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Redefining Collaborative Governance in the Digital Age: insights from an integrative systematic review on the role of ICT in collaboration

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Abstract. Governments increasingly face wicked and complex problems that demand innovative approaches and multisectoral collaboration. The “collaborative governance” concept emphasizes government-led coordination among public, private, and civil society actors to foster consensus and collective action. Simultaneously, Information and Communication Technology (ICT) has emerged as a transformative force in governance, facilitating leadership, trust-building, and stakeholder participation. ICT remains peripheral in foundational collaborative governance frameworks despite its potential, revealing a critical conceptual gap in understanding its role. This study addresses this gap through a systematic review of two decades of academic literature (2003–2023), focusing on how ICT is framed, its functional roles, and the tools it offers to support governance processes. The findings highlight ICT’s capacity to reshape leadership dynamics, foster trust in distanced communication, and enhance participatory mechanisms. Recognizing the absence of a comprehensive framework, the study proposes adapting the “Integrative Framework for Collaborative Governance,” positioning ICT as an operational, non-human participant in joint capacity for action while trust and value-based decision-making remain human-centered. By bridging public administration and ICT scholarship, this research advocates for a paradigm shift that integrates ICT into collaborative strategies for addressing wicked problems. It underscores the necessity of sociotechnical approaches to governance and offers actionable insights for policymakers and practitioners navigating the complexities of an increasingly digital and interconnected world.

Keywords. Collaborative Governance, Communication Technology, Artificial intelligence (AI)

Introduction

Governments worldwide face an increasing prevalence of wicked and complex problems—multifaceted challenges that are resistant to resolution and demand innovative approaches to collective action. Addressing these issues necessitates seamless cooperation among governments, markets, and civil society (Kettl, 2015; Bryson et al., 2006). The mainstream framework of “collaborative governance” (Emerson et al., 2012; Ansell & Gash, 2007) underscores the importance of government-led, multisectoral coordination to foster consensus and cooperation across diverse stakeholders.

Simultaneously, Information and Communication Technology (ICT) has emerged as a transformative enabler of governance innovation, notably in facilitating leadership and trust-building. ICT provides tools and methodologies that redefine traditional collaboration processes, enhance stakeholder participation, and solve geographic and cultural barriers (Gloor, 2006). However, despite its potential, ICT is peripheral in the foundational discourse on collaborative governance. Seminal frameworks by Emerson et al. (2012) and Ansell and Gash (2007) largely omit ICT as a critical component, leaving a significant conceptual gap in understanding its role within governance structures.

This study addresses this gap by conducting a systematic and integrative review of two decades of academic literature (2003–2023). The review focuses on how ICT is framed, its functional roles, and the tools it offers to support collaborative governance, focusing on trust-building processes in distanced communication. Recognizing the absence of a comprehensive framework, the study proposes an advancement in the “Integrative Framework for Collaborative Governance” designed by Emerson et al. (2012). ICT is included in the model as a non-human participant that redefines the joint capacity for action in collaboration dynamics.

This research lays the groundwork for future interdisciplinary exploration by bridging public administration and ICT scholarship. It advocates for a paradigm shift, urging policymakers and practitioners to embrace ICT as a central element in strategies for addressing wicked problems through multisectoral collaboration. As Herbert Simon (2019, p. 110) observed, “*Human beings, viewed as behaving systems, are quite simple. The apparent complexity of our behavior over time largely reflects the complexity of the environment in which we find ourselves.*” This complexity is magnified in today’s rapidly evolving technological landscape, compelling governments to adapt. This study explores ICT’s critical role in fostering this adaptation, particularly amidst the mounting pressures of environmental, social, and political challenges.

Research background

Collaborative governance in a digital era

The academic debate has increasingly focused on the engagement of public and private actors or multisectoral collaboration in forums for consensus-building and coordinated action. The concept of “collaborative governance” mainstreams this debate. Ansell and Gash (2007, p. 2) define collaborative governance as “a governing arrangement where one or more public agencies directly engage non-state stakeholders in a collective decision-making process that is formal, consensus-oriented, and deliberative and that aims to make or implement public policy or manage public programs or assets.”

However, the literature on “collaborative governance” does not emphasize information and communication technology (ICT) as a “game changer” in collaboration. Foundational frameworks, such as those by Ansell and Gash (2007) and Emerson et al. (2012), do not even mention the term “technology” or include ICT as a variable or assumption. Emerson et al. (2012) suggest a leadership role for a “technologist,” but ICT itself is not considered a resource. Similarly, Ostrom’s (2011) “Institutional Analysis and Development Framework” does not consider ICT as a dimension.

Only in 2018 was the concept of “platforms” incorporated into the collaborative governance debate (Ansell & Gash, 2018). However, their definition of “platforms” is rooted in traditional organizational and programmatic settings, explicitly distancing itself from ICT-focused paradigms (Ansell & Gash, 2018, p. 29).

This disconnect can be partly attributed to skepticism toward sociotechnical approaches. Influential thinkers like Herbert Simon (2019) have shaped debates on technology's role in organizations, often prioritizing human and social structures over technological dimensions. During the 1970s and 1980s, knowledge management was synonymous with information technology (Mischen, 2015). However, sociotechnical approaches faced criticism for the challenges of integrating social systems with technological advancements (Hanseth & Monteiro, 1997).

