandung, Lebak Siliwangi, Coblong, Bandung, Jawa Barat 40132. Phone: (022) 2506280.

b. Technology Development Background

The Microelectronics Center (PME) of the Bandung Institute of Technology (ITB) officially developed its smartphone to compete in the low-end smartphone market in Indonesia, and the first smartphone released was named "Digicoop". The Digicoop brand stands for Digital Cooperation. This smartphone comes with a simple design but looks attractive and is equipped with pretty good specifications.

The Microelectronics Center (PME) of the Bandung Institute of Technology (ITB) is not alone in producing Digicoop, but collaborates with the Indonesia Mandiri Digital Cooperative, PT. Jalawave Integra, PT VS Technology Indonesia, and PT TSM. Production of this smartphone will be carried out in Cikarang, West Java. 5,000 Digicoop smartphone units have been produced.

And the most interesting thing about this smartphone is the network sector, where Digicoop supports the 4G LTE network for super fast internet access which is very comfortable when used for browsing. Then for the operating system, Digicoop runs on the ID3OS operating system which is a ROM for Android.

For the screen, Digicoop comes with a 4.7 inch screen with a resolution of 480 x 800 pixels combined with IPS LCD screen technology which is quite comfortable when used for playing games or

watching videos. For RAM, Digicoop has 1 GB RAM which is fast enough for multitasking.

Meanwhile, for the camera, Digicoop comes with a 2 MP front camera and a 5 MP rear camera complete with autofocus and LED Flash features which are sufficient for selfies and capturing every moment. And for the battery, the Digicoop comes equipped with an 1800 mAh battery which is long enough for gaming.

c. Price and Specifications of Innovation Product

Price	1.2 million
Status	Caming Soon
Networks	Networks GPRS, EDGE, 3G, 4G LTE HSDPA: 42.2 mbps & HSUPA : 5.76 mbps LTE Cat 4 150/50 Mbps Dual SIM
Dimensions	Dimension: Material : Plastics
Monitor	Monitor 4.8 inci IPS LCD Resolution 480 x 800 pixels Density ~ 220 ppi
Operating System	ID3OS ROM dari Android
Processor	CPU : Quad Core 1.5 GHz
RAM	1 GB
Memory	Internal 8 GB, Eksternal 32 GB
Rear Camera	5 MP, Autofocus, LED Flash
Front Camera	2 MP
Sensors	Accelerometer, Proximity
Battery	Li-Ion 1800 mAh (Removable)

d. Strength & Weakness of Innovative Products

Strength	Weakness
• 4.7 inch screen with IPS LCD technology which is quite comfortable to operate. • Supports dual SIM, both of which support the 4G LTE network. • Runs on the ID3OS operating system which is a ROM for Android. • Powered by a 1.5 GHz Quad Core processor which provides quite fast performance. • 1 GB RAM is quite smooth when used for multitasking many applications. • 8 GB internal storage which is enough to store lots of games. • 5 MP rear camera complete with LED Flash feature. • 1800 mAh battery which is long enough for playing games.	The front camera is only 2 MP which is not optimal for selfies.

e. PRODUCT INNOVATION PROTOTYPE

f. KATSINOV MEASUREMENT RESULTS

The results of KATSINOV measurements of Digicoop innovation products can be explained as follows:

KATSINOV 1

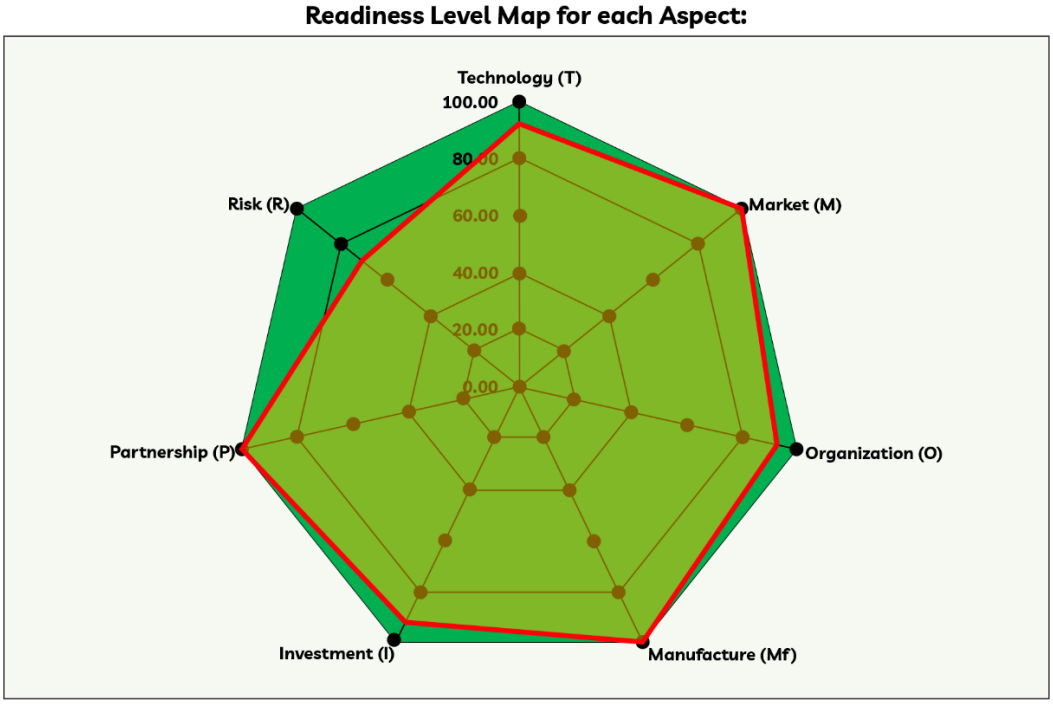
KATSINOV 1

		Σ or % Fulfilled						Indicator of KATSINOV 1
		Put a cross (X) in the appropriate column						
No.	Aspect	0	1	2	3	4	5	**(0=not fulfilled; 1=20%; 2=40%; 3=60%; 4=80%; 5=100% or fulfilled)**
1.	T					X		New ideas that provide solutions to problems faced by society.
2.	T					X		Observations of basic scientific principles and scientific publications have been carried out
3.	T						X	Uniqueness (USP/Unique Selling Point) or novelty has been identified.
4.	T						X	Research stages and targets have been identified
5.	T						X	The technology to be developed is scientifically feasible
6.	M						X	Innovation is carried out based on customer requests and/or needs (as fulfillment of community needs as a solution to the problem)
7.	M						X	Customer needs, wants and requests have been identified
8.	M						X	The target market location has been identified
9.	O					X		Have an innovation strategy
10.	O						X	The project scope and tasks of the Innovation Team have been defined
11.	O						X	Required resources and services have been ascertained
12.	O						X	Seamless communication channels are available
13.	Mf						X	Identified the implications (consequences or direct results of the findings of a scientific research) basic manufacturing.
14.	Mf						X	Identified manufacturing concept
15.	Mf						X	There is proof of manufacturing concept through analytics or laboratory experiments.
16.	I						X	There is a business model concept for the idea being developed.
17.	I						X	There are results of customer, market and competitor analysis of the ideas developed.
18.	I				X			There is evidence that the idea developed has provided a solution for the customer.
19.	P						X	Develop a strategy to build networks and partnerships
20.	P						X	Potential partners have been identified
21.	R					X		Technology risk assessment has been a consideration in every step of the research
22.	R				X			Preparation of technology risk control plans at the research stage.
		0	0	0	2	4	16	
Σ		102						
%		75.45%						

KATSINOV 1

Noted

Katsinov 1 radar chart:



Notes:

- The biggest weakness is in the aspect of ideas that provide solutions, where the achievement has not been 100% complete. This is because the ideas developed for this product have not been fully fulfilled by technological design aspects. It has been proven that on the way after product delivery, there are still consumer desires that must be fulfilled regarding the idea.
- This innovation strategy is a plan or an outline of the direction for action in an effort to achieve predetermined targets. Innovation in strategy implementation plays a role in achieving a sustainable competitive advantage in global competition. Global competition forces entities to innovate by reducing production costs and increasing technological capabilities as well as product innovation.
- The investment aspect (I) in Katsinov 1 is almost perfect, reaching 100% progress, except for ideas that have provided solutions to end customers, where it has only reached 40%. This means that there are still consumer desires that have not been fulfilled.
- On the risk aspect (R) in Katsinov 1, the readiness of all elements is still below 60%. The element of technological risk assessment that should be considered in every step of the research has not been carried out completely.

KATSINOV 2

KATSINOV 2

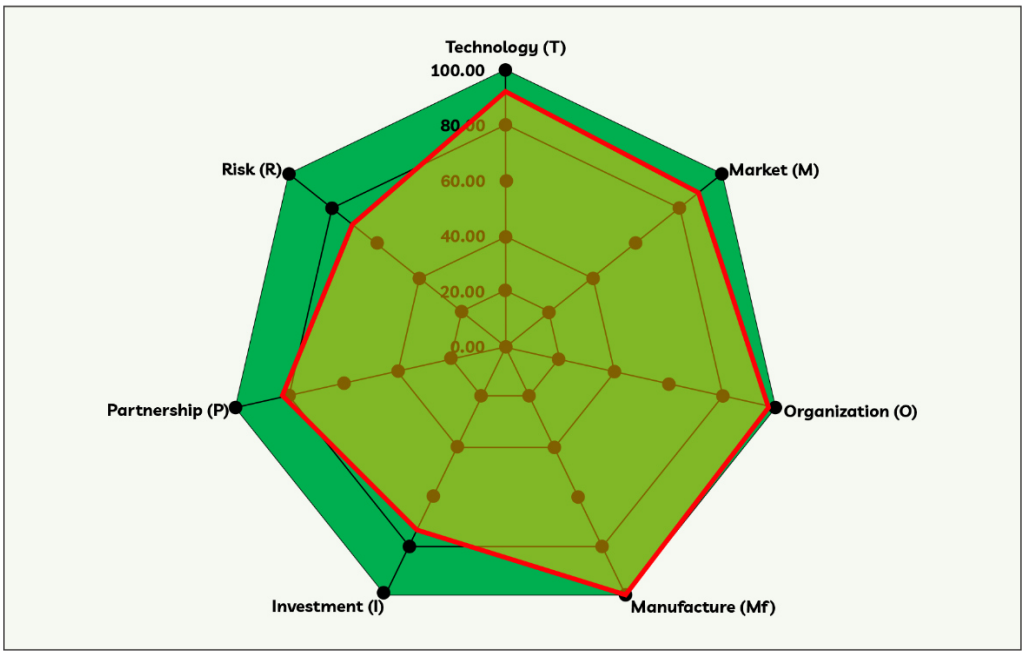
		Σ or % Fulfilled						Indicator of KATSINOV 2
		Put a cross (X) in the appropriate column						
No.	Aspect	0	1	2	3	4	5	(0=not fulfilled; 1=20%; 2=40%; 3=60%; 4=80%; 5=100% or fulfilled)
1.	T					X		Validation has been carried out on the individual components of the technology.
2.	T						X	The prototype has been demonstrated in the relevant environment.
3.	T						X	The technology is declared technically feasible.
4.	T					X		IP registration has been carried out (for example: patents, industrial designs, copyrights, brands, etc.).
5.	T					X		Technically able to provide solutions to problems faced by society.
6.	M					X		End customers identified.
7.	M						X	A detailed market launch plan has been issued.
8.	M					X		Intellectual capital has begun to be prepared.
9.	O						X	An analysis and a business plan have been issued
10.	O						X	There is involvement of key individuals.
11.	O						X	The project requirements and list of project partners have been approved.
12.	O						X	Responsibilities and time limits have been agreed.
13.	Mf						X	Identification of technology and critical components is complete.
14.	Mf						X	Materials, tools and prototype test equipment, as well as personnel expertise have demonstrated the readiness of the sub system/system in a relevant production environment.
15.	I				X			There is a selling point advantage (Market Value Proposition/MVP) and has been tested on customers.
16.	I					X		The solutions offered to customers generate favorable traction in the market.
17.	I					X		There is evidence that validation of the value proposition, channels, customer segments, relationship models with existing customers, and revenue streams has been carried out.
18.	P					X		Information mining and partner selection have been carried out
19.	P					X		Building a more appropriate partnership pattern
20.	R					X		Technology risk studies have been carried out in every step of technology development
21.	R				X			Preparation of technology risk control plans at the technology development stage.
		0	0	0	2	10	9	
Σ		91						
%		86.67%						

KATSINOV 2

Noted

Katsinov 2 radar chart:

Readiness Level Map for each Aspect:



Notes:

- Partners have been decided from developing devices to applications, namely: KDIM (Digital Cooperative Indonesia Mandiri), APJII (Association of Indonesian Internet Service Providers), MASTEL (Indonesian Telematics Society), Kemkominfo (Ministry of Communication and Information), BEKRAF (Creative Economy Agency), until ITB (Institute Technology Bandung) comes with a local touch.
- Input regarding the Market Value Proposition (MVP) owned by the Digicoop Smartphone should be a business or marketing statement used by the company to summarize why consumers should buy products or use the services provided. This statement should convince potential consumers that one particular product or service will add more value or solve a problem better than other similar offerings.
- This means that packaging this MVP into a means of product marketing needs to be done more intensively by involving experts in the field of product marketing.
- The next investment element is that the solution offered to customers creates a profitable attraction in the market. This has not yet been completed because there has never been a sociological study/study related to potential customers, the assumption is that an understanding of customers is considered sufficient. However, it turns out that more effort is still needed to understand consumers more clearly.
- In terms of the risk aspect, the document has not been made specifically, but intuitively the team has taken it into account in every step, especially with regard to cooperation with other parties.
- The first element of preparing a technology risk control plan has not been carried out at every step of technology development. This is important because it mitigates potential failures that may occur. For example, risk studies are carried out on projects, products, processes and businesses. At least there is a document about: the types of risks that will be faced.
- In the second element, namely the preparation of a technology risk control plan at the technology development stage, it also needs to be documented as a form of anticipation. The technology risk control plan at the research stage is very important in order to minimize the possibility of project, product, process and business failure. And at the Katsinov 2 stage where the components have

become the output of the development process, the risk of failure of each component must be a concern of the developer.

KATSINOV 3

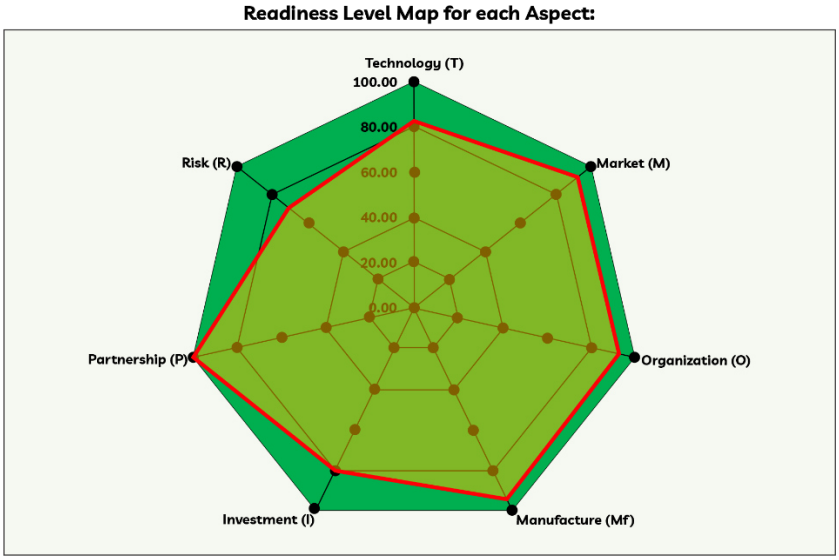
KATSINOV 3

		Σ or % Fulfilled						Indicator of KATSINOV 3
		Put a cross (X) in the appropriate column						
No.	Aspect	0	1	2	3	4	5	**(0=not fulfilled; 1=20%; 2=40%; 3=60%; 4=80%; 5=100% or fulfilled)**
1.	T						X	The actual system of technology has been demonstrated in a real environment.
2.	T						X	External testing of the technology developed has been carried out completely in order to meet technical requirements and regulatory compliance.
3.	T						X	Documentation of the developed technology has been carried out. Recording activities, documenting work instructions, and periodic technical reports.
4.	T						X	The technology being developed has been launched, or the innovation results have been launched.
5.	T				X			Intellectual property has been obtained (e.g. patents, industrial designs, copyrights, brands, etc.).
6.	M					X		Specific needs and customer requirements (as fulfillment of community needs as a solution to the problem) are known.
7.	M						X	Segment, size and market share have been predicted.
8.	M						X	Prices and product launches have been issued.
9.	O						X	Formalize the organization (business structure with staff and collaborators).
10.	O						X	Identify any additional staff needed.
11.	O						X	Distribution of responsibilities and workload
12.	Mf					X		The system design is mostly stable and proven in tests and evaluations.
13.	Mf						X	Proven manufacturing processes and procedures on a pilot scale.
14.	Mf						X	Production is carried out at low rates.
15.	I					X		Successfully define the end state of a technology product taking into account the entire target person, vertical market, and/or geography.
16.	I					X		Validation of the business carried out.
17.	I					X		Identification and validation of key performance indicators that indicate business success
18.	P						X	A formal partnership was carried out.
19.	P						X	Develop and implement cooperation plans.
20.	R					X		Technology risk studies are the basis for technical decision making at the engineering & operation stage.
21.	R				X			Preparation of technology risk control plans at the engineering & Operation stage.
		0	0	0	2	6	13	
Σ		95						
%		90.48%						

KATSINOV 3

Noted

Katsinov 3 radar chart:



Notes:

- Attributes obtained from intellectual property reach 60%. Brand and copyright for the software have not yet been obtained.
- Prediction attributes, size and market share achieved 100%. This smartphone will be adopted by the Indonesian Mandiri Digital Cooperative (KDIM), which is specifically intended for KDIM members.
- To become a member, someone must pay a basic fee of IDR 100,000, and a mandatory fee of IDR 100,000 per month or IDR 1.2 million per year. This is a member contribution fee, not for paying in installments or buying a cellphone.
- System attributes are mostly stable and proven in tests and evaluations to achieve 80%. With experience from PT. VS Technology Indonesia in the manufacturing process has proven production stability.
- In terms of risk aspects, both at Katsivov levels 1 to 3, the documents have not been specifically created.
- In the risk aspect (R) in Katsinov 3 there are 2 elements, namely planning and control in the context of product completion. From the measurement records, both of them do not have documents.
- In the first element of preparing a risk control plan, the technological risk assessment that is the basis for making technical decisions at the engineering & operation stage has not been documented. However, in practice, because the production trial process uses a third party (makloon) or a manufacturing contract, it can be said that the operational process has been taken into account by the manufacturer.
- The smartphone developer was not asked or obliged to create this document so it was not done. However, the developer realized that there was indeed a risk of failure in the product completion aspect which had actually been taken into account even though there was no Logbook or any other type of record that was at risk of failure.

KATSINOV 4

KATSINOV 4

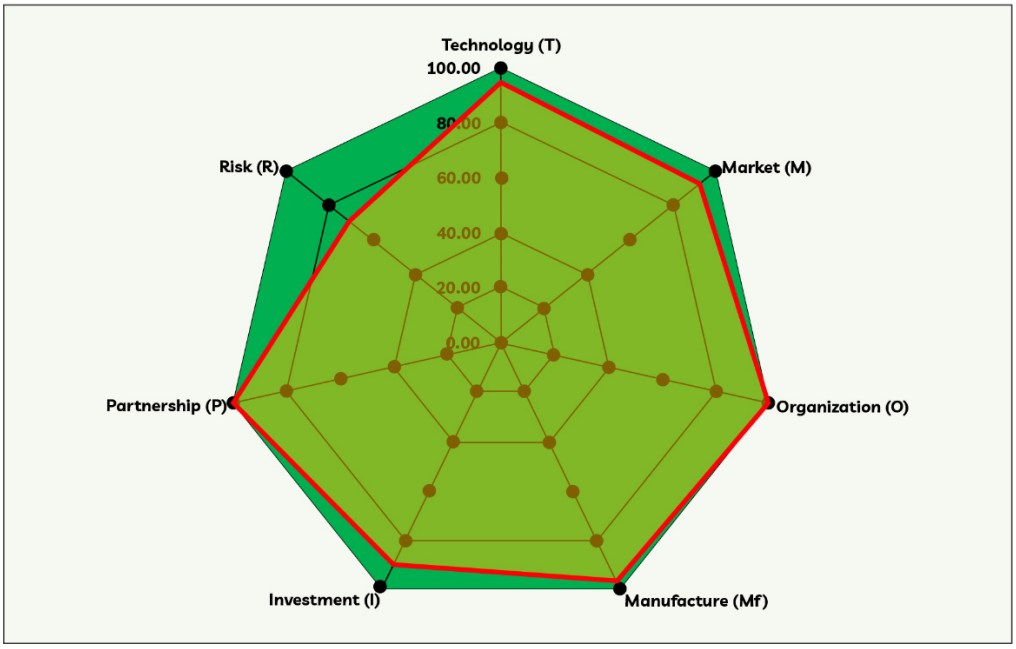
		Σ or % Fulfilled						Indicator of KATSINOV 4
		Put a cross (X) in the appropriate column						
No.	Aspect	0	1	2	3	4	5	(0=not fulfilled; 1=20%; 2=40%; 3=60%; 4=80%; 5=100% or fulfilled)
1.	T						X	Expertise related to the operation and maintenance of technology products has been formed.
2.	T					X		The general use of technology products by the broad market (as meeting people's needs as a solution to their problems) has been identified.
3.	T						X	Identification of key benefits has been carried out through test results.
4.	T						X	There is support for the adoption of technology products by the market.
5.	M						X	Do market positioning.
6.	M						X	Business model set.
7.	M						X	Competitors are well identified. Analyzing
8.	M					X		Marketing is emphasized on properly introducing technology products to customers.
9.	O						X	Determine the form of organization.
10.	O						X	Develop partnerships with independent organizations
11.	O						X	Identify opportunities for product introduction to new partners and markets.
12.	Mf						X	Shows production at full speed and execution.
13.	Mf						X	Start implementing production to meet safety, quality and legal requirements, for example: GMP or CPPOB , GMPD, CPIB, Standards Car Manufacturing, etc.
14.	Mf						X	Start implementing quality assurance according to certain required standards.
15.	Mf					X		There are public demands for the quality, safety and security of the products used.
16.	I						X	Identified market potential
17.	I					X		Identified product/service acceptance in the market.
18.	P						X	Collaboration within the network has been carried out dynamically.
19.	P						X	Management of existing collaborations is carried out.
20.	R					X		Preparation of non-technological risk control plans (organizational and social) at the stage of product introduction to the market.
21.	R					X		Assessment of organizational risks (in particular financial indicators) at the stage of product introduction to the market.
22.	R				X			Study of social impact risks at the stage of product introduction to the market.
		0	0	0	1	6	15	
Σ		102						
%		92.73%						

KATSINOV 4

Noted

Katsinov 4 radar chart:

Readiness Level Map for each Aspect:



Notes:

- The attribute of general use of technology products by the broad market is 80%.
  - Currently, of the 5000 smartphone units produced, only 1000 units have been absorbed by the market.
  - There are even customers who return smartphones.
- Consumer awareness that this type of product is different from similar smartphones on the market has not yet fully emerged.
- Because real consumers (actually) are only found after the product is thrown into the market, there are conditions where consumer responses are rather slow to be accepted by producers. For the real market, which has received as many as 1,000 Smartphone units, it turns out that there are still many complaints (requests for additional) related to embedded features.
- Meanwhile, the second element, namely identifying market potential, has been carried out. However, please note that the total market size or value in rupiah has not been disclosed. By analyzing the market potential, it can be estimated that consumers' absorption of Smartphone products that are to be offered will be clearer in production and investment planning.
- The attribute of implementing Good Manufacturing Practice is 100% achieved. With its experience, PT VS Technology Indonesia has implemented Good Manufacturing Practice.
- Collaboration attributes within the network are dynamically achieved 100%. Collaboration in the network has been carried out both through existing associations and societies, for example: the Indonesian Telematics Society (Mastel) and the Association of Indonesian Internet Network Operators (APJII).
- The product/service acceptance level attribute in the market is 80%.
  - If you see that only around 20% of the product is absorbed, then the level of product acceptance in the market is not optimal.
  - The initial production of 5000 smartphone units only sold 1000 units, meaning only 20% were absorbed by the market. Thus, there is no cash flow that can be reported regarding sales which are still at 20%.
- Attribute market potential achievement is 100%. If you consider the market share for existing Cooperative members (not only KDIM), the market potential is quite large. What needs to be considered is how to offer applications on smartphones that meet the needs of cooperatives and cooperative members.