Trust among participants is a core element of successful governance arrangement (Emerson et al., 2012). Mainstream collaborative governance literature places significant emphasis on face-to-face communication as the foundation of trust-building and collaboration. Ostrom and Walker (2003) and Ansell and Gash (2007) argue that iterative trust-building processes fostered through direct human interaction, are central to collaboration. Ansell and Gash (2007, p. 558) assert that *“an iterative process that often depends on achieving a virtuous cycle between communication, trust, commitment, understanding, and outcomes”* underpins successful collaboration. Similarly, Emerson et al. (2012) emphasize face-to-face communication as vital when conflict levels are low and shared values and objectives are clear. Therefore, reliance on direct interaction between participants limits the recognition of ICT as a facilitator or transformer of collaborative governance.

However, addressing wicked problems such as climate change and economic and social crises requires novel practices in collaborative governance. Less hierarchical approaches from governments (Kettl, 2015) and large-scale, cross-boundary collaborative networks transcending traditional silos are needed (Bryson et al., 2006). This demands rapid and scale-free interaction among actors (Gloor, 2006). Notwithstanding, the interactions must still nurture trust among participants.

New theoretical streams, such as smart governance (Meijer & Bolívar, 2016), suggest that ICT can enable innovative forms of collaboration. However, the broader collaborative governance discourse has yet to fully integrate these perspectives or examine the transformative potential of ICT in addressing complex governance challenges.

ICT potentialities for collaboration

Public administration and ICT scholarships are still “oil and water” with some contact points, such as the e-government concept (Meijer, 2007). Both scholarships are rifted because of stereotypes and a lack of a unifying theory among ICT and public administration studies (Meijer, 2007). The mainstream literature on “collaborative governance” in public administration has also not given much attention to information technology's role in shaping the collaboration process (Kattel et al., 2020).

However, ICT is changing exponentially, and the context at the beginning of 2000, when the mainstream “collaborative governance” debate was spurred, dramatically differs from what we have nowadays. Wicked problems such as climate change and diminishing trust in governments pressure novel trust-building patterns central to innovation. Generational changes and technological developments, among other factors, may contribute to new government and stakeholder relationship patterns (Castells, 2011; Bryson et al., 2006).

Technology-mediated communication is considered honest by enthusiasts, such as Gloor (2006). Recording emails, posts, and messages discourages individuals from lying. In face-to-face communication, an individual can lie and discredit the conversation after getting away with the lie. When interacting online, individuals are truer about their feelings and opinions (Gloor, 2006). In this manner, trust and collaboration are rooted in a “delicate internal

balance of reciprocity (Gloor, 2006).” Some individuals stand out and assume leadership roles, pushing and mediating the working process. The group expects older members to share knowledge with new members in a context of respect for the network working rules and the expectation that knowledge will become an advancement for the online network.

Social capital or a trusted or reciprocal relation among members, is nurtured by meritocracy (fair treatment), transparency (rules are explicit), and consistency (ability to deliver) in the networking process (Gloor, 2006). Members' work quality also gathers trust and, among other factors, substitutes the need for physical contact (Gloor, 2006; Fukuyama, 1996). Individual membership in ICT-mediated collaboration and the needed trust from other members come with a preassigned level of trust: familiarity, reputation, quality of available information, and external recognition. Connection with “hub” nodes enables surrogate trust or other forms of trust building that substitute physical contact or group belonging. Technology, thus, allows the reduction of “digital” distance between individuals, enabling “small worlds” (Gloor, 2006). Gloor (2006) nonetheless recognizes that face-to-face communication is the starting point for a collaborative innovation network. Members of the network’s core must know each other physically to settle the foundations for distributed trust. New members are trusted because they are endorsed by someone already trusted. Face-to-face communication is encouraged to build trust and as an effective mechanism to diffuse ideas and results of the network (Sørensen & Torfig, 2017).

Kattel et al. (2020) claim that technological infrastructure shapes collaborative networks' design and functioning. Technology can reduce the disadvantages that limit collaboration. Technological tools redefine the costs of collaboration and access to political and managerial leadership. Virtual meetings and message apps lessen the expenses and time spent on engagement. The availability of leaders on social media and apps such as LinkedIn creates an opportunity for information and knowledge sharing, with more capacity to demand and issues exposition. Traditionally, diffused groups can concentrate efforts with technological tools and exert more noise and pressure than organized groups. Technology can also affect the institutional design of collaborative governance by redefining the conditions for participant inclusion or exclusion, rules and transparency, decision processes, and deadlines.

This study investigates how the current academic debate on collaborative governance addresses ICT to better understand its role, tools, and how it supports trust-building in a context of distanced communication. *Figure 1* synthesizes the literature gap this systematic and integrative literature review aims to fill. After filling this gap, I propose a model that unifies ICT and collaborative governance.