- on the risk aspect (R) in Katsinov 3 there are 3 elements namely 1) Preparation of a non-technological (organizational and social) risk control plan at the stage of product introduction to the market; 2) Study of organizational risks (especially financial indicators) at the stage of product introduction to the market; 3) Study of social impact risks at the stage of product introduction to the market.
- In the first element, the preparation of a non-technological (organizational and social) risk control plan at the stage of product introduction to the market is a very determining element in the success of the Chasm stage. Where the launch into the market must be followed by the risk planning. Several factors inhibit the development of new products: what should be a lesson for the future are 1) high capital costs due to makloon system manufacturing contracts; 2). Expensive labor costs, namely the feature design workforce that continues to grow in line with consumer demand; 3). Anticipate changes in government policies regarding the business model used through cooperatives; 4). List or hope for new regulations from the government for the continuity of product marketing.
- The second element, namely the study of organizational risks (especially financial indicators) at the stage of product introduction to the market, has not been carried out and has not been documented.
- The third element, namely the social impact risk assessment at the stage of product introduction to the market, has not been carried out and has not been documented.

KATSINOV 5

KATSINOV 5

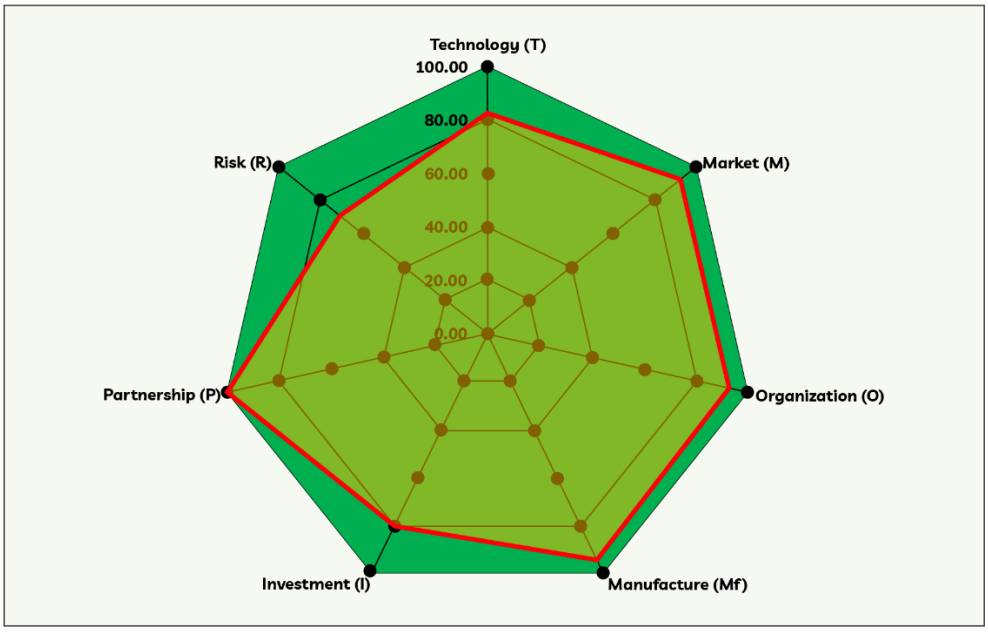
		Σ or % Fulfilled						Indicator of KATSINOV 5
		Put a cross (X) in the appropriate column						
No.	Aspect	0	1	2	3	4	5	(0=not fulfilled; 1=20%; 2=40%; 3=60%; 4=80%; 5=100% or fulfilled)
1.	T						X	There is a guarantee for technology products that are marketed
2.	T						X	Technology product maintenance and/or repair services are provided.
3.	T						X	Supply of spare parts for technology products is provided
4.	T						X	There are development activities with a lower intensity in order to increase the performance of technology products according to customer requests.
5.	M					X		Providing complete services and solutions.
6.	M					X		Carry out product differentiation.
7.	M					X		Business model refinement.
8.	M					X		Using partnerships to compete in the marketplace.
9.	O						X	Increase organizational effectiveness and collaboration
10.	O					X		Make the necessary restructuring
11.	O						X	Identification of increasing opportunities to match technology products with market needs
12.	O						X	Review of technical and commercial processes to improve rices and profits.
13.	Mf						X	Implementing Lean Manufacturing in total.
14.	Mf					X		There is a need for input (both internal and external) to management to improve performance
15.	Mf					X		Implement quality assurance according to standards (SNI) intensively.
16.	Mf					X		There is a guarantee of the quality, safety and security of products used by the public
17.	I		X					Identified market expansion needs
18.	I		X					There is an increase in production capacity.
19.	P						X	Dynamically increasing collaboration within the network
20.	P					X		Improving the quality of cooperation management that has been running.
21.	P				X			Cooperation in product distribution and marketing
22.	R				X			Preparation of non-technological risk control plans at the stage of market maturity.
23.	R				X			Organizational risk assessment (especially financial indicators) at the market maturity stage is reached.
24.	R				X			Social impact risk assessment at the market maturity stage is reached.
		0	2	0	4	9	9	
Σ		95						
%		79.17%						

KATSINOV 5

Noted

Katsinov 5 radar chart:

Readiness Level Map for each Aspect:



Notes:

- In the attribute of increasing production capacity, the achievement is 0%, meaning that it is not possible to increase production capacity because product absorption by the market is still relatively small.
- The market expansion requirement attribute is 0%, meaning that the market has not been mastered because product absorption by the market is still relatively small, still at the level of early adopters. This condition is still quite tough, because they have to go through a chasm to reach the main market or middle adopters.
- The business model is undergoing severe tests, related to low consumer awareness. Thus it still requires effort in market education.
- in the risk aspect (R) in Katsinov 4 there are 3 elements, namely 1) Preparation of a non-technological risk control plan (organizational and social) at the stage of product introduction to the market; 2) Study of organizational risk (especially financial indicators) at the stage of product introduction to the market; 3) Assessment of social impact risk at the stage of product introduction to the market.
- In the first element, the preparation of a non-technological (organizational and social) risk control plan at the stage of product introduction to the market is a very determining element in the success of the Chasm stage. Where the launch into the market must be followed by the risk planning. Several factors inhibit the development of new products: what should be a lesson for the future are 1) high capital costs due to makloon system manufacturing contracts; 2). Expensive labor costs, namely the feature design workforce that continues to grow in line with consumer demand; 3). Anticipate changes in government policies regarding the business model used through cooperatives; 4). List or hope for new regulations from the government for the continuity of product marketing.
- The second element, namely the study of organizational risks (especially financial indicators) at the stage of product introduction to the market, has not been carried out and has not been documented.
- The third element, namely the social impact risk assessment at the stage of product introduction to the market, has not been carried out and has not been documented.

g. CONCLUSION

The conclusions that can be given based on the KATSINOV measurement results are:

1) The main note from the Katsinov measurement results is that it has reached Katsinov Level 4, meaning that this innovative product has been able to reach initial production and has reached the hands of early adopters but has not yet reached the early majority. Regarding this condition, we can look back at the market identification process that was carried out which was still limited to hypothetical markets. That is, the originally planned market was assumed to be as described by the digital cooperative, which would require certain features which were then included in the product (software) design.
2) In the Tenological Aspect (T). In Katsinov 1 to Katsinov 4, it seems that good progress has been shown, in the sense that from the start of the concept, components, completion has been completed with a high achievement score (> 80%). There are several assessment notes on this technology aspect. One of the biggest weaknesses is the aspect of the idea that provided the soul at the beginning of the innovation process. The idea developed for this product came from prospective customers, namely from cooperatives, but it turns out that real consumers have not yet fully fulfilled the technological design aspect. It is proven that on the journey after product delivery there are still consumer desires that must be fulfilled regarding the idea. This means that there are several levels of potential consumers that must be considered, namely level 1 of digital cooperatives who will buy products in batches (large parties), and level 2 are real consumers, namely cooperative members who will enjoy the services and technological features of this Digicoop Smartphone product. Apparently the introduction of level 2 consumers is still weak.
3) In the Market Aspect (M). Measurement records show that the Custumize Smartphone market potential is large, but there are no records (documents) of market surveys/research conducted. So it could be that this potential has not yet been fully identified. Concerns that this potential turns out to be very small could happen.
4) On the Organizational Aspect (O). The measurement records provide a description of the smooth evolution of the organization. This means that in the Digicoop Smartphone project, organizational

forms have been considered, from previously semi-formal to formal, and from previously based on contractual relationships to coordinating relationships under one organizational control. This indicates that the Digicoop Smartphone innovation project has been successful in building its innovation organization. Especially the development of concepts and components into a customer-oriented organization through the creation of Customer Relations Management (CRM) which was formed at the end of the Chasm stage. And at the same time an organization was built that involved third parties, for example related to Complaints, after sales which were also successful. But back to the business model that has not been fully operational, it still leaves problems with low market absorption.

5) On the Partnership Aspect (P). Regarding smartphone development partnerships, attention has been paid to which parties will be invited to work together, both in the scope of design development and up to the supply chain and manufacturing. Measurement notes: The supply chain used by the developer has taken note of its reputation, namely a supply chain that has been proven successful in supplying a range of products on the market and selling well in the market. The supply chain partners have been considered, but there are only a few things noted from components that have experienced technology failures because they do not have adequate testers. With this tester, for example, a battery tester can identify the quality of components quickly.
6) On Investment Aspect (I). The investment aspect has become part of this innovation product development organization. In fact, investors are the biggest party to receive the risk of failure. Some measurement notes: part of the investment aspect is whether the customer's wishes have been fulfilled, it turns out that there have been developments. Even though this is commonplace, if it turns out that the desire set forth in the technology design (in the form of a Customize Smartphone) has used up a lot of resources it will have fatal consequences for the investment that has been invested. This means that solutions for customers that are immeasurable can threaten the sustainability of product completion. Note Further investment in the use of human resources Design may be too wasteful in the sense that the promised features change too frequently, thus consuming time and design manpower.

7) On the Risk Aspect (R). The relatively weak aspect of the Digicoop Smartphone project is that risk management has not been identified or planned either at the technology development stage or at the market evolution stage.

h. RECOMMENDATION

Policy recommendations that can be given from the results of KATSINOV measurements are:

No.	Policy Recommendations/ Regulations	Responsible Institution
1.	In the framework of the barrier to entry policy, it is important to issue regulations in the form of a Presidential Decree regarding the obligation to use products or technology resulting from domestic innovation (universities, government and private R&D institutions, the general public), as well as giving priority to including products or technology resulting from domestic innovation. into the LKPP e-catalog (Government Goods/Services Procurement Policy Institute).	▪ Ministry of Research, Technology and Higher Education Cabinet Secretary
2.	In the framework of the barrier to entry policy, it is important to issue a Minister of Research, Technology and Higher Education Regulation regarding TKDN (Domestic Content Level) in Higher Education. This increases the utilization of domestic innovation results (especially higher education) in the higher education environment.	▪ Ministry of Research, Technology and Higher Education Ministry of Industry
3.	Minister of Research, Technology and Higher Education Regulation concerning Double Tax Deduction. **Notes:** ▪ Double tax deduction for research and development activities is the research and development activities (expenses) carried out by the company in the profit and loss report, which will be doubled, so that the taxable income (earnings before tax - EBT) becomes more low. ▪ This means that the company pays less tax than it should. Double tax reduction is one of the incentives provided by the government to business actors.	▪ Ministry of Research, Technology and Higher Education Ministry of Finance

Technical recommendations that can be given from the KATSINOV measurement results are:

No.	Aspect	Bandung Institute of Technology (ITB)	Independent Indonesian Digital Cooperative (KDIM)
1.	Technology	▪ The product development team optimally explores market needs, especially application needs for Digicoop smartphones that support the KDIM business model. ▪ The ideation process in developing Android-based applications must involve potential users and open to feedback from users for continuous improvement. ▪ Digicoop's state of the art technology must follow developments in smartphone technology on the market.	KDIM must be clear and firm in identifying the need for the type of application that supports the business model it is developing.
2.	Market	▪ If it is focused on a particular market segment (for example: KDIM members), the technology offered must adapt to the business needs of KDIM and KDIM members.	▪ KDIM seeks intensive education to prospective members. ▪ In increasing the number of cooperative membership, the aspects of benefits (both profit and benefit) of being a member must be put forward.
3.	Organization	▪ ITB is not a business entity, so there should be a transfer of technology to a business entity that has a core business in the smartphone sector (eg: PT. TSM).	▪ KDIM as the party that is the distributor of Digicoop smartphones.
4.	Partnership	▪ Parties involved in the development of Digicoop must have clear functions and roles.	▪ The function and role of KDIM as the sole distributor of Digicoop.
5.	Manufacture	▪ It is necessary to pay attention to the design to cost of digicoop products through value analysis.	▪ KDIM must provide input to technology developers (in this case ITB) regarding end user demands in terms of function, performance and cost.

No.	Aspect	Bandung Institute of Technology (ITB)	Independent Indonesian Digital Cooperative (KDIM)
6.	Investment	▪ Product - Market Fit needs to be further strengthened through adjustments between market demand and the technology products offered.	▪ KDIM must provide input to technology developers (in this case ITB) related to the demands of end users.
7.	Risk	▪ In developing a new product, it is important to carry out a risk assessment.	▪ In doing business, especially those related to digicoop smartphones, it is very important to carry out a risk assessment.

2. Case Example 2: SMAG *(Smart Magnetic Material)*

a. Person Contact

Responsible for innovation activities:

1) **Guritno Gustianto, S.Far.** (PT. Sigma Utama)
   Kontak: Phone: (021)8756310/ 8753042; Email: guritno@sigmautama.com
2) **Dr. Wisnu Ari Adi, S.Si., M.Si.** (BATAN)
   Kontak: Phone: (021)7560922/7560926; Email: dwisnuaa@batan.go.id

b. Technology Development Background

Utilization of local natural resources, especially rare earth metals (REM), is the main support in this activity, especially synergy between R&D institutions and industry. REMs contained in monazite minerals require appropriate processing technology with research that has been carried out for a long time, especially to obtain radioactive free REMs. The economic potential of monazite, which was previously a by-product of tin mining, can be increased in value in line with its great need as a raw material for advanced industries.

The National Nuclear Energy Agency (BATAN) has mastered the technology for processing monazite into REMs hydroxide (RE(OH)3) which is radioactive free, even to the oxides of REM elements contained in monazite such as Lanthanum (La), Cerium (Ce), and Neodymium concentrate (Nd).

The focus of the application in this activity is specifically the use of La-oxide for smart magnetic material (SMAG) applications. The first step in the industrialization of LTJ from monazite minerals has begun with the establishment of the RE(OH)3 pilot plant which uses process technology from PTBGN-BATAN at PT. Timah (Persero) located in Tanjung Ular in 2015. Then in 2017, this process technology was perfected at PTBGN. Meanwhile, in the same year, a REM-oxide pilot plant was built at PSTA-BATAN. The results obtained from the pilot plant have been utilized by PSTBM-BATAN in collaboration with PT. Sigma Utama and Dislitbang TNI AL through "Development of anti-radar detection coating based on Smart Magnetic Material (SMAG) for application on warship hull specimens to increase the capability of the TNI Navy's defense equipment as the world's maritime axis".

c. Competitive Advantage

The advantages of an innovative anti-radar detection coating based on Smart Magnetic Material (SMAG) are:

1) Anti-radar detection coating based on smart magnetic material (SMAG) for application on warship hull specimens to increase the capabilities of the Indonesian Navy's defense equipment.
2) No rare earth metal (REM) based industries have been established in Indonesia.

d. TECHNOLOGY & MARKET READINESS

The achievement in 2018 was the successful scale up of the manufacture of anti-radar pigment with a capacity of 500 kg per batch to be used as anti-radar detection paint filler, then applied to the actual object in the form of the TNI AL Patkamlam SADARIN ship which was planned to be carried out at the Pondok TNI AL Military Base Rowing, Jakarta. In 2019 it is targeted to obtain test results and product certification for anti-radar detection paint.

There is high market potential both domestically and abroad for RE(OH)3, especially in the form of REM oxides such as lanthanum oxide, cerium oxide and neodymium oxide. Mastery of the technology for making REM oxide REMs is very important because until now no factory making REM oxide from monazite has been established in Indonesia.

e. PROTOTYPE

Photo Caption: (a). SMAG paint products; (b). SMAG paint test results on Indonesian Navy Patrol Boats; (c). Pilot scale SMAG paint production line.

f. PROTECTION OF INTELLECTUAL PROPERTY RIGHTS

At the patent and brand processing stage.

g. KATSINOV MEASUREMENT RESULTS

The results of the KATSINOV measurement of the SMAG innovation product can be explained as follows:

KATSINOV 1

KATSINOV 1

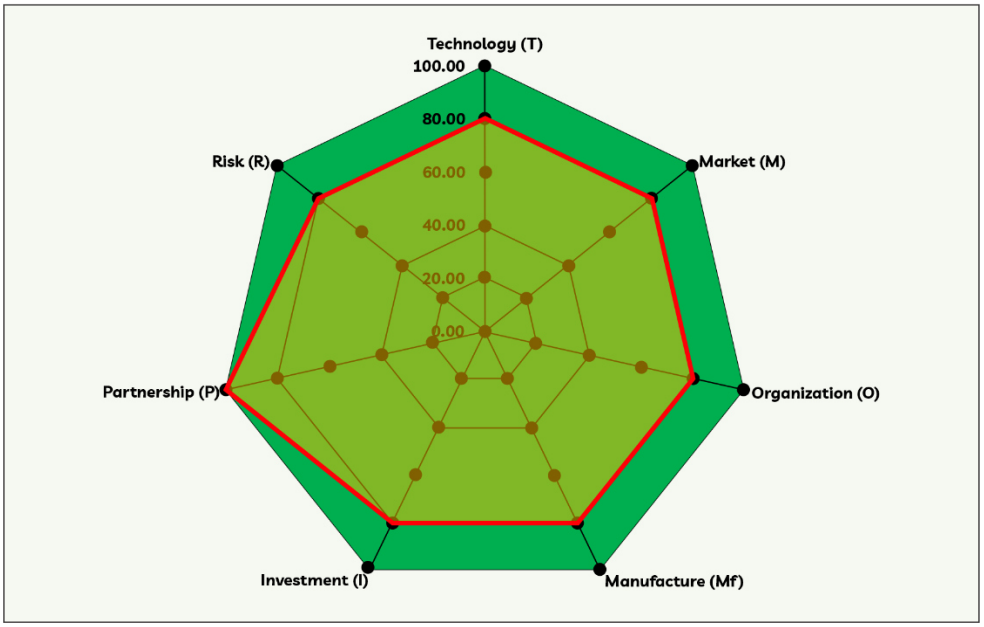
		Σ or % Fulfilled						Indicator of KATSINOV 1
		Put a cross (X) in the appropriate column						
No.	Aspect	0	1	2	3	4	5	(0=not fulfilled; 1=20%; 2=40%; 3=60%; 4=80%; 5=100% or fulfilled)
1.	T					X		New ideas that provide solutions to problems faced by society.
2.	T					X		Observations of basic scientific principles and scientific publications have been carried out
3.	T					X		Uniqueness (USP/Unique Selling Point) or novelty has been identified.
4.	T					X		Research stages and targets have been identified
5.	T					X		The technology to be developed is scientifically feasible
6.	M					X		Innovation is carried out based on customer requests and/or needs (as fulfillment of community needs as a solution to the problem)
7.	M					X		Customer needs, wants and requests have been identified
8.	M					X		The target market location has been identified
9.	O					X		Have an innovation strategy
10.	O					X		The project scope and tasks of the Innovation Team have been defined
11.	O					X		Required resources and services have been ascertained
12.	O					X		Seamless communication channels are available
13.	Mf					X		Identified the implications (consequences or direct results of the findings of a scientific research) basic manufacturing.
14.	Mf					X		Identified manufacturing concept
15.	Mf					X		There is proof of manufacturing concept through analytics or laboratory experiments.
16.	I					X		There is a business model concept for the idea being developed.
17.	I					X		There are results of customer, market and competitor analysis of the ideas developed.
18.	I					X		There is evidence that the idea developed has provided a solution for the customer.
19.	P						X	Develop a strategy to build networks and partnerships
20.	P						X	Potential partners have been identified
21.	R					X		Technology risk assessment has been a consideration in every step of the research
22.	R					X		Preparation of technology risk control plans at the research stage.
		0	0	0	0	2	20	
Σ		90						
%		81.82%						

KATSINOV 1

Noted

Katsinov 1 radar chart:

Readiness Level Map for each Aspect:



Notes:

- The idea of innovation is quite good, but it needs to be thought about in relation to the radar's own detection capabilities of friends' defense equipment. This really requires further research so that it is not only the anti-radar function of the enemy, but also that there is a specific capability for detection by friendly radars.
- This innovation idea is based on the TNI's needs regarding stealth technology that supports defense system tools and equipment.
- Raw materials in the form of Rare Earth Metals are abundant in Indonesia.
- Research and development of anti-radar detection coatings based on smart magnetic material (SMAG) is fully supported by the industry, namely PT. Main Sigma.

KATSINOV 2

KATSINOV 2

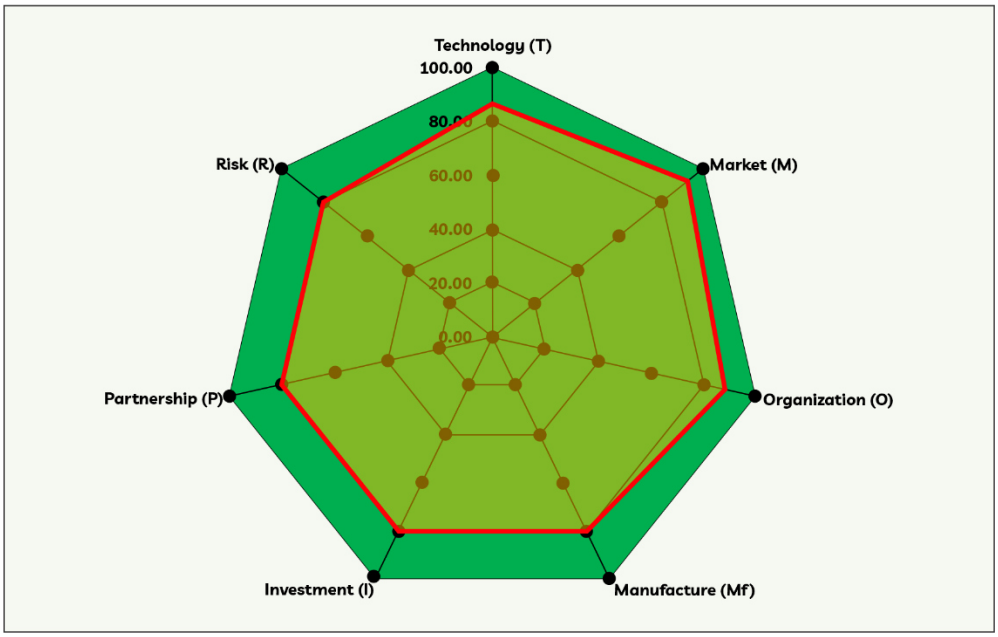
		Σ or % Fulfilled						Indicator of KATSINOV 2
		Put a cross (X) in the appropriate column						
No.	Aspect	0	1	2	3	4	5	**(0=not fulfilled; 1=20%; 2=40%; 3=60%; 4=80%; 5=100% or fulfilled)**
1.	T						X	Validation has been carried out on the individual components of the technology.
2.	T						X	The prototype has been demonstrated in the relevant environment.
3.	T						X	The technology is declared technically feasible.
4.	T				X			IP registration has been carried out (for example: patents, industrial designs, copyrights, brands, etc.).
5.	T					X		Technically able to provide solutions to problems faced by society.
6.	M					X		End customers identified.
7.	M						X	A detailed market launch plan has been issued.
8.	M					X		Intellectual capital has begun to be prepared.
9.	O						X	An analysis and a business plan have been issued
10.	O					X		There is involvement of key individuals.
11.	O					X		The project requirements and list of project partners have been approved.
12.	O					X		Responsibilities and time limits have been agreed.
13.	Mf					X		Identification of technology and critical components is complete.
14.	Mf					X		Materials, tools and prototype test equipment, as well as personnel expertise have demonstrated the readiness of the sub system/system in a relevant production environment.
15.	I					X		There is a selling point advantage (Market Value Proposition/MVP) and has been tested on customers.
16.	I					X		The solutions offered to customers generate favorable traction in the market.
17.	I					X		There is evidence that validation of the value proposition, channels, customer segments, relationship models with existing customers, and revenue streams has been carried out.
18.	P					X		Information mining and partner selection have been carried out
19.	P					X		Building a more appropriate partnership pattern
20.	R					X		Technology risk studies have been carried out in every step of technology development
21.	R					X		Preparation of technology risk control plans at the technology development stage.
		0	0	0	1	14	5	
Σ		89						
%		84.76%						

KATSINOV 2

Noted

Katsinov 2 radar chart:

Readiness Level Map for each Aspect:



Notes:

- Brand registration is needed for product branding in the market. While a patent may not be issued in order to protect the confidentiality of the formula or the technology contained therein.

KATSINOV 3

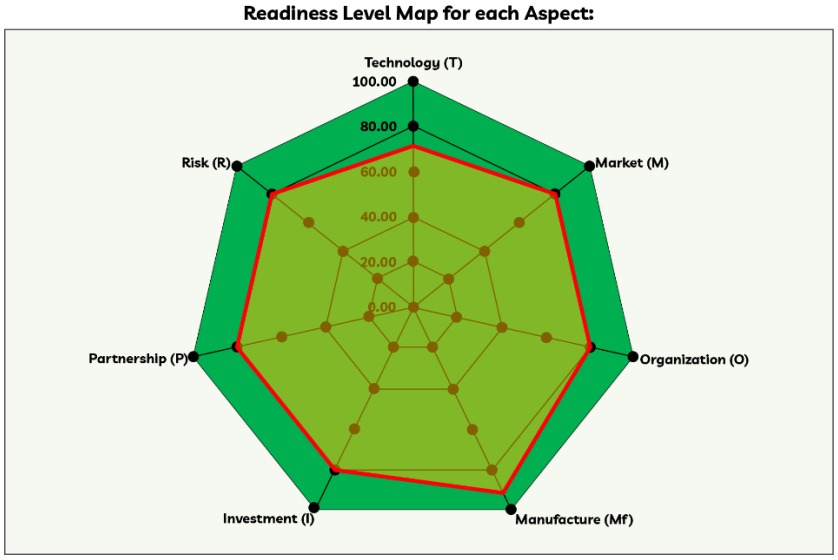
KATSINOV 3

		Σ or % Fulfilled						Indicator of KATSINOV 3
		Put a cross (X) in the appropriate column						
No.	Aspect	0	1	2	3	4	5	(0=not fulfilled; 1=20%; 2=40%; 3=60%; 4=80%; 5=100% or fulfilled)
1.	T						X	The actual system of technology has been demonstrated in a real environment.
2.	T					X		External testing of the technology developed has been carried out completely in order to meet technical requirements and regulatory compliance.
3.	T					X		Documentation of the developed technology has been carried out. Recording activities, documenting work instructions, and periodic technical reports.
4.	T					X		The technology being developed has been launched, or the innovation results have been launched.
5.	T				X			Intellectual property has been obtained (e.g. patents, industrial designs, copyrights, brands, etc.).
6.	M					X		Specific needs and customer requirements (as fulfillment of community needs as a solution to the problem) are known.
7.	M					X		Segment, size and market share have been predicted.
8.	M					X		Prices and product launches have been issued.
9.	O					X		Formalize the organization (business structure with staff and collaborators).
10.	O					X		Identify any additional staff needed.
11.	O					X		Distribution of responsibilities and workload
12.	Mf						X	The system design is mostly stable and proven in tests and evaluations.
13.	Mf						X	Proven manufacturing processes and procedures on a pilot scale.
14.	Mf					X		Production is carried out at low rates.
15.	I					X		Successfully define the end state of a technology product taking into account the entire target person, vertical market, and/or geography.
16.	I					X		Validation of the business carried out.
17.	I					X		Identification and validation of key performance indicators that indicate business success
18.	P					X		A formal partnership was carried out.
19.	P					X		Develop and implement cooperation plans.
20.	R					X		Technology risk studies are the basis for technical decision making at the engineering & operation stage.
21.	R					X		Preparation of technology risk control plans at the engineering & Operation stage.
		0	0	0	1	17	2	
Σ		86						
%		81.90%						

KATSINOV 3

Noted

Katsinov 3 radar chart:



Notes:

- Brand registration is needed for product branding in the market. At this stage, formal collaboration is required with partners who will produce, and a license agreement is made.
- A scale-up of anti-radar pigment production with a capacity of 500 kg per batch has been successfully carried out to be used as anti-radar detection paint filler, then applied to the actual object in the form of the Indonesian Navy's Patkamlam SADARIN ship which is planned to be carried out at the Indonesian Navy's Pondok Dayung Military Base, Jakarta.

KATSINOV 4

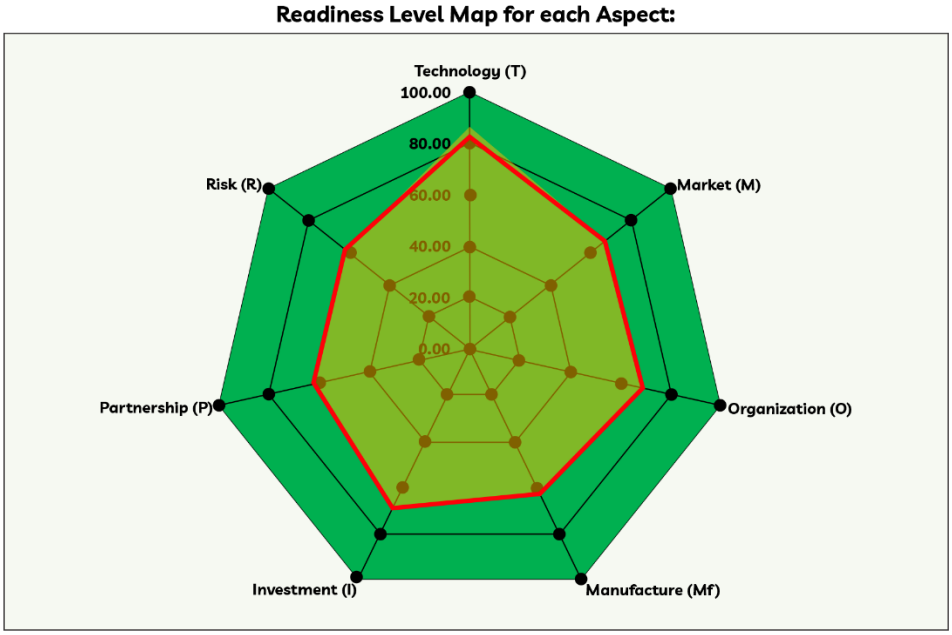
KATSINOV 4

No.	Aspect	0	1	2	3	4	5	Indicator of KATSINOV 4 (0=not fulfilled; 1=20%; 2=40%; 3=60%; 4=80%; 5=100% or fulfilled)
		Σ or % Fulfilled						Put a cross (X) in the appropriate column
1.	T					X		Expertise related to the operation and maintenance of technology products has been formed.
2.	T					X		The general use of technology products by the broad market (as meeting people's needs as a solution to their problems) has been identified.
3.	T					X		Identification of key benefits has been carried out through test results.
4.	T					X		There is support for the adoption of technology products by the market.
5.	M					X		Do market positioning.
6.	M				X			Business model set.
7.	M				X			Competitors are well identified. Analyzing
8.	M				X			Marketing is emphasized on properly introducing technology products to customers.
9.	O					X		Determine the form of organization.
10.	O				X			Develop partnerships with independent organizations
11.	O				X			Identify opportunities for product introduction to new partners and markets.
12.	Mf				X			Shows production at full speed and execution.
13.	Mf				X			Start implementing production to meet safety, quality and legal requirements, for example: GMP or CPPOB , GMPD, CPIB, Standards Car Manufacturing, etc.
14.	Mf				X			Start implementing quality assurance according to certain required standards.
15.	Mf				X			There are public demands for the quality, safety and security of the products used.
16.	I					X		Identified market potential
17.	I				X			Identified product/service acceptance in the market.
18.	P				X			Collaboration within the network has been carried out dynamically.
19.	P				X			Management of existing collaborations is carried out.
20.	R				X			Preparation of non-technological risk control plans (organizational and social) at the stage of product introduction to the market.
21.	R				X			Assessment of organizational risks (in particular financial indicators) at the stage of product introduction to the market.
22.	R				X			Study of social impact risks at the stage of product introduction to the market.
		0	0	0	1	6	15	
Σ		73						
%		66.36%						

KATSINOV 4

Noted

Katsinov 4 radar chart:



Notes:

- In order for the product to be accepted, there needs to be development related to the ability to be detected by friendly radar, so not just anti-radar by opposing parties.
- Identification of competing technologies is required;
- The business model needs to be validated and defined.
- A military worthiness certificate is required.

h. CONCLUSION

The conclusions that can be given based on the results of the KATSINOV measurements are:

1) SMAG is at the KATSINOV level 3, which is marked by the completion of technology development and all system functions have been proven in the field through demonstrations in real environments.
2) In order for SMAG to be used by the TNI, a military worthiness certificate must be carried out.

i. RECOMMENDATION

Recommendations that can be given from the results of KATSINOV measurements are:

1) The development of SMAG should be based on the operation requirements (opsreq) issued by the end user, namely the TNI.
2) The industry should have from the start prepared all documents for the Military Worthiness Certificate process in accordance with their dimensions.

Attachment 1 EXPLANATION OF KEY ACTIVITIES/ ATTRIBUTE

Indicator KATSINOV 1

No	Aspects	Key Activities/ Attributes	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
1	**T**	New ideas that provide solutions to problems faced by the community.	The strength of an innovation is determined by the new ideas or ideas offered, whether or not it provides solutions to the problems faced by society. In general, new ideas or ideas are obtained through the process of creating new ideas or better known as ideation. The ideas or ideas obtained are a form of solution to the problems faced by society today.	**Score 0:** No new ideas were found that provided solutions to the problems faced by the community; **Score 1:** Found new ideas that are incremental in nature, but have not offered the right solution to the problems faced by the community; **Score 2:** Found new ideas that are incremental in nature, and offer the right solutions to problems faced by the community; **Score 3:** Found a new idea that is distinctive, but has not offered the right solution to the problems faced by the community; **Score 4:** Found new ideas that are distinctive, and offer the right solutions to problems faced by the community; **Score 5:** New ideas that are breakthrough or disruptive and provide solutions to problems faced by the community.	Proposal R&D
2	**T**	Observations of basic scientific principles and scientific publications have been carried out	New ideas or ideas offered must be based on correct scientific basic principles. Therefore, observation of basic scientific principles and scientific publications is very important in order to create a scientific and technical foundation that is the basis for the application of new ideas or ideas to users. Research as an effort to obtain the truth must be based on the scientific thought process outlined in the scientific method. The scientific method is the framework for the creation of scientific knowledge. Research conducted using scientific methods contains two important elements, namely observation and reasoning. The scientific method is based on the idea that if a statement is to be accepted as a truth, the statement must be able to be verified or tested empirically (based on facts).	**Score 0:** Basic scientific principles and scientific publications have not been observed; **Score 1:** Basic scientific principles and scientific publications have been observed, but have not provided strong scientific support for the success of realizing the new ideas or ideas offered; **Score 2:** Observations of basic scientific principles and scientific publications that provide weak scientific support for the success of realizing new ideas or ideas offered; **Score 3:** Observations of basic scientific principles and scientific publications have been carried out that provide strong enough scientific support for the success of realizing the new ideas or ideas offered; **Score 4:** Observations of basic scientific principles and scientific publications have been carried out that provide strong scientific support for the success of realizing new ideas or ideas offered. **Score 5:** Observations of basic scientific principles and scientific publications have been carried out that provide very strong scientific support for the success of realizing new ideas or ideas offered.	Literature review (in scientific proposals/reports), scientific publications (writings published in scientific journals/proceedings)

No	Aspects	Key Activities/ Attributes	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
3	**T**	Has been identified as unique (USP/*Unique Selling Point*) or novelty	In essence, an innovative new idea or idea must have a USP (unique selling point) and novelty. USP (unique selling point) is a factor that distinguishes a product from its competitors, such as the lowest cost, highest quality or the first product of its kind. A USP can be thought of as "what your competitors don't have." While novelty is an element of novelty or findings from research. In principle, a novelty is a factor that strengthens the USP of an innovation product.	**Score 0:** Does not have novelty and USP (unique selling point); **Score 1:** Has a USP (unique selling point), but does not have novelty; **Score 2:** Has novelty, but USP (unique selling point) is relatively weak; **Score 3:** Have novelty is incremental and have a strong USP (unique selling point); **Score 4:** Have a novelty that is distinctive and a strong USP (unique selling point); **Score 5:** Have novelty, breakthrough or disruptive, and a strong USP (unique selling point).	Proposal R&D
4	**T**	The stages of research and targets have been identified.	To realize a new idea or idea into a prototype, the stages of Research (research) and Development are carried out in a targeted manner. Research or research is often described as an investigative process that is carried out actively, diligently, and systematically, aiming to find, interpret, and revise facts. Research activities are a process of obtaining or obtaining knowledge or solving problems faced, which is carried out scientifically, systematically and logically. Broadly speaking, the stages taken in carrying out research have three stages, namely: the planning stage, the implementation stage, and the research report stage. Meanwhile, development is an activity to increase the usefulness and carrying capacity of science and technology that has been proven to be true and safe to improve the function and benefits of science and technology.	**Score 0:** The research stage and target have not been identified; **Score 1:** The research stage has been identified, but the target has not been identified; **Score 2:** The stages of the research and the target have not been identified in detail; **Score 3:** The research stages have been identified in sufficient detail, but the target has not been clearly identified; **Score 4:** The research stages and targets have been identified in sufficient detail and clarity; **Score 5:** The stages of the research and the targets have been identified in detail and clearly.	Proposal R&D
5	**T**	The technology to be developed is scientifically feasible (scientific feasibility)	What is meant by the technology developed is scientifically feasible (scientific feasibility) if it has been tested theoretically through scientific research.	**Score 0:** Theory testing has not been carried out through scientific research; **Score 1:** In preparation for carrying out theoretical testing through scientific research; **Score 2:** Initial testing of the theory through scientific research has been carried out; **Score 3:** Theory testing has been carried out through intensive scientific research, and a conclusion has not been reached that the technology developed is scientifically feasible (scientific feasibility); **Score 4:** Theory testing has been carried out through intensive scientific research, and it is almost concluded that the technology developed is scientifically feasible (scientific feasibility); **Score 5:** Theory testing has been carried out through intensive scientific research, and it has been concluded that the technology developed has been scientifically feasible (scientific feasibility).	Worksheets of research activities; Scientific publications

No	Aspects	Key Activities/ Attributes	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
6	**M**	Innovation is carried out based on customer requests and/or needs (as a fulfillment of community needs as a solution to the problem)	Whether the new ideas or ideas offered are based on customer requests and/or needs (as meeting the needs of the community as a solution to the problem). In general, new ideas or ideas offered can be "technology push" or "market pull". Definition of Technology Push: New products are obtained from production technology, the use of advanced technology and ease of operation, with little attention to the market. In other words, a new product or technology is encouraged or sold to the market (potential customers) who do not ask for or know about the new product or technology. Technology Push will lead to radical innovation. While the Definition of Market Pull: New products are determined by the market based on customer needs. The type of new product is determined through market research & customer feedback, with little attention to technology. Need Pull will lead to the formation of incremental innovation.	**Score 0:** Innovation is rooted in technology, without attention to the market; **Score 1:** Innovation is rooted in technology, with little attention to the market; **Score 2:** Innovation is based on technology, with an orientation of attention to the market; **Score 3:** Innovation is based on market needs, but is not supported by market research; **Score 4:** Innovation is rooted in market needs, supported by market research & without adequate customer feedback; **Score 5:** Innovation is rooted in customer needs, through market research & customer feedback.	R&D Proposals; Documents from market research.
7	**M**	Customer needs, wants, and demands have been identified	In the process of exploring new ideas or ideas through the ideation stage, it is necessary to identify who the target users are, namely by knowing the needs, wants, and demands of potential users or customers. By knowing the needs, wants, and demands of users, it can be the basis for product design at the prototyping stage.	**Score 0:** No market research was conducted; **Score 1:** Market research has been conducted, but the needs, wants, and demands of the end customer have not been identified; **Score 2:** Market research has been carried out, and customer needs have been identified; **Score 3:** Market research has been conducted, and customer desires have been identified; **Score 4:** Market research has been conducted, and customer demand has been identified **Score 5:** Market research has been conducted, and the needs, wants, and demands of the end customer have been identified.	R&D Proposals; Documents from market research.
8	**M**	The location of the market to be visited has been identified	At the concept stage in realizing this new idea or idea, the innovator is obliged to identify the target market location. The basis for determining the target location of this market is size, reach and geography.	**Score 0:** No market research has been conducted; **Score 1:** Preparation and start of market research; **Score 2:** Market research has been carried out, and the market has been identified based on geographical variables; **Score 3:** Market research has been carried out, and several options for the market location to be targeted have been identified; **Score 4:** The results of market research are being tested and applied to the market options to be targeted; **Score 5:** Market research has been carried out, and the location of the market to be targeted has been identified.	R&D Proposals; Documents from market research.