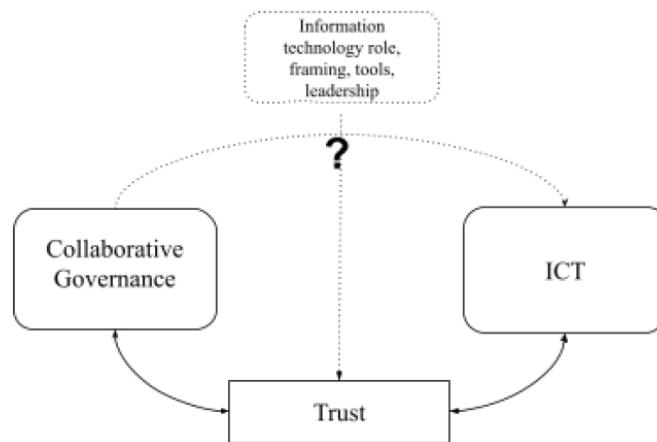


Figure 1. Gap filling with the systematic and integrative literature review
Source: Own elaboration

Methodology

This study adopts a systematic and integrative literature review approach, encompassing 20 years of peer-reviewed journal publications. Webster and Watson (2002) highlighted the scarcity of systematic reviews on system organization and, specifically, on information and communication technology (ICT). While systematic literature reviews are more common in fields like public management and political science, there remains a significant gap in bridging these domains with ICT scholarship. This research addresses this gap by synthesizing the academic discourse on how the scholarly literature on collaborative governance incorporates ICT.

Systematic literature reviews involve structured selection and analysis of publications within a given field of knowledge. Unlike simple collections of papers, systematic reviews follow a rigorous protocol for identifying, screening, and analyzing studies, ensuring methodological rigor and reproducibility (Okoli & Schabram, 2010). These reviews aim to summarize existing evidence, identify gaps in the literature, and provide a framework to guide future research endeavors.

This study adheres to the guidelines proposed by Okoli and Schabram (2010), who synthesized methodologies from health and management research to develop robust literature reviews in the field of system information. The primary goal of this review is to present and summarize current knowledge on the relationship between ICT and the academic discourse on collaborative governance. By organizing the review around key concepts and themes, this study aligns with Neuman's (2011) definition of an integrative review, synthesizing diverse perspectives within a cohesive framework.

Focus and Analytical Framework

The selected papers were analyzed to explore the following:

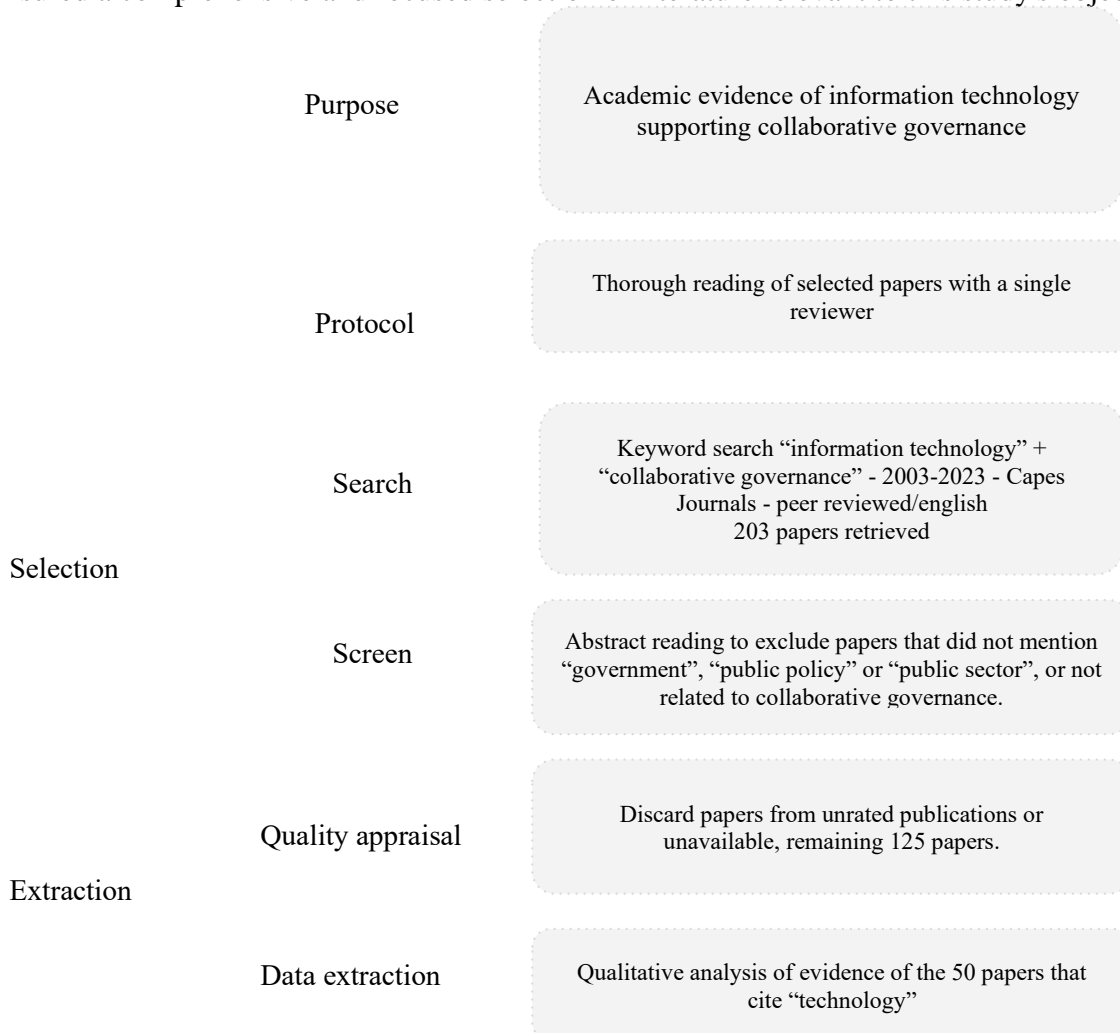
- How ICT is framed within the collaborative governance debate.
- The roles and tools of ICT in enhancing collaboration and decision-making.
- The impact of ICT on leadership, coordination, and trust-building.
- Opportunities and threats posed by ICT in collaborative governance.