No	Aspects	Key Activities/ Attributes	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
9	O	Have an innovation strategy	Strategy is a plan or an outline of a course to act in an effort to achieve a predetermined goal. Innovation plays a major role in economic activities. Entities (e.g., companies, universities, R&D institutions, teams) that innovate are expected to penetrate new markets, maintain existing market share and increase competitive advantage. Innovation is an important element of an entity's business strategy. Innovation in the implementation of strategies plays a role in achieving sustainable competitive advantage in global competition. Global competition forces entities to innovate by reducing production costs and improving technological capabilities and innovating products.	**Score 0:** Do not have an innovation strategy yet; **Score 1:** The preparation stage for the preparation of the innovation strategy; **Score 2:** In the process of preparing the innovation strategy; **Score 3:** Has developed an innovation strategy, but has not yet been determined; **Score 4:** Have developed and established the innovation strategy; **Score 5:** Have prepared, established and implemented the innovation strategy.	R&D Proposals; Innovation roadmap
10	O	The project scope and tasks of the Innovation Team have been defined	This organization at Katsinov 1 level is still in the form of an R&D organization, or engineering organization. The form of organization at this level is generally still in the form of a team. In the R&D or engineering organization, the scope of the program/activity and the team's tasks will be identified.	**Score 0:** The project scope and tasks of the Innovation Team have not been defined; **Score 1:** The preparation stage for the preparation of the project scope and tasks of the Innovation Team; **Score 2:** In the process of preparing the project scope and tasks of the Innovation Team; **Score 3:** The scope of the project and tasks of the Innovation Team have been completed; **Score 4:** The scope of the project and tasks of the Innovation Team have been completed, and are still in the process of determining; **Score 5:** The scope of the project and tasks of the Innovation Team have been prepared and determined.	R&D Proposals; Decree of the Innovation Team
11	O	The resources and services needed have been confirmed	To ensure the success of the implementation of innovation activities, resources that include human resources (e.g., researchers, engineers), funding sources, and laboratory facilities must be ensured. However, not all innovation implementing institutions (industry, R&D and universities) have laboratory facilities (both for the implementation of research and testing), therefore to facilitate the implementation of innovation, services are needed, both for production tests and product testing, from other institutions that have these facilities. Therefore, efforts to ensure the availability of these resources and services are very important.	**Score 0:** There is no certainty of the resources and services needed; **Score 1:** There is certainty of human resources (e.g. researchers, engineers); **Score 2:** There is certainty of human resources (e.g. researchers, engineers) and laboratory facilities; **Score 3:** There is certainty of human resources (e.g., researchers, engineers), sources of funds, and laboratory facilities; **Score 4:** There has been certainty of human resources (e.g., researchers, engineers), sources of funding, and laboratory facilities, but efforts can still be made to ensure the support of other services needed; **Score 5:** There is certainty of human resources (e.g., researchers, engineers), sources of funds, as well as laboratory facilities, as well as other services needed.	Proposal R&D
12	O	Seamless communication channels available	Communication can be interpreted as a process of creating and using information by individuals and groups to be able to connect with each other or with the social environment of society. There are three components that are key in the communication process, namely the message or information, the source or giver of the message, and the recipient of the message.	**Score 0:** There are no uninterrupted communication channels available that include communication channels at the internal level of the activity organization, library and e-library facilities, telecommunication and internet facilities; **Score 1:** There are unobstructed communication channels related to library facilities and e-library; **Score 2:** There are unimpeded communication channels related to library and e-library facilities, as well as telecommunication and internet facilities; **Score 3:**	Organization of activities/ STKK (Engineering Work Procedure System), Library and/or e-library facilities,

No	Aspects	Key Activities/ Attributes	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
			Communication channels have an important role in forming a good communication. Formal channels have a purpose or focus on the interests of the organization and to achieve the goals of the organization, and are usually done quite formally. For example, with the process of written communication through memos, letters, or statements through press conferences where the process has been regulated in certain procedures. Communication in an organization is the process of delivering and exchanging messages that occur and are carried out by parties in an organization. Communication in an organization also shows how the interaction that occurs in the organization, how the parties or members in the organization relate to each other.	There are barrier-free communication channels related to library and e-library facilities, telecommunication and internet facilities, as well as the stage of building barrier-free communication at the level of the activity organization; **Score 4: Score 5:** There are uninterrupted communication channels related to communication at the internal level of the activity organization, library and e-library facilities, telecommunication facilities and the internet.	Telecommunication and internet facilities
			To support the smooth running of innovations, seamless communication channels are very important, especially related to the search for scientific publications and patents, the search for suppliers of materials and equipment, the search for other services needed (production tests, product tests), and the reporting of research results.		
13	**Mf**	Identify the implications (consequences or direct consequences of the findings of a scientific research) of manufacturing bases.	At the Katsinov 1 level, it is mandatory to identify the consequences or direct consequences of the findings of a scientific research. The new product developed must be designed in such a way that the cost of materials, manufacturing costs and storage costs can be kept to a minimum. There are three basic criteria that underlie economical manufacturing, namely: 1). product design; 2). material selection; and, 3). manufacturing process.	**Score 0:** Basic manufacturing implications have not been identified; **Score 1:** the stage of preparation for the implementation of the identification of the implications (consequences or direct consequences of the findings of a scientific research) of the basis of manufacturing; **Score 2:** Initial identification of the implications (consequences or direct consequences of the findings of a scientific research) of the basis of manufacturing has been carried out; **Score 3:** The implications (consequences or direct consequences of the findings of a scientific research) of the basis of technical manufacturing have been identified; **Score 4:** The implications (consequences or direct consequences of the findings of a scientific research) of the basic manufacturing technically, and in the process of resolving the basic implications of manufacturing economically; **Score 5:** The implications (consequences or direct consequences of the findings of a scientific research) of the basis of manufacturing, both technical and economic, have been identified.	Study of manufacturing concept

No	Aspects	Key Activities/ Attributes	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
14	**Mf**	Identified manufacturing concepts.	The intended manufacturing concept includes the definition of the manufacturing process technically and economically. The manufacturing process is technically the process of manufacturing products with the help of machines and controls, even done fully automatically, but still through manual supervision. While the manufacturing process economically is a value-added process from raw materials to finished products through a production process.	**Score 0:** Manufacturing concept has not been identified; **Score 1:** Preparation stage for the implementation of manufacturing concept identification; **Score 2:** Initial identification of the manufacturing concept has been carried out; **Score 3:** The concept of manufacturing has been identified in the sense of a technical manufacturing process; **Score 4:** The concept of manufacturing has been identified in the sense of the technical manufacturing process, and in the process of completing the concept of manufacturing in the sense of the manufacturing process economically; **Score 5:** A manufacturing concept has been identified that includes the definition of the manufacturing process technically and economically	Study of manufacturing concept
15	**Mf**	There is a proof of concept manufacturing through analytics or laboratory experiments	Proof is carried out on the manufacturing concept that has been identified, which includes technical and economic. The concept of manufacturing is technically carried out through testing of product design, material selection, and production processes. Meanwhile, the concept of manufacturing economically is carried out through a simulation of the calculation of added value starting from raw materials to finished products.	**Score 0:** Validation of the manufacturing concept has not been carried out through analytics or laboratory experiments; **Score 1:** In the preparation stage of validation of manufacturing concepts through analytics or laboratory experiments; **Score 2:** Initial validation of the manufacturing concept has been carried out through analytics or laboratory experiments, with an achievement of 40%; **Score 3:** Validation of the manufacturing concept has been carried out through analytics or laboratory experiments with an achievement of 60%; **Score 4:** Validation of the manufacturing concept has been carried out through analytics or laboratory experiments with an achievement of 80%; **Score 5:** The validation of the manufacturing concept has been completed through analytics or laboratory experiments, and proof of the manufacturing concept has been obtained.	Results of Validation and testing of manufacturing concepts
16	**I**	There is a concept of a business model for the idea being developed	Businesses are not able to survive by relying only on product and service innovation. The business model is a new approach to creating a competitive advantage. By innovating a company's business model, it can kill every step of its competitors.	**Score 0:** Does not have a business model concept for the idea being developed; **Score 1:** Preparation and start to develop a business model concept based on the ideas developed; **Score 2:** Developing a business model concept for the developed idea; **Score 3:** The concept of the business model for the developed idea is not complete and clear; **Score 4:** The concept of the business model for the developed idea is quite complete and clear; **Score 5:** The concept of the business model for the developed idea is complete and clear.	Canvas Business Model
17	**I**	There are results of analysis of customers, markets and competitors of the ideas developed	For the purpose of facilitating the commercialization process of the ideas developed, it is important to conduct an analysis of customers, markets, and competitors. This is all done in one market research activity. With market research, it can also be known who needs the products or services offered, where the products or services are needed, and what kind of product quality consumers need. And it can also be known how big the demand is and the potential demand, when the demand peaks and when the demand decreases from consumers.	**Score 0:** No customer, market and competitor analysis of the developed idea; **Score 1:** Starting to compile customer, market and competitor analysis of the developed idea; **Score 2:** There are only competitor analysis results of the developed idea; **Score 3:** There are only customer analysis results of the developed idea; **Score 4:** There are only customer and competitor analysis results of the developed idea; **Score 5:** There are results of customer, market and competitor analysis of the ideas developed.	Documents from market research.

No	Aspects	Key Activities/ Attributes	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
18	I	There is evidence that the ideas developed have provided solutions for customers	If a new product as a manifestation of the new idea developed is accepted by the market, then this indicates that there is a harmony between the new idea and the market demands. Therefore, proof that the developed idea has provided a solution for the customer can be done through experiments, pilot projects, market tests, etc.	**Score 0:** There is no evidence that the ideas developed have provided solutions for customers; **Score 1:** Start experimenting and piloting the ideas developed to provide solutions for customers; **Score 2:** Experiments and pilots have been completed (not yet analyzed based on strengths, weaknesses, opportunities and challenges- SWOT analysis); **Score 3:** There is Weak evidence that the ideas developed have provided solutions for customers; **Score 4:** There is strong enough evidence that the idea developed has provided a solution for the customer **Score 5:** There is very strong evidence that the idea developed has provided a solution for the customer	Results of validation and testing of developed ideas, Results of market tests.
19	P	Develop a strategy to build work networks and partnerships	Partnerships in general will be established if there are parties who feel that there is a weakness in implementation if a development is only the focus of interest of one party. In other words, partnerships are actually the right solution for those who aspire to accelerate development progress. In today's modern era where everything can be controlled with cutting-edge technology, the success of an institution or organization still depends heavily on the success of creating partnerships. The strategy of building work networks and partnerships is an effort to anticipate that the partnership will not encounter impasse or failure due to unprincipled things or misunderstandings can occur.	**Score 0:** There is no strategy to build work networks and partnerships yet; **Score 1:** The preparation stage for the preparation of strategies to build work networks and partnerships; **Score 2:** Identify strengths, weaknesses, opportunities and threats in building work networks and partnerships; **Score 3:** SWOT Analysis; **Score 4:** Analysis of internal and external factors to lower the strategy; **Score 5:** A strategy for building work networks and partnerships has been obtained.	The results of the SWOT analysis build work networks and partnerships
20	P	Potential partners have been identified	The identification of potential partners aims to: 1). Determine the relevance of partners to the development programs carried out; 2). Mapping the roles and contributions of partners; and, 3). Maximizing partner roles and contributions.	**Score 0:** Potential partners have not been identified; **Score 1:** Preparation stage of potential partner identification; **Score 2:** Initial identification related to the relevance of the partner to the development program carried out; **Score 3:** Advanced identification that includes the relevance of the partner to the development program undertaken, as well as a map of the partner's role and contribution; **Score 4:** The identification completion stage which includes the relevance of the partner to the development program carried out, the map of the partner's role and contribution, and efforts to maximize the role and contribution of the partner; **Score 5:** Potential partner identification results are available, which includes the relevance of the partner to the development program carried out, the map of the partner's role and contribution, as well as efforts to maximize the role and contribution of the partner.	List of potential partners, the results of the potential partner identification study

No	Aspects	Key Activities/ Attributes	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
21	**R**	Technology risk assessment has been a consideration in every step of the research.	The risk assessment carried out in each step of the research is very important to mitigate the potential for failure that may occur. Risk assessments are carried out on aspects of organization, human resources, materials, equipment, and funding.	**Score 0:** No technology risk assessment and not considered in any step of the research; **Score 1:** Research materials or technology risk studies are being prepared; **Score 2:** The technology risk study has been completed (not yet considered); **Score 3: Risk** assessment has been a consideration in several research steps; **Score 4:** Risk assessment has been a consideration in almost every step of the research; **Score 5:** Risk assessment has been a consideration in every step of the research	Risk assessment at the research stage (organizational aspects, human resources, materials, equipment, and funding); Research report
22	**R**	Preparation of technology risk control plans at the research stage.	A technology risk control plan at the research stage is very important to be carried out in order to minimize the possibility of failure in aspects of organization, human resources, materials, equipment, and funding	**Score 0:** No technology risk control plan was prepared at the research stage; **Score 1:** Have ideas/ideas of technology risk control at the research stage; **Score 2:** The outline of the technology risk control plan material at the research stage has been prepared; **Score 3:** Start developing a technology risk control plan at the research stage; **Score 4:** The stage of completing the preparation of the technology risk control plan at the research stage; **Score 5:** Develop a technology risk control plan at the research stage	Technology risk control plan at the research stage (organizational aspects, human resources, materials, equipment, and funding).

Indicator KATSINOV 2

No	Aspects	Key Activities	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
1	**T**	Validation of individual components of the technology has been carried out.	Validation and testing of individual components of the technology were carried out both in a laboratory environment (in TKT 4) and in a simulation environment (in TKT 5). The individual components of the resulting technology need to be tested and must meet the required qualifications before being integrated into a prototype.	**Score 0:** No tests have been conducted on individual components of the technology; **Score 1:** Preparation for the implementation of validation and testing of individual components of the technology separately; **Score 2:** Validation and testing of individual components of the technology began separately in a laboratory environment; **Score 3:** Have completed and passed the validation and testing of individual components of the technology separately in a laboratory environment; **Score 4:** Validation and testing began in the simulation environment; **Score 5:** Has completed and passed validation and tests in laboratory and simulation environments.	Results of validation and testing in laboratory and simulation environments.
2	**T**	Prototypes have been demonstrated in relevant environments	At this level, a prototype (alpha) has been obtained that is ready for scale-up, where the actual operating environment conditions are known, investment needs for equipment and manufacturing processes are identified, modeling & simulation for the performance of technological systems in the operating environment has shown success, and based on the results of engineering feasibility tests. Based on the level of technological readiness, it has reached TKT 6.	**Score 0:** No prototype a (alpha) demonstration has been carried out in the relevant environment; **Score 1:** preparation to carry out the stages of prototype a (alpha); **Score 2:** Prototype a (alpha) has been obtained and the actual operating environment conditions are known; **Score 3:** A (alpha) prototype has been obtained, the actual operating environment conditions are known, as well as the success of modeling & simulation for the performance of the technology system in the operating environment; **Score 4:** Prototype a (alpha) has been obtained, the actual operating environment conditions are known, the need for investment in equipment and manufacturing processes, the success of modeling & simulation for the performance of technological systems in the operating environment; **Score 5:** Prototype a (alpha) has been obtained, the actual operating environment conditions are known, the need for investment in equipment and manufacturing processes, the success of modeling & simulation for the performance of technological systems in the operating environment, and based on the results of the engineering feasibility test.	Output in the form of prototype a(alpha), modeling & simulation results, test results

3	**T**	Technology declared technically feasible	Technical feasibility is related to the technology that will later be applied to the system to be developed, or has been produced by Purnarupa (prototype) a (alpha). This prototype a (alpha) will be ready to be tested in internal tests, pre-clinical trials for the health sector, laboratory scale tests, or organoleptic tests in the food sector. Technically, the system is considered feasible with the following conditions: 1) The proposed system is quite practical because the available technology is enough to be applied; 2) The necessary technology is available in the market and meets the required capacity; and, 3) The technical experts needed to operate the technology appropriately are already owned by the user. The prototype a (alpha) that has been produced is based on the results of the engineering feasibility test, which is ready to be scaled up or made into prototype b (beta). This technically feasible technology means that it has been able to pass through the valley of death, where technically this technology is ready for the test stage in the real environment.	**Score 0:** The technology is not yet technically feasible; **Score 1:** Preparation stage for prototype a (alpha); **Score 2:** Purnarupa (prototype) a (alpha) obtained; **Score 3:** Purnarupa (prototype) a (alpha) was obtained, and the initial test was carried out; **Score 4:** Purnarupa (prototype) a (alpha) was obtained, and test iterations were carried out; **Score 5:** The technology is declared technically feasible (engineering feasibility) through testing.	Output in the form of prototype a(alpha), modeling & simulation results, prototype test results a(alpha)
4	**T**	Intellectual property has been registered (e.g. patents, industrial designs, copyrights, brands, etc.).	At this level, inventors are expected to register intellectual property, such as patents, industrial designs, copyrights, brands, etc., against the uniqueness (USP/unique selling point) or novelty of the technology developed. This intellectual property registration aims to protect the rights inherent in the resulting invention, especially against the economic potential that may be obtained. An application for IPR registration can be made by choosing one of the following ways: 1). Directly to the Directorate General of Intellectual Property Rights; 2). Through the Regional Offices of the Ministry of Law and Human Rights of the Republic of Indonesia throughout Indonesia; 3). Through a registered IPR Consultant Legal Representative.	**Score 0:** Intellectual property registration has not been carried out; **Score 1:** The stage of studying the requirements for intellectual property registration; **Score 2:** Stage of preparing intellectual property registration requirements; **Score 3:** Stage of completing the intellectual property registration requirements; **Score 4:** Intellectual property registration stage; **Score 5:** Have been registered and have received proof of payment of the application fee.	Proof of payment of application fee

5	**T**	Technically able to provide solutions to problems faced by the community.	Technical feasibility is related to technology that will later be applied to the system to be developed. Technically, the system is considered feasible with the following requirements: 1) The proposed system is quite practical because the available technology is enough to be applied; 2) The necessary technology is available in the market and meets the required capacity; 3) The technical experts/operators needed to operate the technology appropriately are owned by the user; and, 4). The demands of product specifications that are based on the need for solutions to problems faced by the community have been successfully achieved or met.	**Score 0:** Technically it has not provided solutions to the problems faced by the community; **Score 1:** The stage of identifying the need for solutions to the problems faced by the community; **Score 2:** The proposed system is quite practical because the available technology is enough to be applied; **Score 3:** Technically, the system is considered feasible with the following requirements: 1) The proposed system is quite practical because the available technology is enough to be applied; 2) The necessary technology is available in the market and meets the required capacity; **Score 4:** Technically, the system is considered feasible with the following requirements: 1) The proposed system is quite practical because the available technology is enough to be applied; 2) The necessary technology is available in the market and meets the required capacity; 3) The technical experts/operators needed to operate the technology appropriately are owned by the user; **Score 5:** Technically, the system is considered feasible with the following requirements: 1) The proposed system is quite practical because the available technology is enough to be applied; 2) The necessary technology is available in the market and meets the required capacity; 3) The technical experts/operators needed to operate the technology appropriately are owned by the user; and, 4). The demands of product specifications that are based on the need for solutions to problems faced by the community have been successfully achieved or met.	Hashil Uji Purnarupa (Prototype) A (Alfa)
6	**M**	Identified end customers	End-customer identification aims to make a sale to the right buyer. Therefore, customer identification activities must be able to obtain data about customers that can be used as a basis for determining sales levels, usage periods, customer distribution areas and others. This is to ensure that the product is focused on customer needs, identify latent or hidden needs, as a basis for setting product specifications, ensure that no critical customer needs are missed or forgotten, and build a common understanding of customer needs among the development team.	**Score 0:** No identification of the end customer to be targeted; **Score 1:** The end customer identification process has begun; **Score 2: The** initial process of identification of the final customer has been carried out; **Score 3: The** end customer identification process has been completed; **Score 4:** The end customer's profile has been analyzed; **Score 5: The** details of the potential end customer's profile are fully delineated.	The document of the results of market research, There is evidence that product specifications are raised based on the profile of the end customer identified.
7	**M**	Detailed market launch plan has been issued	The plan to launch a new product to the market is part of a business plan that must be prepared in an effort to commercialize an invention. The product launch strategy is carried out by applying segmentation, targeting, and positioning (STP) to move new business in the right direction, in addition to applying the 4Ps—product, price, place, and promotion by ensuring that the four P's are aligned with each other and with the STP strategy.	**Score 0:** Do not have a business plan; **Score 1:** Have an idea/idea of a product launch plan to market; **Score 2:** The outline of the product launch strategy plan to the market has been prepared; **Score 3:** A product go-to-market strategy document is being prepared; **Score 4:** Analysis and finalization stage of preparation of product launch strategy documents to the market; **Score 5:** The complete product launch strategy document (business plan) including STP and 4P has been completed	Business Plan (Rencana Usaha)

8	**M**	Intellectual capital has begun to be prepared	The important role of Intellectual Capital (IC) as a strategic intangible asset for companies has been proven. The role of ICs has been proven to affect business performance, increase company value, increase organizational effectiveness, competitive advantage, and also create prosperity for the company. The components of Intellectual Capital (IC) include: Human Capital, Structural Capital, and Customer Capital. **Description:** **1). Human capital** refers to factors such as skills, competencies, experience, education, motivation, and the like. It is an IC foundation that is not owned by the organization, but is controlled by individuals who work for the organization; **2). Structural capital** consists of internal processes, infrastructure, information systems, cultures, routines, and procedures that enable the function of human capital to be productive. It is wholly owned and controlled by the organization; **3). Relationship Capital/ Customers** refers to the knowledge embedded in relationships with customers, strategic partners, suppliers, distributors, investors, public bodies and other stakeholders that affect the life of the organization. It is not owned or controlled by the organization.	**Score 0:** No information related to intellectual capital; **Score 1:** There is an idea/idea to prepare intellectual capital; **Score 2:** The preparation of intellectual capital details has begun; **Score 3:** The finalization stage of the preparation of intellectual capital details; **Score 4:** The details of the intellectual capital have been prepared and described incompletely; **Score 5:** Details of intellectual capital have been prepared and fully outlined	Infrastructure data, HR qualifications, partner list
9	**O**	Has been issued an analysis and business plan	Business analysis is a set of tasks and techniques used to work as a liaison between stakeholders to understand the structure, policies, and operations of an organization, and recommend solutions that enable the organization to achieve its goals. A business plan is a formal statement of the purpose of a business, as well as the reasons why the founder believes that the goal can be achieved, as well as what strategies or plans will be implemented to achieve those goals. A business plan is very important as a tool to be a guide and tool to find investor support for those of you who are going to start a business, or who are developing a business.	**Score 0:** No analysis and business plan have been prepared; **Score 1:** Preparation for the preparation of a business plan; **Score 2:** Start the initial preparation of the business plan; **Score 3:** Business analysis completion stage; **Score 4:** Has completed the business analysis, and the business plan completion stage; **Score 5:** An analysis and business plan have been issued.	Business Plan (Rencana Usaha)

10	**O**	There is the involvement of key individuals	Key Individuals are individuals whose knowledge, creativity, inspiration, reputation, and/or skills are essential to the survival or growth of an organization. Many businesses have key people who are responsible for strategic positions for the company, or have unique and hard-to-replace skills such as intangible assets that are critical to the organization.	**Score 0:** Does not possess and involves key individuals; **Score 1:** Have several key individuals who have unique skills, but are not actively involved; **Score 2:** Having several key individuals who have unique skills, but are less given responsibility in strategic positions; **Score 3:** Have several key individuals who have unique skills, and are given responsibilities in strategic positions; **Score 4:** Having key individuals who have unique skills that are difficult to replace in a very adequate amount, but have not been optimally given responsibility in strategic positions; **Score 5:** Have key individuals who have unique skills that are difficult to replace in very adequate numbers, and are given responsibilities in strategic positions.	List of teams and qualifications of personnel in Teams.
11	**O**	Approval of project requirements and list of project partners has been carried out	Projects in business and science are usually defined as a collaborative effort and also often involve research or design, which is planned to achieve a specific goal. A project can also be defined as a temporary, temporary, and non-permanent venture, which has a specific goal with a firm implementation time. The main challenge of a project is to achieve the goals and objectives of the project by being aware of the limitations that have been understood beforehand. In general, these limits are the scope of work, the time of work, the budget of work, and safety factors. Approval of project requirements and a list of partners are prerequisites in starting an activity.	**Score 0:** There are no project requirements and a list of project partners yet; **Score 1:** in the process of identifying project requirements and a list of project partners; **Score 2:** there are already project requirements, but there are no partners yet, or vice versa; **Score 3:** There are already project requirements and a list of project partners, but they have not been approved; **Score 4:** There are already project requirements and a list of project partners, and in the approval process; **Score 5:** There are already project requirements and a list of approved project partners.	Program/project proposals that have been approved by the head of the institution/agency
12	**O**	Responsibility agreement and deadline agreement have been made	In the management of a project, it is necessary to identify and group types of work, according to the delegation of authority and responsibilities of personnel and lay the foundation for the relationship between each element of the organization. An organizational structure that is in accordance with the needs of the project and a clear framework for the elaboration of the duties of the personnel in charge, as well as the capabilities of personnel according to their expertise, will obtain positive results for the organization. Project time limits must be set. Time problems can cause cost losses if it is later than planned and will be profitable if it can be accelerated.	**Score 0:** No project responsibilities and deadlines have been approved yet; **Score 1:** in the process of identifying burdens and responsibilities in the implementation of the project, and the process of preparing the schedule; **Score 2:** there is already a project responsibility, but there is no project deadline yet, or vice versa; **Score 3:** there is already responsibility and approval of the project deadline, but it has not been approved; **Score 4:** There is already a person in charge and the project deadline, and in the approval process; **Score 5:** Responsible person has been provided and the project deadline has been approved.	Program/project proposals that have been approved by the head of the institution/agency
13	**Mf**	Identification of critical technologies and components is complete	At the level of manufacturing readiness, this level is a phase of technology development. In this phase, the identification of critical/possible technologies and components has been completed. The majority of manufacturing processes have been defined and characterized, but there have been significant changes to engineering/design. The initial design of the critical components has been completed. The productivity study of key technologies has been completed.	**Score 0:** Technologies and critical components have not been identified; **Score 1:** Preparation for identification of critical technologies and components; **Score 2:** Initial identification of critical technologies and components began with an achievement of 40%; **Score 3:** Identify technologies and critical components in the solution with an achievement of 60%; **Score 4:** Identify technologies and critical components in the solution with an 80% achievement; **Score 5:** Has been fully identified (100% achievement) technology and critical components.	List and specifications of production tools.

14	**Mf**	Materials, tooling and prototype test equipment, as well as personnel expertise have been shown the readiness of the sub-system/system in a relevant production environment.	Materials, tooling and prototype test equipment, as well as personnel expertise have been demonstrated in a relevant production environment. The cost breakdown analysis includes the trade design. Target costs are allocated. Productivity considerations form a system development plan. Long-term directives and key supply chain elements have been identified.	**Score 0:** The readiness of the sub-system/system in a relevant production environment cannot be shown; **Score 1:** The initial preparation stage to build the readiness of the sub-system/system in a relevant production environment; **Score 2:** Has demonstrated the readiness of the sub-system/system in a relevant production environment that includes material readiness; **Score 3:** Has demonstrated the readiness of the sub-system/system in a relevant production environment that includes the readiness of materials and tools; **Score 4:** Has shown the readiness of the sub-system/system in a relevant production environment which includes the readiness of materials, tooling and prototype test equipment; **Score 5:** The readiness of the sub-system/system in a relevant production environment has been demonstrated which includes the readiness of materials, tools, prototype test equipment, and personnel expertise.	Initial production plan or LRIP (Low Rate Initial Production)
15	**I**	There is a market *value proposition* (MVP) advantage and has been tested to customers	Market Value Proposition (MVP) is a statement of why consumers buy, choose, and use the products or services offered. This statement assures potential consumers that the product or service offered has a better value/solution than other similar products/services.	**Score 0:** Not yet identified the value proposition; **Score 1:** Has an advantage in selling value but has not conducted a market survey; **Score 2:** The advantage of the selling value (value proposition) is being tested through market surveys; **Score 3:** Has an advantage in selling value compared to competitors for a limited market; **Score 4:** The value proposition is being verified and validated through applied tests for a wider market; **Score 5:** Has an advantage over competitors and is tested in a wider market survey	Canvas Model Business; Market test reports.
16	**I**	The solutions offered to customers give rise to a lucrative attraction in the market.	In running a business, it is certainly not enough just to have an idea that has been in accordance with customer needs. When a good idea is not able to win the market competition, of course this will not make the business grow. Therefore, in addition to being in accordance with customer needs, ideas that have been developed into prototypes must be tested to have more value than competitors through market tests, calculations of business profit projections, etc.	**Score 0:** No evidence; **Score 1:** Ideas developed into prototypes according to customer needs; **Score 2:** The prototype developed has more value than competitors; **Score 3:** the prototype developed is carried out by market tests; **Score 4:** Profit projection is carried out on the prototype developed; **Score 5:** Obtained projected profits from the developed prototype	Market research (market and competitor analysis); Market test reports.

17	**I**	There is evidence that validation has been carried out on value propositions, channels, customer segments, existing customer relationship models, and revenue streams	**A Value Proposition (MVP)** is a business or marketing statement convincing potential consumers that one particular product or service being developed will add more value or better solve a problem than other similar offerings. **Channel** is a means developed by an organization to reach customers so that it can be a medium for conveying ideas to services provided by the organization. **Customer segment** is the determination of a segment that will be the marketing target for the product being developed. **The existing customer relationship model** is the concept of an organization's relationship with customers that is developed and so that customers are tied to the product being developed. **Revenue flow** is the identification of sources and streams of income in a business from customers to the organization. By being identified, it can be seen the effectiveness of customer segmentation, channels, relationship models with customers and whether the set value proportionality is appropriate.	**Score 0:** No evidence; **Score 1:** MPV and customer segment have been determined; **Score 2:** The channel and relationship model with existing customers has been established; **Score 3:** Revenue stream analysis has been generated; **Score 4:** Validation has been carried out between MPV, customer segments, channels, relationships with existing customers and revenue streams; **Score 5:** The existing evidence is interrelated in determining the revenue alittan	Business plan; Market research; Market test report
18	**P**	Information mining and partner selection have been carried out	The purpose of information mining and partner selection is (1) to find out information on partnerships that will be carried out according to the needs of partner companies/institutions/organizations. (2) conducting selection or selection of potential organizational institutions as partners. Conceptually, a partnership is defined as a long-term commitment between two or more organizations with the intention of achieving certain business goals by maximizing the effectiveness of the resources of each participant. This partnership requires mutual understanding because it requires a change in traditional relationships to a culture of mutual sharing regardless of organizational boundaries. The advantage of a partnership lies in trust.	**Score 0:** Information mining and partner selection have not been carried out; **Score 1:** Partner information is excavated; **Score 2:** Obtained a partner database, and the preparation of criteria for partner selection; **Score 3:** Obtained a partner database and criteria for partner selection; **Score 4:** **A** partner database and partner selection criteria were obtained, and partner selection began to be carried out; **Score 5:** Information mining and partner selection have been carried out, and a partner database, partner selection criteria and potential partner selection results have been obtained.	Selected partnership information documents; Documents of potential organizational institutions.
19	**P**	Build more precise partnership patterns	Building partnership relationships in business development aims to achieve common business goals by producing several partnership patterns such as parenting patterns, plasma core patterns, sub-contract patterns, futuristic patterns, parallel patterns, partnership patterns as needed. Conditions for forming a partnership: a. The existence of two or more parties; b. Have a common vision in achieving goals; c. There is an agreement; d. Needing each other.	**Score 0:** The right partnership pattern has not been established; **Score 1:** Examining the concept of partnership patterns; **Score 2:** A more appropriate partnership pattern concept has been obtained; **Score 3:** Validate the concept of a more appropriate partnership pattern; **Score 4:** Efforts to develop a partnership pattern based on the concept that was prepared; **Score 5:** A more appropriate partnership pattern has been built in business development to achieve common business goals.	Memorandum of Understanding or MoU

20	**R**	Technology risk studies have been conducted in every step of technology development	At the stage of technology development, it still contains high technological risks, therefore risk assessments are important. The technology risk assessment carried out is in line with technology development activities. After TKT 4, the cost needs increased in order to obtain an industrial prototype. After TRL 5, the complexity of technology development increased, as not only technology problems were faced, but also other problems such as manufacturing, marketing and strategy, investment and organization. After TKT 6, the risk increased because not only the technology risks were faced, but also business risks, product risks, process risks, and project risks.	**Score 0:** There is no technology risk study and is not considered in every stage of technology development; **Score 1:** Research materials or technology risk studies are being prepared in each stage of technology development; **Score 2:** The technology risk assessment at each stage of technology development has been completed (not yet considered); **Score 3:** Risk assessment has been a consideration in several stages of technology development; **Score 4:** Risk assessment has been a consideration in almost every stage of technology development; **Score 5:** Risk assessment has been a consideration in every stage of technology development	Risk assessment at the stage of technology development; Technology development report
21	**R**	Preparation of technology risk control plans at the technology development stage.	A technology risk control plan at the technology development stage is very important to be carried out in order to minimize the possibility of failure in technology development and commercialization.	**Score 0:** No technology risk control plan was prepared at the technology development stage; **Score 1:** Have ideas/ideas of technology risk control at the stage of technology development; **Score 2:** The outline of the technology risk control plan at the stage of technology development has been prepared; **Score 3:** Start developing a technology risk control plan at the technology development stage; **Score 4:** The stage of completing the preparation of the technology risk control plan at the stage of technology development; **Score 5:** Prepare a technology risk control plan at the stage of technology development	Technology risk control plan at the technology development stage.

Indicator KATSINOV 3

No	Aspects	Key Activities	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
1	**T**	The actual system of technology has been demonstrated in the actual environment	The prototype is close to or in line with its operational system plan. This situation reflects the development step of TKT 6, requiring a demonstration of a real system prototype in an operational environment. Prototypes at this level are b (beta) prototypes that have been tested in a real environment.	**Score 0:** Prototype b (beta) prototype has not been obtained; **Score 1:** In the process of completing prototype prototype b (beta); **Score 2:** Prototyping of prototype b (beta) has been completed; **Score 3:** A prototype prototype b (beta) has been obtained, and testing has begun in an actual environment; **Score 4:** Prototype b (beta) has gone through the testing stage in a real environment; **Score 5:** Prototype b (beta) has successfully passed testing in a real environment.	Test results of prototype b (beta)
2	**T**	External testing of the developed technology has been carried out in full in order to meet technical requirements and regulatory compliance	To meet the demands of technology application in certain fields, the technology developed must go through external tests in order to meet technical requirements and regulatory compliance. For example: for pharmaceutical products, this stage is a Phase 3 clinical trial to obtain a product registration number; For medical devices, this stage is a phase 3 clinical trial of an industrial-scale prototype to ensure a wider level of effectiveness for Certification and Standardization, as well as the necessary licensing applications.	**Score 0:** External tests have not been carried out in order to meet technical requirements and regulatory compliance; **Score 1:** Preparation for external tests in order to meet technical requirements and regulatory compliance; **Score 2:** External tests have been carried out in order to meet technical requirements and regulatory compliance; **Score 3:** The implementation of external tests in order to meet technical requirements and regulatory compliance has been completed 60%; **Score 4:** The implementation of external tests in order to meet technical requirements and regulatory compliance has been completed 80%; **Score 5:** Have obtained a certificate of external test results, and obtained a marketing license for the developed technology product.	External test results; Test Certificate
3	**T**	Documentation of the technology developed has been carried out	In the engineering system, the management of activity recording, documentation of work instructions, and periodic technical reports is emphasized. The management of documentation of the developed technology will be useful in the process of technology transfer, further development of technology, and if there is a claim from another party, it can be used as authentic evidence.	**Score 0:** No documentation of the technology developed; **Score 1:** The initial stage of managing activity recording, documentation of work instructions, and periodic technical reports; **Score 2:** The process towards managing the recording of activities, documentation of work instructions, and periodic technical reports in a systematic manner; **Score 3:** The management of activity recording, documentation of work instructions, and periodic technical reports has been carried out systematically, but has not been documented; **Score 4:** Systematic management has been carried out on the recording of activities, documentation of work instructions, and periodic technical reports, but the documentation is not organized and structured; **Score 5:** Systematic management of activity recording, documentation of work instructions, and periodic technical reports, as well as documentation with orderly and structured document coding.	Documentation system for recording activities, documentation of work instructions, and periodic technical reports.

No	Aspects	Key Activities	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
4	**T**	The launch of the developed technology has been carried out, or the launch of innovation results	The commercialization stage involves planning and implementing a launching strategy for new products to the market. In throwing a product, companies must decide: when, where, to whom, and how. In essence, the launch of a new product to the market is a stage of introducing the product to the targeted potential customers.	**Score 0:** The technology has not been launched, or the innovation results have not been launched; **Score 1:** Has planned to launch the developed technology or launch the results of innovation; **Score 2:** It has been decided when, where, to whom, and how to implement the launch of the developed technology or the launch of the innovation results; **Score 3:** In preparation for the implementation of the launch of the developed technology or the launch of innovation results; **Score 4:** Has been launched the technology developed or the launch of the results of innovation. **Score 5:** Has launched the developed technology or launched the results of innovation, and shows success in terms of acceptance of new products by the market.	Report on the implementation of the launch event of the innovation results.
5	**T**	Intellectual property has been acquired (e.g. patents, industrial designs, copyrights, brands, etc.).	The benefits of Intellectual Property include: 1). Company Assets, 2). Business Development Support, 3). Prevention of Unfair Business Competition and Competitiveness Enhancement, 4). Innovation/Creativity Booster, 5). Image Shaping. Objects in the field of intellectual property: a). Copyright: art, literature & science; b). Patents: technological inventions; c). Brand: trade symbol of goods and services; d). Industrial Design: product appearance; e). Integrated Circuit Layout Design: IC (Integrated Circuit) circuit layout design; f). Trade Secrets: confidential information of economic value; g). Geographical Indication: protected as a sign that indicates the area of origin of an item.	**Score 0:** Intellectual property has not been obtained (e.g. patents, industrial designs, copyrights, brands, etc.); **Score 1:** The stage of studying intellectual property registration requirements (e.g., patents, industrial designs, copyrights, trademarks, etc.); **Score 2:** The stage of preparing intellectual property registration requirements (e.g., patents, industrial designs, copyrights, trademarks, etc.); **Score 3:** Have registered intellectual property (e.g., patents, industrial designs, copyrights, brands, etc.), and have received a submission letter from the Director General of Intellectual Property Rights; **Score 4:** Still waiting for the issuance of an intellectual property certificate (e.g. patents, industrial designs, copyrights, brands, etc.); **Score 5:** Has acquired intellectual property (e.g. patents, industrial designs, copyrights, brands, etc.).	Intellectual property certificate
6	**M**	Special needs and customer needs (as meeting the needs of the community as a solution to the problem) are known	To understand the needs, wants and expectations of customers in a real way, we should: a). involve customers in developing new services; b). Organizing and implementing services in focus groups; c). Actively view customer feedback; d). Asking customers about the services that are important to them; e). analyzing market trends; f). analyze competitors; and, g). pay attention to staff feedback.	**Score 0:** No identification and analysis of customer needs and expectations; **Score 1:** Initiating the identification and analysis of customer needs and expectations; **Score 2:** An outline of the identification material and analysis of customer needs and expectations has been prepared; **Score 3:** Identification and analysis of customer needs and expectations is being carried out; **Score 4:** Identification and analysis of customer needs and expectations has been completed; **Score 5:** Results Customer needs identification and analysis have been validated	Market research
7	**M**	Segments, size and market share have been predicted	**Market segments** are groups of people or groups of organizations that have similar characteristics so that they also have the same needs for products and services. **Market size** is the total number of people who give up something, usually in the form of money in exchange for the goods or services they want. **Market share** is the part of the Market Size that we target to sell our goods or services to earn money.	**Score 0:** Unpredicted segment, size, and market share; **Score 1:** Preparation of surveys and studies for segment, size, and market share predictions; **Score 2:** The outline of the survey material and baseline data has been prepared; **Score 3:** The stage of completing surveys and studies to predict segments, sizes, and market shares; **Score 4:** Survey and study of segments, size and market share have been completed; **Score 5:** the results of the segment, size, and market share prediction study have been validated.	Market and marketing plan

No	Aspects	Key Activities	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
8	**M**	Pricing and product launch have been released	Price has an important role as a tool for success in marketing strategies. Pricing also plays an important role in product positioning strategies. Price is a sign for buyers, a competitive instrument, and a way to improve financial performance. When we do pricing, it means that we have created a series of marketing strategies. The launch of new products/services is important for the purpose of attracting customer attention. A successful launch of a new product/service will not only make the new product/service stand out in the market, but also increase sales, repeat demand, and profits.	**Score 0:** no description of the estimated price yet; **Score 1:** The estimated price has been outlined but there is no product launch plan yet; **Score 2:** The estimated price has been outlined and there is a general product launch plan; **Score 3:** The estimated price has been outlined and there is a detailed product launch plan; **Score 4: The** price estimate has been submitted according to the type of product but is incomplete; **Score 5:** The estimated price has been presented according to the type of product in full	Calculation of the selling price for each product/service launched.
9	**O**	Formalize the organization (business structure with staff and collaborators)	Formality is the standardization or standardization of duties and positions in an organization. The higher the degree of formalization, the more orderly the behavior of subordinates in an organization. In order for a business to run successfully, it needs to be organized. In organizing a business, of course, you must pay attention to the existing business elements. To manage a business organization requires management or management as well as a responsible person called a manager. Management is the process of planning, organizing, leading and controlling the work of the members of the organization and using all the resources of the organization to achieve the goals of the organization that have been set.	**Score 0:** There is no demand for organizational formalities; **Score 1:** **Score 2:** Due to business demands, organizational formalities began to be sought; **Score 3:** Organizational formality efforts have been made, although still not de jure and de facto; **Score 4:** Organizational formality efforts have been carried out de facto, but not de jure, or vice versa; **Score 5:** De jure and de facto organizational formalities have been carried out to meet business demands.	Organizational structure, organizational work procedures.
10	**O**	Identify some additional staff needed	To run an organization, adequate human resources are needed, both in terms of number and qualifications. Therefore, there must be manpower planning. Manpower planning is a process of identifying, evaluating, and planning the fulfillment of human resource needs who will occupy certain positions in the company in accordance with predetermined needs standards.	**Score 0:** There is no thought related to the identification, evaluation and planning of human resources to determine the need for additional staff; **Score 1:** The need for additional staff is carried out without identification, evaluation and planning of human resources; **Score 2:** In determining additional needs, staff begin to consider the identification, evaluation and planning of human resources; **Score 3:** The need for additional staff has been carried out based on the results of identification, evaluation and planning of human resources, even though it has not been structured and systematic; **Score 4:** The need for additional staff has been structured based on the results of identification, evaluation and HR planning; **Score 5:** The need for additional staff has been structured and systematic through the process of identification, evaluation and planning of human resources.	HR needs plan.

No	Aspects	Key Activities	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
11	**O**	Distribution of responsibilities and workloads	In order to succeed in a project or work, a description of the distribution of responsibilities and workload within the organization is needed. The Workload Description aims to determine the number of employees needed to complete a job and how much responsibility or workload can be delegated to an employee.	**Score 0:** No distribution of responsibilities and workloads; **Score 1:** Identification stage of responsibility and workload distribution; **Score 2: Score 3:** Start implementing the distribution of responsibilities and workloads; **Score 4:** The distribution of responsibilities and workloads has been implemented, although it has not been structured and systematized; **Score 5:** The distribution of responsibilities and workloads has been carried out in a structured and systematic manner by adjusting business demands.	Describe the distribution of responsibilities and workloads within the organization.
12	**Mf**	The design of the system is mostly stable and proven in tests and evaluations.	At this level the system design has been finalized and is quite stable entering low-rate production through testing and evaluation. System design is the depiction and sketching or arrangement of several things that are still separate into a whole and functional whole. The system test and evaluation is a continuation of the system design stage which aims to assess whether the designed system is in accordance with the initial design, how well the system functions, see the advantages and disadvantages of the system, and the stability of the system's function.	**Score 0:** The system design has not been obtained; **Score 1: Score 2:** System design has been obtained; **Score 3:** The system design began to be tested and evaluated; **Score 4:** Iteration of test and evaluation of system design to obtain system design stability; **Score 5:** A system design that is mostly stable has been obtained through testing and evaluation.	Manufacturing system design; the results of the test and evaluation of the design of the manufacturing system.