Data collection

This systematic review employed a structured approach to identify relevant literature at the intersection of collaborative governance and ICT. The search was conducted using the "Capes Journals" platform, one of the largest collections of academic journals, encompassing databases such as ScienceDirect, EBSCO, Scopus, and others, with access to over 34,000 journals.

The search criteria included only English-language, peer-reviewed publications from 2003 to 2023. Figure 2 outlines the specific criteria used for paper selection. Abstracts of all retrieved papers were reviewed, and publications explicitly referencing the term "technology" were selected for a detailed reading.

Zotero (version 6.0.20) was used as the primary tool for citation and document handling to facilitate paper management, organization, and analysis. This systematic process ensured a comprehensive and focused selection of literature relevant to this study's objectives.



Analysis

Figure. 2. Steps of the systematic integrative literature review
Source: Own elaboration following Okoli and Scharabam (2010).

Data extraction

The qualitative analysis of the 50 papers considered the following coding scheme, which was informed by the working concepts developed above.

Table. 1. Coding scheme

Dimension	Guiding Questions
D1. Collaboration design	Does the paper cite the word "technology" in the context of "collaborative governance"? Topic (public policy, issue or subject)
D2. Technology framing	How is ICT framed? (identify the main working concept)
D3. Technology role	What is the role played by ICT in "collaborative governance" ?
D4. Technological tools	What ICT tools were developed to support "collaborative governance"? How does ICT (re) define actors' roles and coordination patterns
D5. Technology and leadership	(horizontal/hierarchical) and affects leadership patterns in "collaborative governance"?
D6. Communication and trust building patterns	How ICT influenced communication and trust-building patterns in "collaborative governance"?
D7. Opportunities and Threats	Identify opportunities and threats in the relationship between "ICT" and "collaborative governance"

Source: Own elaboration

Results

The search and screening steps of the systematic literature review retrieved a total number of 203 papers. Papers that did not address collaborative governance were discarded, totaling 39%. The remaining 125 papers (61%) addressed collaborative governance. From this share, 50 papers cited the word "technology," while 75 papers did not cite technology in the context of collaborative governance. Of the total 125 papers that cite or not technology, 95 were case studies. The case studies mainly dealt with environmental issues, notably water and energy management. Smart cities and local development were also recurrent topics.

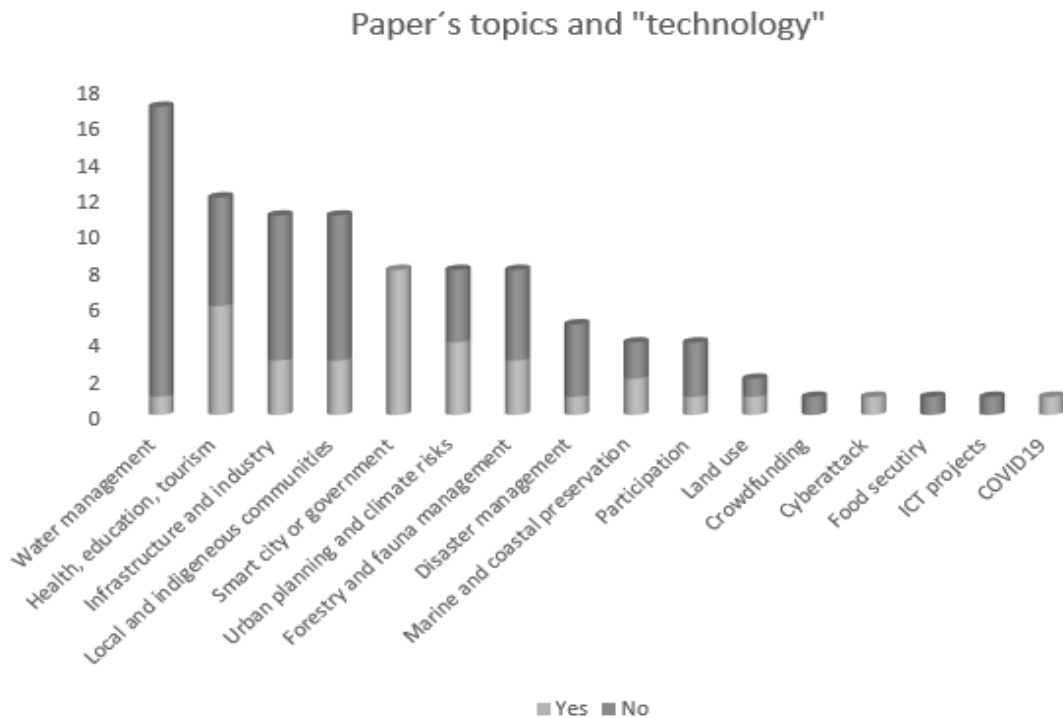


Figure 3. Case studies by topic and if it cited the word “technology” (n = 95).
Source: Own elaboration.