No	Aspects	Key Activities	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
13	**Mf**	Manufacturing processes and procedures are proven on a pilot scale.	The scale up stage from the scale of research in the laboratory to the industrial or commercial scale. Scaling up or enlarging production capacity to an industrial or commercial scale turns out to be in many ways not a simple thing. This is because a number of equipment used in the industrial world is not the same as the scale of a laboratory. Visually, the tools used in the industry will be very different from the laboratory scale. Laboratory scale with a qualitative orientation while industrial or commercial scale is quantitative or economical orientation. To get a better idea of its commercial condition, it is recommended to make a pilot or prototype as a model that will later be easier to scale up. The existence of the pilot scale stage or model is intended to minimize risks before scaling up further. The scale of the pilot as such a model must be sufficiently representative for its large-scale process. Process variables need to be carefully identified and the most important thing is the essence of the process and its operating conditions. The selection of the tool and its specifications are the next step in this phase. Controlling process conditions on a larger scale will be more difficult without the support of adequate equipment and instrumentation. Trial and error to find the optimal conditions of the process is both challenging and fun to solve. Adequate references and a supportive experience will make the scaling up process easier and more enjoyable.	**Score 0:** Still in the development stage of manufacturing processes and procedures on a laboratory scale; **Score 1:** In the process of testing and validating manufacturing processes and procedures on a laboratory scale; **Score 2:** Activity stage of manufacturing process and procedure development on a pilot scale; **Score 3:** Manufacturing processes and procedures have been obtained on a pilot scale, and testing and validation of manufacturing processes and procedures on a pilot scale have begun; **Score 4:** In the process of test iteration and validation of manufacturing processes and procedures on a pilot scale; **Score 5:** Manufacturing processes and procedures have been proven in pilot-scale tests and validation.	Document the results of the test and evaluation of processes and procedures on a pilot scale.
14	**Mf**	Carried out production at a low rate	Low Rate Initial Production (LRIP) is a term commonly used to define the initial and small production stages. In this LRIP phase as a test stage for preparation for full-scale production, where weaknesses or immaturity in the design of systems or production methods can be known.	**Score 0:** Detailed system or production method design has not been made; **Score 1:** Detailed production system or method design is being carried out through engineering and manufacturing development activities; **Score 2:** Detailed system or production method design has been obtained; **Score 3:** The test stage is being carried out on the results of designing a detailed system or production method; **Score 4:** The test iteration stage against the results of the detailed system design or production method, and has shown to be stable; **Score 5:** Low Rate Initial Production (LRIP) has been implemented.	Logbook of Low Rate Initial Production (LRIP)

No	Aspects	Key Activities	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
15	**I**	Successfully define the final condition of the technology product by considering the entire target person, vertical market, and/or geography	The product development carried out has been completely in accordance with the needs of the established market segment by considering the customer profile, including suitability to the needs of individual customers, the specific industry that is the customer, and the tendency of preferences or trends in a particular region or geography. What is meant by a vertical market is a market for products designed for a specific industry. Meanwhile, the market based on geography can be local, regional, national, and international markets.	**Score 0:** No evidence; **Score 1:** business chain analysis has been carried out; **Score 2:** has identified target person, vertical market and preferences or trends in the geographical area; **Score 3:** market analysis has been carried out on 2 out of 3 customer categories (target person, vertical market and preferences or trends in the geographical area); **Score 4:** market analysis has been carried out on all customer categories; **Score 5:** products developed according to the preferences of all customer categories	Product specifications; Marketing plan.
16	**I**	Validation is carried out on the business carried out.	Validation of the business we are doing is very important to ensure that our business is profitable. The business validation methods that we are doing include: 1). Analyze whether the business carried out can generate profits; 2). learning directly with experts or with the community in the business field they are engaged in; 3). adjusting the interests and resources needed in a particular business; 4). Analyze whether we and our business can grow.	**Score 0:** No evidence; **Score 1:** there is already a canvas business concept; **Score 2: the** concept of the canvas business model has been comprehensive; **Score 3:** has identified aspects of the financial feasibility analysis; **Score 4:** Financial feasibility analysis has been carried out; **Score 5:** the business developed has met the financial performance analysis	Business feasibility analysis (market potential, technical feasibility, and financial feasibility)
17	**I**	Identify and validate key performance indicators that indicate business success.	In business institutions, performance measurement (performance review) is the main part of the management process. To see the measure of performance, a key performance indicator is needed, which is a metric used to help an organization determine and measure progress towards organizational goals. To get the right key performance indicators, it is necessary to identify and validate several indicators that reflect business success.	**Score 0:** There is no evidence of a feasibility study of the establishment of KPIs on the feasibility and success of the business; **Score 1:** There is weak evidence; **Score 2:** Evidence weaknesses are being refined; **Score 3:** Evidence refinement has been completed; **Score 4:** Evidence of the determination of KPIs on the feasibility and success of the business has been analyzed; **Score 5:** The determination of KPIs on the feasibility and success of the business has been validated	Business plan
18	**P**	Formal partnerships are carried out	Formal partnership means that the partnership pattern has been agreed upon in the form of an agreement. So legally formally the partnership has provided a bond for the two parties who are partners.	**Score 0:** In exploring partnerships; **Score 1:** Partnerships that are not formal and binding in nature begin to be established; **Score 2:** The stage of looking for a formal and binding partnership pattern; **Score 3:** Agreed to enter into an agreement that is binding on the two partners; **Score 4:** Preparation of agreement documents that are binding on the two partners; **Score 5:** The partnership pattern has been agreed in the form of an agreement, so that legally the partnership has provided a bond for the two partners.	Memorandum of Understanding or MoU document, Partnership Cooperation Agreement (PKS) document, or work contract

No	Aspects	Key Activities	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
19	**P**	Develop and implement cooperation plans.	Formal partnerships must be complemented by a partnership cooperation plan. To develop a cooperation plan, it can start from determining targets; choosing the right team leader; determine tasks; budget and time; arrange logically.	**Score 0:** No partnership cooperation plan has been made; **Score 1:** The exploration stage of the cooperation plan to be prepared; **Score 2:** Start to prepare a cooperation plan Score **3:** Completion of the cooperation plan document; **Score 4:** Cooperation plan documents have been obtained; **Score 5:** There are documents and implementation of the cooperation plan.	Memorandum of Understanding or MoU document, Partnership Cooperation Agreement (PKS) document, or work contract
20	**R**	Technology risk assessment is the basis for technical decision-making at the engineering & operation stage	The risk assessment carried out in each innovation step is very important to mitigate potential failures that may occur. Risk assessments are conducted on potential failures in the application of technology or implementation in projects, products, processes, and businesses.	**Score 0:** Risk control plan is not prepared at the engineering and operation stages; **Score 1:** Risk control plans are initiated and prepared at the engineering and operation stages; **Score 2:** An outline of the risk control plan has been prepared at the engineering and operation stages; **Score 3:** A technology risk control plan is being prepared at the engineering and operation stages; **Score 4:** Completed the preparation of a technology risk control plan at the engineering and operation stages; **Score 5:** The technology risk control plan at the engineering and operation stages has been validated	Technology risk study report
21	**R**	Preparation of technology risk control plans at the engineering & Operation stage.	A technology risk control plan at the technology application stage is very important to be carried out in order to minimize the possibility of project, product, process, and business failure.	**Score 0:** No technology risk control plan was prepared at the stage of technology implementation; **Score 1:** Risk control plan has been initiated and prepared at the stage of technology application; **Score 2:** An outline of the risk control plan has been prepared at the stage of technology implementation; **Score 3:** A technology risk control plan is being prepared at the stage of technology implementation; **Score 4:** Completed the preparation of a technology risk control plan at the stage of technology application; **Score 5:** The technology risk control plan at the technology implementation stage has been validated	Technology risk control plan document

Indicator KATSINOV 4

No	Aspects	Key Activities	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
1	**T**	Expertise related to the operation and maintenance of technological products has been formed.	The level in this technological aspect has gone through the TKT 9 level, where the introduction of new products to the market is carried out intensively. In order to facilitate service to customers, new products offered must be provided with a manual book containing technical specifications, how to use/operate, how to maintain, and technical instructions in case of problems (trouble shooting), as well as a Customer Service address to be contacted in case of severe problems.	**Score 0:** There is no manual book that contains how to use/operate, how to maintain, technical specifications, and technical instructions in case of problems (trouble shooting); **Score 1:** Technical specifications are available only; **Score 2:** Technical specifications and how to use/operate are available; **Score 3:** Technical specifications, how to use/operate, and how to maintain; **Score 4:** Technical specifications, how to use/operate, how to maintain, and technical instructions in case of problems (trouble shooting); **Score 5:** There is a manual book that contains technical specifications, how to use/operate, how to maintain, and technical instructions in case of trouble shooting, and equipped with a Customer Service address that can be contacted in case of severe problems.	Manual book about operation, maintenance and troubleshooting.
2	**T**	The general use of technology products by the broad market (as meeting the needs of society as a solution to their problems) has been identified	New products offered to customers generally have certain technical specifications and are intended for specific uses or purposes as well. Therefore, it is very important to identify related to the general use of the product offered by the end user, as this will be very closely related to use/operation, maintenance, technical specifications, and trouble shooting.	**Score 0:** The common use of technology products by the broad market has not been identified; **Score 1:** At the stage of testing and validating technological components developed in a laboratory environment; **Score 2:** At the stage of testing and validating the components of the technology developed in the relevant environment; **Score 3:** At the stage of testing and validating the components of the technology developed in the actual environment; **Score 4:** A stable technology system with technical specifications suitable for the application environment has been obtained; **Score 5:** The general use of technology products by the broad market has been determined through the determination of certain technical specifications and is intended for specific uses or purposes as well.	Technical specifications.
3	**T**	Key benefits have been identified through test results	New product testing aims to provide a more detailed assessment of the chances of success of a new product, identify the various final adjustments required for the product, and establish various important elements in the marketing program that will be used to introduce the product to the market. In general, there are 4 activities in testing new products, including: 1). Technical Testing; 2). Preferences and satisfaction testing; 3). Market simulation testing; and, 4). Market testing.	**Score 0:** Testing has not been carried out to identify the key benefits of the new product; **Score 1:** Test preparation stage for the identification of key benefits of the new product; **Score 2:** Testing begins to identify key benefits of new products; **Score 3:** Intensive testing has been carried out, but the key benefits of the new product have not been identified; **Score 4:** Starting to identify the key benefits of the new product; **Score 5:** Key benefits from the new product have been obtained through testing.	Test results
4	**T**	There is support for the adoption of technology products by the market.	The product adoption process is grouped into five stages, namely: awareness, interest, evaluation, trying, and adoption. The adoption process is a mental process that a person must go through from the first time they hear about innovation to the final adoption. In order to successfully adopt products by end users, support is needed for technology adoption by the market, namely by educating the market through information on the advantages of the products offered, as well as emphasizing the solutions offered to customers by using the products offered.	**Score 0:** There is no support for the adoption of technology products by the market; **Score 1:** The initial stage of market education to build support for the adoption of technology products; **Score 2:** Market awareness of technology products has been built; **Score 3:** Market awareness and interest in technology products have been built; **Score 4:** Have developed awareness, interest, and trying technology products; **Score 5:** There has been adoption of technology products by the market.	Tools for educating customers (e.g. manual books, leaflets).

No	Aspects	Key Activities	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
5	**M**	Market positioning is carried out	Market Positioning is an action or step from a producer to design a company's image and value proposition where consumers in a certain segment understand and appreciate what a certain segment does, understand and appreciate what a company does, compared to its competitors. Positioning plays a very large role in marketing strategy, after conducting market analysis and competitor analysis in a company's internal analysis (total situation analysis).	**Score 0:** The market has not been positioned for new products/services; **Score 1:** Preparation to position the market for new products/services; **Score 2:** Preparing a strategy outline and content analysis about the market positioning of new products/services; **Score 3:** The stage of completing the strategy and content analysis about the market positioning of the new product/service; **Score 4:** The results of the market positional analysis of bar products/services have been compiled; **Score 5:** The results of the market positional analysis of new products/services have been implemented factually	Marketing strategy
6	**M**	Established business model	A business model describes the idea of how an organization creates, delivers, and captures value – be it economic, social, or other forms of value. A business model is the easiest and simplest way to describe the business you have in mind. Stages of creating an Osterwalder-style Business Model: 1). Determine the customer segment. 2). Determine the product, service or value proposition. 3). How to deliver the product to the customer. 4). How will the relationship be formed between customers and businesses. 5). Determine where the source of income or revenue streams comes from. 6). Determine the required resources or key resources. 7). Determine the main activities in the business or key activities. 8). Determine who are the main partners needed in the business or key partners. 9). Finally, where are the sources of expenditure or cost structures.	**Score 0:** The business model has not been established; **Score 1:** Preparation and initiation of business model design; **Score 2:** Outline of concepts and materials related to business model design has been prepared; **Score 3:** Business model design and completion; **Score 4: The** results of the business model design have been analyzed; **Score 5:** The business model has been established.	Canvas business model
7	**M**	Competitors are well identified	A competitor is a company that produces or sells the same or similar goods or services to the products we offer. The competitors of a company can be categorized as strong competitors and weak competitors or there are close competitors who have the same product or have similar products. Things to know from competitors are about: 1). completeness, quality, design and shape of the product; 2). price offered; 3). distribution channels or locations of branches owned; 4). the promotion carried out; 5). Competitor activity plan in the future.	**Score 0:** Competitors have not been identified; **Score 1: A** competitor identification study has been initiated and prepared; **Score 2:** An outline of the concept and material of the competitor identification study has been prepared; **Score 3: The** competitor identification study has been designed and completed; **Score 4:** The results of the competitor identification study have been analyzed; **Score 5:** Competitors have been identified and established.	Market research
8	**M**	Marketing emphasizes on introducing technology products well to its customers	Demand in the introduction stage usually comes from the core market, namely consumers who have more funds and are looking for products that they really want. Therefore, the price of new products is usually quite high (because it has not been mass-produced, efficiently, and to cover development and research activities, as well as promotional costs), so consumers with such types are aimed at by manufacturers. Profits are also still very low (even tend to lose) because they bear the large marketing costs (especially promotions) and other costs, while sales are still very low. At the stage of product introduction, promotion is focused on trying to build prymary demand, namely demand in the product class, not on the product brand. New products also generally cause distribution problems, because often retailers and wholesalers are not willing to take risks in selling new products. Therefore, the cost of promotion is very high because in addition to being aimed at providing information to the end consumer about the existence of the product, it is also to attract the interest of distributors so that they want to sell the products offered.	**Score 0:** The stage of introducing the product to its customers in the market has not been carried out; **Score 1:** Initiating and preparing a strategy for introducing (promoting) and marketing products to customers in the market; **Score 2:** Start to outline strategies and materials (tools/instruments) for promotion and marketing of products to customers in the market; **Score 3:** The promotion and marketing strategy has been compiled and analyzed; **Score 4: The** promotion and marketing strategy of the product to its customers in the market begins to be implemented; **Score 5:** Promotion and marketing run effectively so that the company gains added value.	Marketing strategy

No	Aspects	Key Activities	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
9	O	Establishing organizational forms	At this Katsinov 4 level, an organization can no longer be an R&D organization, but must be a legal entity because it is closely related to business and economic transactions. The form of organization can be: 1). the formation of a new business entity, for example in the form of PT, CV, UD, etc.; 2). A new unit or division within its parent company. If the formality of the organization leads to the formation of a new business entity, the provisions of laws and regulations governing the formation of a new business entity apply. Some of the things that must be met are: Deed of Establishment of the Company, TDP (Company Registration Certificate), SIUP (Trading Business License), Company Domicile Statement, and HO (Hinder Ordonantie) or Disturbance Permit. If the formality of the organization leads to the formation of a new unit or division in the indusk company, the internal provisions of the indusk company shall apply.	**Score 0:** No organization yet; **Score 1:** There is already an R&D organization; **Score 2:** Transformation from an R&D organization to a business organization has begun, although the organizational form has not yet been determined; **Score 3:** There has been a transformation of the R&D organization into a business organization, although the organizational form has not yet been determined; **Score 4:** There has been an organizational transformation and the organizational form has been determined, but it has not yet been incorporated as a legal entity; **Score 5:** There has been a form of business organization and legal entity.	Documents related to the legal entity of the organization.
10	O	Developing partnerships with independent organizations	A business entity must have partners who can support the sustainability of its business, namely product development partners (e.g., R&D, Higher Education), partners who support capital (e.g., investors and banks), supplier partners (e.g., vendors, suppliers), marketing partners (e.g., distributors, other marketing channels), partners for after-sales (e.g., service channels for spare parts sales, maintenance, and repair).	**Score 0:** There has been no partnership development with independent organizations; **Score 1:** Preparation stage for developing partnerships with independent organizations; **Score 2:** Start developing partnerships with independent organizations; **Score 3:** Has developed partnerships with independent organizations, although not yet formal and binding; **Score 4:** Start building partnerships with independent organizations that are formal and binding; **Score 5:** Has built partnerships with independent organizations that are formal and binding.	List of partners in the business
11	O	Identify opportunities for product introduction to partners and new markets	Promoting a new product in order to introduce it to customers so that they can see and try it is your first step in making a sale. Even the best products must pass this stage of introduction if the audience does not know their existence. Therefore, you as a business owner or professional marketer must use various marketing techniques as effectively as possible to ensure that your target market has received the correct information about your products. The introduction of new products to new partners and customers is an important initial effort for the introduction and marketing of new products that are released. Therefore, the identification of opportunities for the introduction of new products to partners and new markets is of paramount importance.	**Score 0:** No new products have been introduced to new partners and markets; **Score 1:** New product development stage; **Score 2:** Completion stage of new product development; **Score 3:** New products have been obtained that are ready to be introduced to the market; **Score 4:** The process of identifying opportunities for product introduction to partners and new markets; **Score 5:** Opportunities have been identified for product introduction to new partners and markets, and the introduction and marketing of new products have been introduced.	Market Research; Marketing strategy
12	Mf	Shown production at full speed and execution.	Full Rate Production (FRP) is essentially economic production. Economic production is to make a product in such a way that it is financially profitable, this means that costs must be reduced so that it can be accepted and competitive, besides that there must be a need for the product, or if it does not exist, it is necessary to create a need and market for the product.	**Score 0:** Detailed system or production method design has been obtained; **Score 1:** The test stage is being carried out on the results of the detailed system design or production method; **Score 2:** The test iteration stage against the results of the detailed system design or production method, and has shown to be stable; **Score 3:** Low Rate Initial Production (LRIP) has been implemented; **Score 4:** Preparation for production at full speed through tests and evaluations; **Score 5:** Production has been successfully carried out at full speed.	Logbook of full-speed production execution.