The United States, China, Sweden, and Australia are the countries most studied in terms of case study localities. However, collaborative governance studies are found across countries with different cultural and historical contexts. Table 2 informs the number of case study papers by country or group of countries.

Table 2. Country or group of countries of the case studies (n = 95)

<=2 papers	3-5 papers	> 5 papers
Austria; Brazil; Chile; Denmark; East Africa; Estonia; Ethiopia; Finland/Sweden; Germany/Australia; Great Britain/Germany;Iran; Italia; Mexico; Mozambique; Norway; Philippines; Romania; South Africa; Switzerland; United Arab Emirates; United States/Mexico; Vietnam/Cambodia; Zambia, India, Sweden and South Africa; Canada; Canada/Sweden; England;Germany; Ghana; Japan; Korea; Portugal	Europe; Indonesia; Spain;Netherland	Australia; China; United States ;Sweden

Source: Own elaboration.

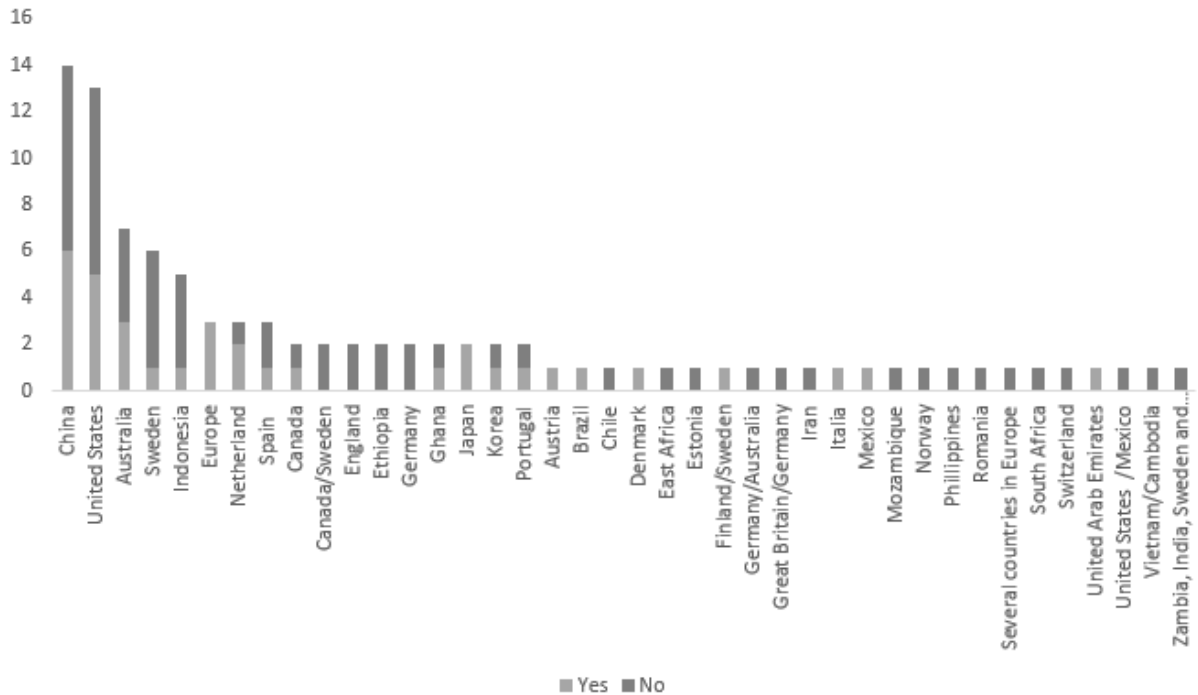


Figure 4. Number of case studies by country informing if it cites or not the word “technology.”

Source: Own elaboration.

China's academic and public policy efforts in collaborative governance, especially on land and urban policies, are noticeable. Papers from Chinese authors focus on developing indexes and tools to evaluate governance. Chinese studies also lead the debates on climate change and energy, mostly at the urban scale.

Most studies that cite technology concentrate on health and smart city topics (*Figure 3*). It is symptomatic that few of the water-related case studies cited technology in the discussion on collaborative governance. I infer that this comes from the tradition in this field in the North American academy referenced in the studies of Elinor Ostrom's Institutional Analysis and Development Theory (Ostrom, 2011). Technology is not cited among most studies referencing Ansell and Gash's (2019) concept of collaborative governance.