No	Aspects	Key Activities	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
13	**Mf**	Started implementing production to meet safety, quality and legal requirements, e.g.: GMP (Good Manufacturing Practice) or CPPOB (Good Processed Food Production Practices), CPOB (Good Drug Production Practices), CPIB (Good Fish Hatchery Practices), Car Manufacturing Standards, etc.	In production, it has begun to meet the provisions of safety, quality, and legal requirements imposed nationally and internationally. For example: GMP (Good Manufacturing Practice) or CPPOB (Good Processed Food Production Practices), CPOB (Good Drug Production Practices), CPIB (Good Fish Hatchery Practices), Car Manufacturing Standards, etc.	**Score 0:** The production has not met the safety, quality, and legal requirements imposed nationally and internationally; **Score 1:** The preparatory stage for the management of security, quality, and legal requirements enforced nationally and internationally; **Score 2:** Administrative management of security, quality, and legal requirements enforced nationally and internationally has begun; **Score 3:** Verification and/or appraisal stage by the authorized institution in order to obtain security, quality, and legal requirements that are applied nationally and internationally; **Score 4:** Has been declared to meet the requirements of security, quality, and legal requirements imposed nationally and internationally; **Score 5:** The production has implemented and fulfilled the provisions of safety, quality, and legal requirements imposed nationally and internationally.	Certificate, SOP (Standard Operating Procedures).
14	**Mf**	Start implementing quality assurance according to certain required standards	Quality Assurance (QA) is a way to prevent errors or defects in products and avoid problems when providing solutions or services to customers.	**Score 0:** Not yet implementing quality assurance according to certain required standards; **Score 1:** The preparation stage implements quality assurance according to certain required standards; **Score 2:** Start implementing quality assurance according to certain required standards; **Score 3:** The management stage gets quality assurance accreditation according to certain required standards; **Score 4:** The verification and/or appraisal stage by the authorized institution in order to obtain quality assurance accreditation according to certain required standards; **Score 5:** Have obtained a certificate and carried out quality assurance according to certain required standards.	Certain standard certificates as required
15	**Mf**	There are public demands for the quality, security and safety of the products used.	**1). The definition of quality** includes all privileges or advantages that provide total satisfaction to consumers, including excellence in product quality, price, timeliness, service, safety and moral considerations. Quality/quality is always customer-focused. Thus products are designed, produced and services are provided to meet customer desires. Because quality refers to everything that determines customer satisfaction, a product produced can only be said to be of quality if it is in accordance with the customer's wishes, can be used well, and is produced (produced) in a good and correct way. **2). Product security and safety will** be associated with the implementation of the Indonesian National Standard (SNI) and licensing. SNI is a technical requirement or provision that is standardized through a consensus process by considering aspects of health, safety, security and environmental functions in Indonesia as well as advances in science and technology, to be used optimally. Meanwhile, licensing will be related to permit regulations enforced by authorities in their fields, for example BPOM (POM Agency), Ministry of Health, Ministry of Industry, Indonesian Ulema Council (MUI), etc. **3). Customer Feedback** is a form of interaction in certain communication media that allows users to express their opinions to business owners after interacting with services, both in terms of product quality, security and safety. How to get customer feedback can be through surveys and questionnaires. This customer feedback is a customer demand for the quality, security and safety of the products used.	**Score 0:** There is no awareness of paying attention to the community's demands on the quality, security and safety of the products used; **Score 1:** The stage of initial awareness to accept and meet public demands for the quality, security and safety of the products used; **Score 2:** The stage of making efforts to obtain feedback from the public or customers on the quality, security and safety of the products used; **Score 3:** Has received feedback from the public or customers on the quality, security and safety of the products used, but has not made efforts to meet these demands; **Score 4:** Has received and fulfilled the demands of the community or its customers for the quality, security and safety of the products used, even though it is not optimal; **Score 5:** Has received and fulfilled optimally demands from the public or customers for the quality, security and safety of the products used.	Customer feedback

No	Aspects	Key Activities	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
16	I	Identified market potential	Market potential is the size or total value of the market in rupiah if all people who have an interest in products/services and have purchasing power, buy products/services. By analyzing the market potential, we can estimate the consumer absorption of the products/services we want to offer. This is very important as a measure of whether the business sector that we will enter still promises profits or not.	**Score 0:** Market potential has not been identified; **Score 1:** Market potential identification has begun; **Score 2:** Market potential has been identified; **Score 3:** The results of the identified market potential began to be analyzed; **Score 4:** The results of the identification of market potential have been analyzed; **Score 5:** It has been estimated that consumer absorption of the products/services offered is through the identification and analysis of market potential.	Market research
17	I	Identification of the acceptance of products/services in the market	At the Katsinov 3 level, segments, sizes and market share have been predicted. At the Katsinov 4 level, the introduction of new products/services to the market begins, where marketing is emphasized on the introduction of products/services to customers. Therefore, the identification of the acceptance of products/services in the market is very important.	**Score 0:** The acceptance of the product/service in the market has not been identified; **Score 1:** Preparation for the implementation of identification of acceptance of products/services in the market; **Score 2:** Identification of the acceptance of the product/service in the market has been carried out; **Score 3:** Identification of the acceptance of products/services in the market has been completed and began to be analyzed; **Score 4:** The results of the identification of the acceptance of products/services in the market have been analyzed; **Score 5:** The results of the analysis of the identification of the acceptance of products/services in the market, have been considered in the preparation of marketing strategies.	Results of introducing new products/services to the market
18	P	Cooperation has been carried out in the network dynamically	An entrepreneur cannot live alone in running his business, but there is a relationship with outside parties both as suppliers, customers, and intermediary traders. Therefore, a business network is needed so that the business we run is sustainable. Business networks and communication have proven to play an important role in business development. There is a positive correlation between the development of economic telecommunications. Various types of business networks in business development can take the form of: 1). production networks; 2). network marketing; 3). service network; 4). Cooperation network (purchasing, labor, production development, production); 5). Business network (access to professional services, such as: management consultants, accounting, etc.); 6). Network between business groups (payment system, product price and quality, packing method, etc.).	**Score 0:** Not seeing the partner network as strategic for the success of their business; **Score 1:** Starting to realize that building cooperation in the network dynamically is a strategic thing for the success of the business; **Score 2:** Start searching for networks that can support his business; **Score 3:** Have found and started building cooperation in a network that can support their business; **Score 4: Score 5:** Has carried out and utilized cooperation in the network dynamically.	Memorandum of Understanding or MoU Document and Partnership Cooperation Agreement (PKS) Document
19	P	Management of ongoing cooperation is carried out	A network is an important prerequisite for an entrepreneur to start everything in running a business. To build a wide and strong network, friends are needed, so an entrepreneur must have as many friends as possible. Cooperation is a tool where the entrepreneur's profits can be increased by helping himself through mutual help with the motto of work for all. The purpose of this collaboration is to increase the income of each party.	**Score 0:** Cooperation that has been built, but no follow-up; **Score 1:** Still in the planning stage of cooperation implementation; **Score 2:** There has been an agreed cooperation implementation plan, but the implementation is still zero; **Score 3:** Partially implemented the agreed cooperation plan; **Score 4:** Have implemented all agreed cooperation plans; **Score 5:** Have implemented all agreed cooperation plans, and manage (maintain, strengthen, and develop) existing cooperation.	Memorandum of Understanding or MoU Document and Partnership Cooperation Agreement (PKS) Document
20	R	Preparation of non-technological risk control plans (organizational and social) at the stage of product introduction to the market	Common characteristics of the product introduction stage are relatively low sales, relatively small competition, market volume tends to grow slowly (due to high market resistance), there are still many product modifications in development and testing (because the problems that arise are not as predicted or may also be caused by a wrong understanding of the market), distribution is still limited, production and marketing costs are very high, as well as a relatively high failure rate. Therefore, a non-technological risk control plan (organizational and social) is needed at the stage of introducing products to the market.	**Score 0:** There is no non-technological risk control plan at the stage of product introduction to the market; **Score 1:** Have a plan and preparation for non-technological risk control at the stage of introducing products to the market; **Score 2:** Start developing a non-technological risk control plan at the stage of introducing products to the market; **Score 3:** The stage of completing the preparation of a non-technological risk control plan at the stage of introducing products to the market; **Score 4:** Prepare a non-technological risk control plan at the stage of product introduction to the market; **Score 5:** The non-technological risk control plan at the stage of product introduction to the market has been validated	Marketing plan; Marketing strategy; Non-technological risk control planning documents at the stage of product introduction to the market.

No	Aspects	Key Activities	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
21	R	Assessment of organizational risks (especially financial indicators) at the stage of product introduction to the market.	At the stage of product introduction, promotion is focused on trying to build prymary demand, namely demand in the product class, not on the product brand. New products also generally cause distribution problems, because often retailers and wholesalers are not willing to take risks in selling new products. Therefore, the cost of promotion is very high because in addition to being aimed at providing information to the end consumer about the existence of the product, it is also to attract the interest of distributors so that they want to sell the products offered. Organizational risk assessment (especially financial indicators) at the stage of introducing products to the market is urgently needed.	**Score 0:** Organizational risk assessment (especially financial indicators) has not been carried out at the stage of product introduction to the market; **Score 1:** Preparation for the implementation of organizational risk assessments (especially financial indicators) at the stage of product introduction to the market; **Score 2:** The concept and outline of the implementation of the organizational risk assessment (especially financial indicators) at the stage of introducing products to the market have been prepared; **Score 3:** Organizational risk assessment (especially financial indicators) begins to be carried out at the stage of introducing products to the market; **Score 4:** The results of the organizational risk assessment (especially financial indicators) at the stage of introducing products to the market have been compiled; **Score 5:** The results of the organizational risk assessment (especially financial indicators) have been obtained at the stage of product introduction to the validated market	Marketing Plan; Marketing strategy; Documents on the results of organizational risk assessments (especially financial indicators) at the stage of introducing products to the market
22	R	Social impact risk assessment at the stage of product introduction to the market.	Factors inhibiting the development of new products: 1). Fear that new products will beat existing products; 2). Higher capital costs; 3). Expensive labor costs; 4). changes in government policies; 5). There are new regulations issued. An assessment of the social impact at the stage of early introduction of products to the market must be carried out to minimize the failure of introducing new products to the market.	**Score 0:** No social impact risk assessment has been carried out at the stage of product introduction to the market; **Score 1:** Preparation for the implementation of social impact risk assessments at the stage of product introduction to the market; **Score 2:** The concept and outline of the social impact risk assessment at the stage of product introduction to the market have been prepared; **Score 3:** Social impact risk assessment begins at the stage of product introduction to the market; **Score 4: The** social impact risk assessment at the stage of introducing products to the market has been completed; **Score 5:** The results of the social impact risk assessment at the stage of product introduction to the market have been validated	Marketing Plan; Marketing strategy; Document the results of the social impact risk assessment at the stage of product introduction to the market.

Indicator KATSINOV 5

No	Aspects	Key Activities	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
1	**T**	There is a warranty for technology products marketed	Warranties, in fact, not only provide benefits to consumers but also to manufacturers. For consumers, the warranty protects against purchasing a defective product, and for the manufacturer, the warranty limits irrational claims from consumers. In addition, manufacturers can also use the warranty as an effective promotional tool for their products, because products with a longer warranty period signal to consumers that the product has better quality. Warranty has 2 important roles, namely (1) as an instrument to protect consumers from buying defective products and also protect manufacturers from unreasonable consumer claims, and (2) as an effective promotional tool to increase product sales.	**Score 0:** Not yet considering warranty as an effective consumer protection effort and promotional tool; **Score 1:** Collective awareness from manufacturers is beginning to emerge to provide warranty to consumers; **Score 2:** The stage of assessing the provision of guarantees to consumers; **Score 3:** Has provided an official warranty in the form of a free service warranty; **Score 4:** Has provided an official warranty in the form of a free service warranty and replacement of spare parts; **Score 5:** It has provided a full official warranty (both free service warranty, spare parts replacement warranty, and new unit replacement warranty) as an effort to protect consumers and an effective promotional tool.	New product promotional brochures; warranty certificate.

No	Aspects	Key Activities	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
2	**T**	Maintenance and/or repair services for technological products are provided.	After-sales service is a service offered by a manufacturer to its consumers after a sales transaction is carried out as a quality assurance for the products it offers or services provided by the principal to consumers for the goods sold in terms of durability and operational reliability. After-sales service can also mean services provided by manufacturers to their consumers after sales transactions are carried out as quality assurance for the products they offer. After-sales service both during the warranty period and post-warranty in the form of: a. availability of after-sales service center (service center); b. availability of spare parts; c. replacement of similar products in the event of irreparable damage during the agreed warranty period; and d. replacement of parts as per warranty during the agreed warranty period. In SNI 2007, the types of after-sales service are divided into two, namely: 1. After-sales service during the warranty period, in the form of a guarantee for inspection, repair and/or replacement of goods or components that do not function at the cost borne by the principal during the use / operation of the goods; 2. Post-warranty after-sales service in the form of periodic maintenance (service) guarantee, repair, replacement and availability of components of the goods concerned, availability of technology, competent technical personnel and maintenance and repair workshops provided at a cost charged to consumers.	**Score 0:** No after-sales service center available, either during warranty or post-warranty; **Score 1:** Preparation for the provision of after-sales service centers, both during and after the warranty; **Score 2:** Start to be available centrally (at the manufacturer's main office) after-sales service center, both during the warranty and post-warranty; **Score 3:** After-sales service centers are available, both during and after the warranty, in the city where the manufacturer is located; **Score 4:** After-sales service centers are available, both during and after warranty, in some major cities; **Score 5:** After-sales service centers are available, both during the warranty and post-warranty, throughout the major cities.	Existence of Service Center; Marketing Plan and After-Sales Service Document.
3	**T**	Spare parts supply for technology products is provided.	The supply of spare parts for these technological products will be closely related to Supply Chain Management. Supply chain is its physical network, namely companies involved in supplying raw materials, producing goods, or delivering them to end users, supply chain management is the method, tool, or approach to management. Supply Chain Management will include: 1). Product development; 2). Procurement; 3). Planning & Control; 4). Operation/Production; and, 5). Delivery/Distribution.	**Score 0:** There is no spare parts supply available for technology products; **Score 1:** Preparation for the supply of spare parts for technological products; **Score 2:** Start to make available centrally (at the manufacturer's parent office) the supply of spare parts for technological products; **Score 3:** Spare parts supply for technology products is available, through after-sales service centers and distributors in the city where the manufacturer is located; **Score 4:** There is a supply of spare parts for technology products, through after-sales service centers and distributors in several major cities; **Score 5:** Spare parts supply for technology products is available, through after-sales service centers and distributors throughout major cities.	Supply Chain Management

No	Aspects	Key Activities	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
4	**T**	There are development activities with a lower intensity in order to increase the performance of technology products according to customer demands.	Product development at the Katsinov 5 level is directed to increase the performance of technological products according to customer demand. Sometimes customer complaints will encourage companies to make solution efforts to answer customer complaints, through product improvements.	**Score 0:** No longer developing; **Score 1:** There has been no significant development, only quality improvement through the Quality Control mechanism during production; **Score 2:** Activities are not only quality improvement through the Quality Control mechanism during production, but have begun to receive feedback from customers; **Score 3:** Sustainable development activities have been carried out in an effort to answer customer complaints through improving product quality according to customer requests; **Score 4:** Continuous development activities have been carried out in an effort to answer customer complaints through improving product quality and function according to customer requests; **Score 5:** Continuous development activities have been carried out in an effort to answer customer complaints through improving product quality, function, and performance according to customer requests.	Customer complaint data and solutions.
5	**M**	Providing complete services and solutions	One of the indicators in achieving the company's goals is perfect service to customers. Customer satisfaction depends on price factors, quality of goods and satisfactory service from business service employees who sell various company products. Setting a minimal pricing strategy by ignoring quality and service backfires on the company which will ultimately make the company's sales conditions unstable.	**Score 0:** Warranty letter of the product/technology marketed; **Score 1:** List of product/technology components that wear out or are easily damaged; **Score 2:** List of spare parts that must be provided to support after-sales service; **Score 3:** List of technical services that must be provided to support after-sales service; **Score 4:** List of after-sales service locations; **Score 5:** Information on after-sales service location, service access, service facilities, service accountability, product availability and human resource competencies based on product needs	Completeness of after-sales service documents, including: 1). Warranty letter of the product/technology being marketed; 2). List of product/technology components that are easily worn or damaged; 3). List of spare parts that must be provided to support after-sales service; 4). List of technical services to be provided to support after-sales service; 5). And others as per product type

No	Aspects	Key Activities	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
6	**M**	Differentiate products	Product differentiation is an effort by a company to distinguish its products from competitors' products in a trait that makes it more special or desirable. A product differentiation strategy in marketing is a strategy of designing a set of valuable differences with the aim of differentiating the company's product offerings from those of competitors. Product differentiation consists of: form, features, performance quality, conformity quality, durability, reliability, ease of repair, and style.	**Score 0:** No product differentiation; **Score 1:** There is a product differentiation plan; **Score 2:** The product differentiation strategic plan has been prepared; **Score 3:** The product differentiation strategy began to be implemented; **Score 4:** The company has not optimally implemented a product differentiation strategy; **Score 5:** The company implements the product differentiation strategy optimally.	Marketing strategy
7	**M**	Business model enhancement	According to Kaplan & Norton (2012), in today's business world, whose success is largely determined by intangible resources (intangible assets), a complete new way is needed to be able to describe the business model visually easily and simply so that it can be managed systematically and measurably. The improvement of this business model can be made possible in order to increase its competitiveness to face its competitors in the market.	**Score 0:** No evaluation and improvement of the business model; **Score 1:** The planning, evaluation and refinement stage of the business model; **Score 2:** Evaluation and refinement of the business model began; **Score 3:** Obtained the results of the evaluation and the stage of refining the business model; **Score 4:** Business model improvements have been made based on the results of the evaluation; **Score 5:** Business model enhancements have been verified and validated	Results of Evaluation and Business Model Improvement Plan.
8	**M**	Using partnerships to compete in the marketplace	Business Partnership is a mutually beneficial business cooperation between small entrepreneurs and medium/large entrepreneurs (Partner Companies) accompanied by coaching and development by large entrepreneurs, so that they need, benefit and strengthen each other. Business partnerships will result in efficiency and synergy of resources owned by the partners and therefore benefit all partners. Partnerships also strengthen efficient and productive market mechanisms and business competition. For small businesses, partnerships are clearly advantageous because they can also benefit from the market, capital, technology, management, and entrepreneurship controlled by large businesses. Large businesses can also take advantage of the flexibility and agility of small businesses.	**Score 0:** Partnerships have not been considered as a factor affecting competitiveness; **Score 1:** Already have a strategic plan for business partnerships; **Score 2: The** partnership strategic plan has been implemented but is not optimal; **Score 3:** The partnership has been optimized for technical aspects (product development, improving production processes, improving quality, and technology access); **Score 4:** Partnerships are optimized for market expansion, distribution, raw material suppliers, profit enhancement and new customer acquisition; **Score 5:** Partnerships have been established in various aspects from upstream to downstream with mutual benefits.	Business partnership strategy

No	Aspects	Key Activities	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
9	**O**	Improving organizational effectiveness and cooperation	Effectiveness is the success of achieving organizational goals. An effective organization is an organization that achieves the goal. Effectiveness as the level of organizational achievement in the short and long term. An organization can be called effective when it can carry out its obligations in fulfilling: 1. customer satisfaction, 2. achieving the organization's vision, 3. fulfilling aspirations, 4. generating profits for the organization, 5. developing the organization's human resources, and 6. having aspirations, as well as having a positive impact on the community outside the organization. Cooperation is a system of work that is done by two or more people to achieve a jointly planned goal. Cooperation in the work team is a necessity in realizing the success of performance and work achievements. Cooperation in the work team will be a driving force that has energy and synergy for the individuals who are members of the teamwork. Communication will run well based on the awareness of responsibility of each member.	**Score 0:** There has been no effort to improve organizational effectiveness and cooperation; **Score 1:** Awareness of efforts to improve organizational effectiveness and cooperation is beginning to emerge; **Score 2:** Begin to consciously make efforts to increase the effectiveness and cooperation of the organization; **Score 3:** Organizational effectiveness and cooperation have been increased so that the achievement of the organization's vision, the development of the organization's human resources, and the fulfillment of aspirations have been achieved; **Score 4:** Increased organizational effectiveness and cooperation have been carried out so that the achievement of the organization's vision, the development of organizational human resources, the fulfillment of aspirations, and the production of profits for the organization have been achieved; **Score 5:** Continuous improvement of organizational effectiveness and cooperation has been carried out so that the achievement of the organization's vision, the development of the organization's human resources, the fulfillment of aspirations, the production of profits for the organization, customer satisfaction, and the positive impact on the community outside the organization have been carried out.	Organizational structure, organizational work procedures, organizational strategic plan.

No	Aspects	Key Activities	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
10	**O**	Make the necessary restructuring	Definition of Corporate Organizational Restructuring It is necessary to evaluate its performance and make a series of improvements, in order to continue to grow and be able to compete. This improvement will be carried out continuously, so that the company's performance is better and can continue to excel in the competition, or at least it can still survive. One of the strategies to improve and maximize the company's performance is by restructuring. Restructuring can mean enlarging or shrinking the structure of the company. The concept of organizational restructuring is basically a form of rearranging (redesigning) the organizational structure to adapt to developments. An organization is said to be able to succeed in the future if it is able to constantly re-engineer itself. The reorganization, which is actually part of the restructuring, is also seen as one of the approaches to restore economic activities, business and investment (economic recovery), as well as job opportunities. In an era of increasingly fierce competition, every time a company has to evaluate its performance, as well as make a series of improvements, in order to continue to grow and be able to compete. This improvement will be carried out continuously, so that the company's performance is better and can continue to excel in the competition, or at least it can still survive. One of the strategies to improve and maximize the company's performance is by restructuring. Corporate restructuring aims to improve and maximize corporate performance.	**Score 0:** No restructuring attempt is required; **Score 1:** There is starting to be an awareness that restructuring is needed in the company; **Score 2: The** company prepares for the required restructuring; **Score 3:** The company begins to carry out the necessary restructuring, starting with performance evaluation; **Score 4:** The company has conducted a performance evaluation and made several improvements in the context of implementing the required restructuring; **Score 5:** The company has made the necessary restructuring, through evaluating its performance and making a series of continuous improvements to continue to grow and be competitive.	Performance evaluation and organizational restructuring of the company.

No	Aspects	Key Activities	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
11	**O**	Identify increasing opportunities to bring technology products together with market needs	In connection with the growth of the market economy, it is necessary to analyze market opportunities that can be utilized. This market opportunity analysis is very important, because companies need to know how many opportunities are available in marketing their products and can determine whether the market is large enough to support other products and still provide profits. In the assessment of a company or business itself or an individual, entrepreneurs should be in the decision-making process must be based on the best information collected. Functional market information: 1). to find new markets that can be entered; 2). find new customers in the existing market; 3). Knowing new products that have the potential to be developed in the future.	**Score 0:** There has been no identification of an increase in opportunities to bring technology products together with market needs; **Score 1:** The implementation of identification of increasing opportunities to bring together technology products with market needs has been prepared; **Score 2:** Identification of increasing opportunities to bring technology products together with market needs has begun to be carried out; **Score 3:** Increased market opportunities that can be entered have been identified; **Score 4:** It has been possible to identify an increase in new market opportunities that can be entered and new customers in the existing market; **Score 5:** It has been identified that there is an increase in opportunities to bring technology products together with market needs, namely in the form of new markets that can be entered, new customers in the current market, and new products that have the potential to be developed in the future.	The results of the identification of increased opportunities to bring technology products together with market needs.
12	**O**	Review technical and commercial processes to improve prices and profits.	Review of technical and commercial processes (such as layouts, production tools, labor, materials, distribution, etc.) is important to improve effectiveness, efficiency, productivity, and profitability for the company.	**Score 0:** There has been no review of technical and commercial processes to improve effectiveness, efficiency, productivity, and profitability for the company; **Score 1:** Preparation for technical and commercial process review; **Score 2:** A review of technical and commercial processes has been carried out to improve effectiveness for the company; **Score 3:** A review of technical and commercial processes has been carried out to improve effectiveness and efficiency for the company; **Score 4:** A review of technical and commercial processes has been carried out to improve effectiveness, efficiency, and productivity for the company; **Score 5:** The results of the review of technical and commercial processes (such as layouts, production tools, labor, materials, distribution, etc.) have been obtained and used to improve effectiveness, efficiency, productivity, and profitability for the company.	Results of the review of technical and commercial processes.
13	**Mf**	Implementing Lean Manufacturing in total.	Lean manufacturing is a way of thinking, philosophy, management methods and strategies to improve efficiency in the manufacturing or production line. This method is adapted from the Toyota Production System (TPS). In every company engaged in the production of goods, most of them will use lean manufacturing. Lean is an effort made by a company to prevent and eliminate waste so that it can increase the added value of products for consumers. This lean concept will be clearly illustrated in the field at the level of the value-added to waste ratio.	**Score 0:** Haven't implemented Lean Manufacturing in total; **Score 1:** Preparation at the top management level to implement Lean Manufacturing in total; **Score 2:** Socialization stage of the implementation of Lean Manufacturing in total; **Score 3:** The initial stage of total Lean Manufacturing implementation; **Score 4:** The process of iteration of the implementation of Lean Manufacturing in total; **Score 5:** Lean Manufacturing has been implemented in total, and has benefited companies and consumers.	Company commitment; Guidelines and strategies for implementing the Lean Manufacturing System.

No	Aspects	Key Activities	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
14	**Mf**	There is a need for input (both internal and external) to management for performance improvement.	Management control is a process that ensures that resources are obtained and used effectively and efficiently in order to achieve organizational goals., in other words, management control can be interpreted as a process to ensure that human, physical and technological resources are allocated to achieve the overall organizational goals. Management control is related to the direction of management activities in accordance with the outline of guidelines that have been determined in the strategic planning process. A management control system is a unit of thought from management accounting methods to collect and report data and evaluate company performance. A management control system seeks to direct various kinds of efforts carried out by all subunits of the organization to lead to the goals of the organization and the goals of its managers.	**Score 0:** In improving performance, input (internal or external) to management is not needed; **Score 1:** There is a need for input (internal and external) to management for performance improvement; **Score 2:** Limited internal input has been made to management for performance improvement; **Score 3:** 360-degree internal input has been made to management for performance improvement; **Score 4:** 360-degree internal and external (micro) input has been made to management for performance improvement; **Score 5:** 360-degree internal and external input (micro and macro) has been made to management for performance improvement.	Management control system
15	**Mf**	Implementing quality assurance according to standards (SNI) intensively	In developing products and services, quality assurance is a systematic inspection process to see if a product or service being developed meets certain requirements. Many companies have separate departments that prioritize quality assurance. A quality assurance system is said to increase customer trust and company credibility, improve work processes and efficiency, and enable companies to compete better with others.	**Score 0:** Has not implemented quality assurance according to standards (SNI) intensively; **Score 1:** There has been an awareness of implementing quality assurance according to standards (SNI); **Score 2:** Efforts to socialize the implementation of quality assurance according to standards (SNI); **Score 3:** Start preparing for the implementation of quality assurance according to standards (SNI); **Score 4:** Has implemented quality assurance according to standards (SNI), although not intensively; **Score 5:** Has implemented quality assurance according to standards (SNI) intensively, and has been used as a tool for management.	Implementation of quality assurance; Customer satisfaction index

No	Aspects	Key Activities	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
16	**Mf**	There is a guarantee for the quality, security and safety of products used by the community.	After passing the stage of customer demands on the quality, security and safety of the products used, then the company must be able to provide guarantees for the quality, security and safety of products used by the community. One way to show the quality assurance, safety and safety of products used by the public is to get recognition and guarantees from the authorities who are given authority through the product certification process and institutional accreditation.	**Score 0:** There is no guarantee of the quality, security and safety of products used by the public; **Score 1:** Building awareness and commitment to realize assurance of quality, security and safety of products used by the community; **Score 2:** Socialization of the implementation plan for product certification and institutional accreditation in the context of guaranteeing the quality, security and safety of products used by the community; **Score 3: Administrative** and technical preparations for the implementation of product certification and institutional accreditation in the context of ensuring the quality, security and safety of products used by the community; **Score 4:** The process of product certification and accreditation of institutions in the context of ensuring the quality, security and safety of products used by the community; **Score 5:** Has received a product certificate and institutional accreditation as a form of assurance for the quality, security and safety of products used by the community.	Product certificates (SNI, halal), distribution permits, etc.
17	**I**	The need for market expansion was identified.	Market expansion is a growth strategy in which a company targets existing products to new markets, market development by targeting new geographic markets, new demographic or psychographic segments, or completely new users. Expansion is an active act of expanding and enlarging the scope of existing businesses. Expansion is needed by companies to achieve efficiency, become more competitive, and to increase company profits or profits.	**Score 0:** No identification of market expansion needs was carried out; **Score 1:** Preparation to identify market expansion needs; **Score 2:** Identification of market expansion needs is starting to be carried out; **Score 3:** In the process of completing the identification of market expansion needs; **Score 4:** Identification of market expansion needs has been completed; **Score 5:** The results of the identification of market expansion needs have been validated	Sales reports; Market development reports; The results of the analysis of the market situation and competitors.
18	**I**	There is an increase in production capacity	Production capacity is one of the company's strategies to increase profits. Production capacity planning strategies can be through market expansion strategies and wait and see strategies.	**Score 0:** There has been no increase in production capacity; **Score 1:** There is a tendency to increase market demand; **Score 2:** There is an increase in production capacity, and the optimum production capacity has not been reached; **Score 3:** There is an increase in production capacity, and the optimum production capacity has been achieved; **Score 4:** There is an increase in production capacity that requires an increase in production capacity; **Score 5:** Production capacity has been increased due to market demand	Data on the development of market demand.

No	Aspects	Key Activities	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
19	**P**	Increased cooperation in the network dynamically	At the Katsinov 4 level, cooperation has been carried out in the network dynamically, both production networks, marketing networks, and service networks. Cooperation in this network needs to be improved in order to get new market opportunities in the midst of increasingly fierce business competition.	**Score 0:** There has been no dynamic increase in cooperation in the network; **Score 1:** Evaluation efforts on cooperation in the network that has been running; **Score 2:** It has been determined that there is a need to increase cooperation in the network that has been running; **Score 3:** Efforts have been made to increase cooperation in the production network; **Score 4:** Efforts have been made to increase cooperation in the production and marketing network; **Score 5:** Efforts have been made to increase cooperation in the network dynamically, both production networks, marketing networks, and service networks.	List of partners involved in cooperation; Partner evaluation.
20	**P**	The quality of cooperation management that has been running has been improved.	Cooperation that has been built with partners must be well maintained and managed. In partnership, all elements get what they need. Synergy between elements is the key in playing their respective roles. Partnership building should be based on the following: common interests, mutual trust and respect, clear and measurable goals, and a willingness to sacrifice other resources, time, energy, and resources. In general, the principles of partnership are equality or equality, openness or transparency and mutual benefit.	**Score 0:** There has been no improvement in the quality of cooperation management that has been running; **Score 1:** Evaluation of the management of cooperation that has been running; **Score 2:** Several weaknesses in the management of cooperation that have been carried out have been identified; **Score 3:** Planning efforts to improve the quality of cooperation management that is already running; **Score 4:** Execution of efforts to improve the quality of cooperation management that has been running; **Score 5:** The quality of cooperation management that has been running with the principles of true partnership has been improved, namely equality, transparency, and mutual benefit.	List of partners involved in cooperation; Partner evaluation.
21	**P**	Cooperation in product distribution and marketing.	Marketing a product to the middle of the market with a wide reach is not an easy matter. Entrepreneurs who become producers often need other parties who act as distributors. Regarding the form of the distribution network and the parties involved in it, it can indeed be different between products one product to another.	**Score 0:** There has been no cooperation in product distribution and marketing with other parties; **Score 1:** Identify potential partners for product distribution and marketing cooperation; **Score 2:** Has appointed partners for product distribution and marketing cooperation; **Score 3:** Product distribution and marketing cooperation agreement; **Score 4:** Execution of product distribution and marketing cooperation; **Score 5:** There has been cooperation in product distribution and marketing with partners, so that the market reach has become wider.	Data distributor
22	**R**	The preparation of non-technological risk control plans (organizational and social) at the market maturity stage has been achieved.	The search and determination of segment targets is very critical at the stage of product market maturity, although segmentation must be considered at each stage. At the introductory stage, there are few (if any) direct competitors, where competition occurs between alternative types of products. As the market moves into maturity, the opportunities (and needs) for segmentation are increasing. At the mature stage, the competition is very strong but it is still possible to seize a niche market through product uniqueness.	**Score 0:** Non-technological risk control plans (organizational and social) have not been prepared at the stage of market maturity has been achieved; **Score 1:** The outline of the non-technological risk preparation has been completed; **Score 2:** Preparation for the preparation of non-technological risk control plans (organizational and social) at the stage of market maturity achieved; **Score 3:** A non-technological risk control plan (organizational and social) is being prepared at the stage of market maturity is reached; **Score 4:** Completion of the preparation of non-technological risk control plans (organizational and social) at the stage of market maturity achieved; **Score 5:** Prepare a non-technological risk control plan (organizational and social) at the stage of market maturity achieved.	Sales data; Risk control plan document.

No	Aspects	Key Activities	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
23	**R**	An assessment of organizational risk (especially financial indicators) at the stage of market maturity is achieved.	In the stage of market maturation generally: 1). The sales growth rate begins to decline and there are no new distribution channels; 2). Flat sales on a per capita basis due to market saturation, and the future of sales is determined by population growth and replacement demand; 3). Sales declined and consumers began to switch to other products. This stage usually lasts longer than the previous stage (the growth stage), and is a formidable challenge for marketing managers. At this stage of market maturation will affect the company's organization and partnership patterns.	**Score 0:** Organizational risk assessment (especially financial indicators) has not been carried out at the stage of market maturity has been reached; **Score 1:** An outline of the preparation of the organization's risk assessment has been prepared; **Score 2:** Preparation for conducting an organizational risk assessment (especially financial indicators) at the stage of market maturity is achieved; **Score 3:** The stage of completing the organizational risk assessment (especially financial indicators) at the stage of market maturity is achieved; **Score 4:** The results of the organizational risk assessment (especially financial indicators) are obtained at the stage of market maturity achieved; **Score 5:** Organizational risk assessment (especially financial indicators) is compiled at the stage of market maturity achieved.	Sales data; Results of the risk study.
24	**R**	A social impact risk assessment at the market maturity stage is achieved.	At the stage of maturation, these markets have characteristics such as product surplus, very tight competition, they create a market niche (a market niche is a market that is very focused on a certain type or service), and a decrease in prices. This condition will have a great social impact, considering that it will affect the livelihood of many people involved in this business, ranging from company employees, vendors/suppliers, distributors, and other related parties.	**Score 0:** No social impact risk assessment has been conducted; **Score 1:** The outline of the preparation of the social impact risk assessment has been completed; **Score 2:** Preparation for a social impact risk assessment at the stage of market maturity is achieved; **Score 3:** The stage of completing the social impact risk assessment at the market maturity stage is achieved; **Score 4:** The results of the social impact risk assessment at the stage of market maturity are obtained; **Score 5:** A social impact risk assessment is prepared at the stage of market maturity achieved.	Risk Study Results

Indicator KATSINOV 6

No	Aspects	Key Activities	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
1	**T**	A review of competitors' technology products is carried out.	In this stage, there was a decrease in sales figures. This can be caused by products that are less competitive with competitors. Almost all types of goods produced by the company are always outdated or obsolete and must be replaced with new goods. In this stage, new goods must have been marketed to replace old items that are already outdated. Although the number of competitors has decreased, cost monitoring has become very important because demand has decreased considerably. If the old goods are not immediately abandoned without replacing them with new ones, then the company can only operate in certain markets that are very limited. Alternatives that can be done by management when sales decline include: a) Updating goods (in the sense of their function); b) Review and improve the marketing program and production program; c) to be more efficient; d) Eliminating poor size, color, and model; e) Eliminating some types of goods to achieve optimal profits on existing goods; and, f) Abandoning the item altogether.	**Score 0:** No review has been conducted on the competitor's technology products; **Score 1:** Discussion of urgency to review technology products owned by competitors at the top management level; **Score 2:** Preparation for the implementation of a review of competitors' technology products; **Score 3:** Review of competitors' technology products has begun; **Score 4:** In the process of completing a review of a competitor's technology product; **Score 5:** The results of the review of the competitor's technology products have been obtained.	Customer complaint list; Review of competitors' technology products
2	**T**	A review of its technological capabilities is carried out to support re-innovation or the development of new technologies.	The company's technological capabilities will greatly support re-innovation or the development of new technologies internally. However, if the technological ability is low, in the implementation of re-innovation or new technology development, partners who have capabilities in the field of R&D are needed, both R&D institutions and universities. Therefore, a review of its technological capabilities to support re-innovation or the development of new technologies is urgently needed. Note: Technological capability is the collective ability of a company to produce products efficiently and be able to meet customer requirements (Nawas M. Syarif, 1986); Technology capability is a company's capability that includes production capability, innovation capability and investment capability (Marjolein and Romijn, 2002).	**Score 0:** There has been no review of its technological capabilities to support re-innovation or the development of new technologies; **Score 1:** Discussion at the top management level related to the urgency of reviewing its technological capabilities to support re-innovation or new technology development; **Score 2:** Preparation for the implementation of a review of its technological capabilities to support re-innovation or the development of new technology; **Score 3:** A review of its technological capabilities to support re-innovation or the development of new technology has begun; **Score 4:** In the process of completing a review of its technological capabilities to support re-innovation or the development of new technologies; **Score 5:** The results of the review of the technological capabilities they have to support re-innovation or the development of new technologies have been obtained.	Results of the review of technological capabilities

No	Aspects	Key Activities	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
3	**T**	It has been decided whether to re-innovate existing technology products, or develop new technology products.	In the condition of product decline, the company begins to be abandoned by consumers to switch to other products so that the number of sales and profits obtained by producers and traders will decrease drastically or slowly but surely and eventually die. This decline in sales was caused by factors such as changes in market tastes, substitution products accepted by consumers (both domestic and foreign), and technological changes.	**Score 0:** It has not been decided whether to re-innovate existing technology products, or develop new technology products; **Score 1:** Decision to conduct a study to determine the choice of re-innovating existing technology products, or developing new technology products; **Score 2:** Preparation for the implementation of the study to determine the choice of re-innovating existing technology products, or developing new technology products; **Score 3:** Start a study to determine the choice of re-innovating existing technology products, or developing new technology products; **Score 4:** In the process of completing the study to determine the choice of re-innovating existing technology products, or developing new technology products; **Score 5:** There has been a decision from management regarding the choice to re-innovate existing technology products, or develop new technology products.	Tp Management's decision related to the implementation of re-innovation and/or stopping.
4	**M**	Market decline has been confirmed	The decline could be sooner or later, due to technological reasons, shifting consumer tastes, and increased competition. Maintaining a product is a burden for both the company and its employees.	**Score 0:** The market decline has not been confirmed; **Score 1:** There are symptoms of a downward trend in the market; **Score 2: The** trend of market trends is being analyzed; **Score 3:** The market decline is starting to be confirmed based on the results of the analysis; **Score 4:** Confirmed market decline based on the results of the analysis; **Score 5:** The market decline has been factually confirmed.	Sales data
5	**M**	Market research for approval of re-innovation (as incremental innovation) or abandon it for the development of more advanced technologies (as breakthrough innovation)	Some of the techniques that can be done to extend the life cycle of products are: a). Increasing Consumption by persuading consumers to increase the use of their products with the various benefits offered; b). Looking for other functions of the product than usual; c). Modifying products to look new and fresh both in terms of content, packaging, dosage, size, benefits, and so on: d). Finding new target consumers.	**Score 0:** Market research has not been conducted to incrementally re-innovate and switch to more advanced technology (breakthrough); **Score 1:** Preparation for the implementation of market research for incremental re-innovation and switching to more advanced technology (breakthrough); **Score 2:** Start conducting market research to incrementally re-innovate and switch to more advanced technology (breakthrough); **Score 3:** Market research is being carried out to incrementally re-innovate and switch to more advanced technology (breakthrough); **Score 4:** Completed market research to incrementally re-innovate and switch to more advanced technology (breakthrough); **Score 5:** The results of market research analysis are considered for top management to determine incremental re-innovation and switch to more advanced technology (breakthrough).	The results of market research for incremental re-innovation and switching to more advanced technology (breakthrough).
6	**M**	Review of market demand	Market demand is the number of goods and services that are desired to be bought or owned at various price levels that apply in the market and at a given time. Market demand is a reflection of consumer behavior.	**Score 0:** No market demand review has been conducted; **Score 1:** Have developed a concept of market demand review; **Score 2:** Preparation for market demand review; **Score 3:** Start the implementation of the market demand review; **Score 4:** The results of the market demand review have been obtained; **Score 5:** The results of the market demand review are considered by top management to make decisions for reinnovation (close down or change over)	Market demand review results

No	Aspects	Key Activities	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
7	**M**	Identify opportunities for market growth or new market expansion	If the existing market is no longer reliable to increase sales, it can be taken by targeting new market segments to be persuaded to become customers. Example: green sampoerna cigarettes that used to target the lower middle class are now starting to target the upper middle class to expand the market segment.	**Score 0:** No market growth or new market expansion opportunities have been identified; **Score 1:** Preparation for identifying opportunities for market growth or new market expansion; **Score 2:** Identification of market growth opportunities or new market expansion begins to be carried out; **Score 3:** The stage of completing the identification of opportunities for market growth or new market expansion; **Score 4:** The results of identifying opportunities for market growth or new market expansion have been obtained; **Score 5:** The results of identifying opportunities for market growth or new market expansion are considered by top management to make decisions for reinnovation (close down or change over)	The results of identifying opportunities for market growth or new market expansion.
8	**O**	There is an organizational role in supporting Re-Innovation or New Technology Development.	The company has an organization that plays a role in supporting the implementation of Re-Innovation or New Technology Development, for example: Department/Division/R&D unit.	**Score 0:** There is no support of management commitment and resource support in the company environment; **Score 1:** Organizing has not had a real direction and action in supporting Re-Innovation or New Technology Development; **Score 2:** The organization has provided direction, but its role has not yet been evident in supporting Re-Innovation or New Technology Development; **Score 3:** There is an organizational role in the form of resource support in the corporate environment; **Score 4:** There is an organizational role in the form of real support in the form of management commitment within the company; **Score 5:** There is an organizational role in the form of real support in the form of management commitment and resource support within the company.	Organizational structure
9	**O**	There is a role for networks in supporting Re-Innovation or New Technology Development.	In reinnovating or developing new technologies, companies can utilize networks such as universities and/or government-owned and/or private R&D institutions.	**Score 0:** Does not have a network to support Re-Innovation or New Technology Development; **Score 1:** Have a network, but there is no role in supporting Re-Innovation or New Technology Development; **Score 2:** Having a network and its role is lacking in supporting Re-Innovation or New Technology Development; **Score 3:** Have a network and have a considerable role in supporting Re-Innovation or New Technology Development; **Score 4:** Have a network and have a large role in supporting Re-Innovation or New Technology Development; **Score 5:** Have a network and there is a huge role in supporting Re-Innovation or New Technology Development.	Cooperation in innovation or development of new technology.

No	Aspects	Key Activities	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
10	**Mf**	There is a need for production innovation or the development of new production technology.	Production technology is a way of increasing production and productivity that can be widely applied in the manufacturing and service industries. Innovation in production technology brings benefits to increase effectiveness, efficiency, and production productivity.	**score 0:** Production innovation or the development of new production technology has not yet become a necessity for the company; **Score 1:** Pressure from competitors in the market is starting to appear which is indicated by a decline in sales; **Score 2: The** company began to make efforts to find various alternatives to survive; **Score 3:** Alternative production innovation or the development of new production technology has not become a priority; **Score 4:** Alternative production innovation or development of new production technology is considered as a priority: **Score 5:** Production innovation or development of new production technology has been decided to be an urgent need for the company.	Production performance evaluation
11	**I**	Identified advanced innovations of products/services based on current and future market needs and demands.	Often customers know what they want, but don't know how to express it. So, asking specific questions will make it possible to gather the insights necessary for business innovation.	**Score 0:** No further innovations have been identified related to additional investment schemes based on current and future market demand; **Score 1:** Preparation of identification of advanced innovations related to additional investment schemes based on current and future market demand; **Score 2:** Identification of further innovations related to additional investment schemes based on current and future market demand has begun; **Score 3:** Completion of the identification of advanced innovations related to additional investment schemes based on current and future market demand; **Score 4:** The results of further innovation identification related to additional investment schemes based on current and future market demand have been obtained; **Score 5:** The results of the identification of advanced innovations are considered by top management to make decisions for reinvestment.	Results of ideas; innovation proposals for additional investment schemes.
12	**P**	A review of the partnership that has been running is carried out.	Partner and partnership reviews are conducted to find out the quality, advantages and disadvantages of partners and partnerships that are already running.	**Score 0:** No review has been carried out on the partnership that is already running; **Score 1:** At the preparatory stage for the implementation of the review of the partnership that is already running; **Score 2:** Review of existing partnerships begins; **Score 3:** In the process of completing the review related to the quality of partners and partnerships that have been running; **Score 4:** Review results related to the quality of partners and partnerships that have been running; **Score 5:** The results of the review of the partnership that are already running have been obtained, and the quality, advantages and disadvantages of the partners and partnerships that are already running have been known.	Results of partner and partnership reviews

No	Aspects	Key Activities	Explanation of the Substance of Key Activities/Attributes	Kiteria Assessment	Proof
13	**P**	Conducting a search for potential partners to support Re-Innovation or New Technology Development.	The search for potential partners to support Re-Innovation or New Technology Development is important in order to support the company's Re-Innovation or New Technology Development.	**Score 0:** Have not conducted a search for potential partners to support Re-Innovation or New Technology Development; **Score 1:** Identify the need for Re-innovation or New Technology Development; **Score 2:** Evaluation of internal capabilities in the implementation of Re-Innovation or New Technology Development; **Score 3:** Identify potential partners to support Re-Innovation or New Technology Development; **Score 4:** The needs and roles of potential partners to support Re-Innovation or New Technology Development have been determined; **Score 5:** Potential partners have been obtained to support Re-Innovation or New Technology Development.	Identify potential partners
14	**R**	A risk assessment is carried out to support the decision of Re-Innovation or New Technology Development.	Re-innovation or the development of new technology has great risks, both technical risks, financial risks, and market risks.	**Score 0:** No risk assessment has been conducted to support the decision of Re-Innovation or New Technology Development; **Score 1:** Preparation for the implementation of risk assessments to support the decision of Re-Innovation or New Technology Development; **Score 2:** Risk assessment begins to be carried out to support the decision of Re-Innovation or New Technology Development; **Score 3:** A risk assessment is being carried out to support the decision of Re-Innovation or New Technology Development; **Score 4:** Completion of risk assessment to support the decision of Re-Innovation or New Technology Development; **Score 5:** The results of the risk assessment analysis are considered for top management to make decisions to re-innovate or develop new technologies.	Results of the risk study

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