Even literature reviews with several case studies do not cite technology when discussing collaborative governance. Lienert et al. (2022) frame a participatory matrix from the review of several studies but do not cite technology. An editorial of a special issue that compiled 19 reviews of different environmental governance strategies, covering over 1,200 research articles, does not cite technology as a dimension. It cites institutions, information, and incentives (Agrawal et al., 2018).

After analyzing how “collaborative governance” and “information technology” are inserted into the overall academic debate, I will discuss the findings related to the coding scheme developed for this research.

D2. How technology is framed

Technology is framed in very distinct ways in the revised papers. Publications that deal with more recent topics, such as smart cities and data collaboratives, consider ICT as a structural factor that redefines leadership, network structures, problem definition, and solution strategies.

These papers are related to authors from the Scandinavian countries, China and Spain. Another segment of papers perceives technology as a collaboration process enhancer, institutional bridge, a tool to increase stakeholder participation and improve communication. Follows a synthesis of recurrent concepts informed by the reviewed papers that indicates how “information and communication technology” is framed within “collaborative governance”:

- ICT is an outcome of collaborative governance where = ICT is the third revolution achieved with a collaborative process (Yu, 2022). Also, the concepts of digital government, data networks, and data interoperability appear as outcomes of collaborative processes.

- ICT is a resource for the improvement of the collaborative process = information technology reduces transaction costs (Bjarstig & Kvastegard, 2016), improves network performance (Chen & Lee, 2018), information systems and data dissemination support collaborative processes (Gonçalves et al., 2021; Ruijter, 2021; Dai et al., 2020; Lee et al., 2019; Klievink et al., 2018; Wang et al. 2022). Information technology allows the inclusion of stakeholders (Miller et al., 2020) and improves social diagnostics (Tian & Ge, 2022).

- The interaction between “ICT and “collaborative governance” is a mind-changing process = ICT allows changes in the pattern of collaboration - allows less hierarchy, and reduces dependency on face-to-face communication, leading to the improvement of democracy (Moreno-Jimenez, Perez-Espes, & Velazquez, 2014); new collaborative web technologies are developed (Salem & Jarrar, 2010); virtual fora governance (Angelstam et al., 2021); open innovation (Criado e Guevara-Gómez, 2021); cybernetic governance (Meijer et al., 2018); use of artificial intelligence to predict problems (Liu, 2021); the concept of netzen and blockchain to trace information (Chen & Liu, 2022); outside-in platforms (Klievink, Bharosa, & Tan, 2016), smart collaboration (Viale et al. 2017).

- “ICT” is a tool to facilitate “collaborative governance” = GPS, infrastructure for resilience (Chen et al., 2022), Internet of Things (Adu-Baffour et al., 2021; Onitsuka et al., 2018, Nam & Pardo, 2014), geographical planning (Páez et al., 2020), smart city 2.0 (Trencher, 2019), blockchain for smart government (Shan et al. 2021).

- “ICT” is an individual and institutional bridge to foster “collaborative governance” = technology bridges institutional boundaries and bonds participants (Fang et al., 2022, Mischen, 2015; Eberhard et al., 2013; Garavaglia et al., 2021), technology providers are strategic stakeholders in collaborative governance (Sedlacek et al., 2020).

- “ICT” is part of the socio-technical system where nature, society, economy, and technology define human dynamics (Chen et al. 2021)

D3. The role played by “information and communication technology” in “collaborative governance”

From the beginning of 2000, papers have already called attention to technology's role in supporting the collaborative process (Noor, 2022; Ben Yahia et al., 2021; Looman et al., 2021; Romanelli, 2020). “Information technology” can redefine leadership roles (Newton et al. 2020; Criado e Guevara-Gómez, 2021), flatten networks (Qiao et al. 2020), and facilitate stakeholder participation and inclusion (Onitsuka et al., 2018, Viale et al. 2017).

Technology allows the integration of different scales and overcomes the physical and cultural distance, such as local versus extra local (Onitsuka et al., 2018), or the inclusion of ethical groups or interaction between people of the opposite sex in certain cultural settings (Salem e Jarrar, 2010). Also, technology can bring technical solutions to collaboration in rural and distant areas. Digital and information technology can supplement information, constrain

power, solve information and power asymmetry between the government and enterprises, and bond multiple subjects (Fang et al., 2022).

Information and knowledge sharing are the main topics of the papers and the primal objective of collaboration. Notwithstanding, some papers do not mention technology as a keyframe when debating information and knowledge sharing (Miller et al., 2019; Crompton et al., 2018). Authors who argue for creating a common interaction space for stakeholder engagement reassert face-to-face interaction (Barandiarán et al., 2019).

A stronger bond of technology and collaboration is mainly achieved in the debates about smart cities, which rely on the discussion on e-government, e-governance, and smart collaboration (Noor, 2022; Romanelli, 2020; Viale et al., 2017). Inside these concepts, information sharing and integrating systems and departments are the main elements in framing ICT, which allows data-based decision-making and is one of the main drivers for increasing the quality of public decisions (Viale et al., 2017). The concept of smart city 2.0 consolidates this approach of data availability platforms and collaboration between different sectors to develop solutions centered on the population's needs (Trencher, 2019).

The "collaborative governance" debate is recurrent in the analysis of challenges for identifying and engaging stakeholders, but most papers do not debate the role of technology in stakeholder engagement; their focus is on leadership and brokerage roles by individuals (Eberhard et al., 2013; Hamilton et al., 2018; Porter et al., 2013). Papers that identify miscommunication as a challenge for collaboration also do not explicitly mention ICT as a game changer (Pratama & Nurmandi, 2020). In the context of environmental issues, the concept of "complex adaptive network governance" is often used, but the papers that use this concept do not cite technology (Miller et al., 2019; Booher & Innes, 2010) or cite superficially (Schultz et al., 2019).

D4. Development of ICT tools to foster or enable collaboration

The COVID-19 epidemic profoundly transformed our relationship with technology, but online collaboration was already an academic reality. Ruijter (2021) informs that a paper from the beginning of the year 2000 already mentioned online meetings as a tool to facilitate collaboration (see Pardo, Gil-Garcia, & Luna-Reyes 2008). Onitsuka et al. (2018) state that information and communication technology (ICT) has spread worldwide since the mid-1990s. The authors state that online communities have become an essential platform for communication and cooperative work (Onitsuka et al., 2018).

Notwithstanding, few papers explicitly cite the devised technological tools in the collaborative process. In the context of the COVID-19 epidemic, modern communication and smart working technologies were enablers of the needed collaboration to deal with the pandemic (Garavaglia et al., 2021). Some studies also mention big data (Dai et al., 2020) and geographical 3D planning (Angelstam et al., 2021; Onitsuka et al., 2018) as facilitators of collaboration. Guerrero et al. (2016) argue that volunteered geographic information (VGI) can feed e-governance arrangements through formal and informal processes. Guerrero et al. (2016) consider the concept of geo-referenced citizen science as a part of the big data phenomenon.

Also, technology can create spaces for collaboration, such as place-based health systems (Gonçalves et al., 2021). George & Reed (2017, p. 2) explain that *place-based governance utilizes local identities to build strengths and capabilities to mobilize the public, private, and civil sectors and address local-level challenges*. Technological tools allow for connecting different scales and geopolitical dimensions. Video conferencing and centralized

project management are examples of how tech tools support managing collaborative processes (Chen & Lee, 2018)

Social media, mobile technologies, portals, and high-speed networks improve transparency, service level, and internal collaboration among government agencies, including people engagement (Scholl e AlAwadhi, 2016). Angelstam et al. (2021, p.3) conclude that “*social interactions in real time became extended beyond physical places through the Internet.*” Extending participation processes with technology, such as interaction with citizens through social media, causes augmenting pressure on governments and challenges collaborative arrangements (Viale et al. 2017). The public sector can make data available and foster the development by the population of solutions such as apps that can organize and supply georeferenced information that enhances the quality of life of the elderly and supports decision-making and action during crisis events (Trencher, 2019). Data availability also allows blockchain and neural network models to assess social conditions such as rural poverty (Tian & Ge, 2022).

Additionally, technology transforms the environment in cybernetic systems (Meijer et al., 2018). Sensors and citizen information transform the reality of cities developing socio-technical practices (Meijer et al., 2018; Pereira et al., 2018).

However, technology development is a daunting task. Mischen (2015) cautioned against database development and its efficient conversion into usable information, but this is just one example of several challenges. Shan et al. (2021) argues that blockchain can help enhance data credibility and facilitate collaboration. However, the risk of data leakage and technology development and control costs are challenges (Shan et al., 2021).

D5. How does "ICT" (re) define actors' roles and coordination patterns (horizontal/hierarchical) and affect leadership patterns in "collaborative governance"?

Collaborative governance arrangements that aim to solve wicked problems or add public value are led by governmental agencies (Peterman et al., 2014; Ansell & Gash, 2007). Some authors support the transition to smart government, an evolution from e-government, where technology only aims at improving government administrative efficiency and service delivery. Smart government transforms relationships into evidence-based and citizen-centric, with governments playing a pivotal role (Pereira et al., 2018).

However, disparate demands from private, public, and non-profit stakeholders challenge a singular role of government (Peterman et al., 2014). The scale of problems surpasses the capacity of the public sector (Moreno-Jimenez et al., 2014).

In this context, governments' traditional hierarchical characteristics are defied in their coordination structure and responsibility distribution. Governments must look for innovative ways, including outside-in innovations, such as technology-supported public-private platforms (Klievink et al., 2016). Co-creation, for instance, mixes hierarchical and non-hierarchical levers of authority, with it coming from private and public actors (Hofstad et al., 2022).

Blockchain and neural network models support improvement in social diagnostics. However, model complexity makes it difficult to understand what constitutes governance. Models designed to deal with rural poverty risk reduce governance to a strategy for wide data gathering and assume data visualization will induce new coordination dynamics (Tian & Ge, 2022).

D6. How "ICT influenced communication and trust-building patterns in "collaborative governance"?"

Information sharing is the prime motivation for a collaborative governance arrangement. However, to share information or knowledge, participants need to trust one another (Binz-Scharf et al., 2012; Dawes et al., 2009; DeSouza, 2009; Hatmaker and Rethemeyer, 2008 cited by Mischen, 2015; Ansell and Gash, 2018; Porter et al., 2013).

"Technology," "leadership," and "trust" were perceived as the three most important enablers of collaboration in a national survey conducted in the United Arab Emirates (Salem & Jarrar, 2010). Some papers indicate that government agencies are challenged by trust-related issues that harm the collaborative process. Salem & Jarrar (2010, p. 63) inform that "political trust" between society and government, "technological trust" or social acceptance of technology within the public sector, and "social trust" meaning changes in social dynamics, are needed to move into a collaborative mode in governance. Trust-building and collaborative processes depend on long-term interactions, with collaboration scope expanding to other stakeholders in time (Hillis et al., 2018).

Authors devote to technology the ability to make trust transmittable among social communities (Salem & Jarrar, 2010). Openness and information sharing are part of a cultural orientation, with knowledge produced through online business or interactions (Salem & Jarrar, 2010).

Nevertheless, information sharing has its setbacks. Sensitive and "behind-the-scenes" may harm future policy processes involving the same parties (Fisher and Sablan, 2018, cited by Robinson et al., 2020). Even in high technology-dependent contexts, the contention of "cyberattacks" can be hindered due to the lack of market incentives to voluntarily disclose information necessary to address the problem in a collaborative governance arrangement (van Erp, 2017). Corporations and ICT consultants do not share information on "cyberattacks" because of competition and other market incentives that harm trust-building (van Erp, 2017).

D7. Identify opportunities and threats in the relationship between "ICT" and "collaborative governance"

As an opportunity, overall, the papers put light on:

- The concept of smart governance embeds the concept of technology-based human management.
- Technology allows for reducing the risks associated with governmental and individual instability. Leadership discontinuity usually hinders collaborative projects. Information technology can mitigate that by settling information-sharing platforms, flattening the hierarchy, and including more people. Multiple governance models help to minimize this government instability.
- Technology allows novel possibilities for democracy and participation. The concepts of netizen, citizen science, and geo-reference citizen are some of the unfold.
- Technology allows the mass diffusion of information and communication.

In what regards to threats:

- Orwellian control: Information technology allows subtle forms of surveillance connected to sophisticated forms of intervention, creating the image of happy passive citizens.
- Civil society is engaged in a one-way interaction, only providing information, without two-way or multi-way interaction with authorities.

- The costs of development and control of platforms are high.
- Information security risks such as data leakage are increasing.
- New technologies, such as blockchain, may enhance trust but do not change stakeholders' decision-making because they are locked in institutional path-dependent contexts where interests do not converge.

Discussion

The systematic and integrative literature review confirms a significant gap between mainstream literature on “collaborative governance” and its integration with “ICT.” Traditional “collaborative governance” studies, particularly in water management, have a long-standing focus but seldom explore the role of ICT in enabling collaboration. However, results show ICT's growing importance in collaborative governance arrangements addressing health, urban planning, and climate risk issues.

From a geographical perspective, China and the United States lead in the number of case studies, with a notable proportion integrating ICT into collaborative governance. Interestingly, case studies from China, Scandinavia, and Spain demonstrate more transformative uses of ICT, showcasing innovative frameworks for enhancing collaboration. This reflects a shift towards leveraging ICT not merely as a tool but as an integral component of governance processes.

Studies on smart cities and government exemplify the emerging intersection of multisectoral collaboration and ICT. ICT redefines leadership roles (Newton et al., 2020), flattens hierarchical networks (Qiao et al., 2020), and supports inclusive stakeholder engagement by bridging cultural and physical distances (Onitsuka et al., 2018; Salem & Jarrar, 2010). These transformations mark a shift from hierarchical to mixed authority structures, fostering public-private co-creation (Hofstad et al., 2022; Klievink et al., 2016). ICT mitigates power asymmetries between governments and stakeholders, addresses data gaps, and facilitates multi-stakeholder engagement (Fang et al., 2022). The concept of smart cities underscores ICT's potential to enhance information sharing, inter-departmental collaboration, and data-driven public policymaking (Viale et al., 2017; Trencher, 2019).

The COVID-19 pandemic further accelerated ICT's role in governance, introducing tools such as video conferencing, centralized project management systems, and big data analytics to enable collaboration across scales and borders (Angelstam et al., 2021; Dai et al., 2020). Geo-referenced citizen data and localized apps enhance decision-making and crisis response (Guerrero et al., 2016; Trencher, 2019). Blockchain and AI offer the potential for nuanced governance diagnostics, though challenges remain in operationalizing their insights (Tian & Ge, 2022).

Trust remains central to successful collaboration, and ICT facilitates trust-building by enhancing transparency, openness, and knowledge sharing (Salem & Jarrar, 2010). Nonetheless, studies indicate that face-to-face communication remains critical for building trust and stakeholder engagement, highlighting the limitations of ICT in traditional governance models (Barandiarán et al., 2019; Miller et al., 2019). While ICT cannot independently nurture social capital or overcome political distrust, its integration with socio-political strategies can drive meaningful governance transformations.

The debate on smart cities highlights how socio-technical synergies are scaling from organizational levels to urban systems, improving societal infrastructure (Meijer et al., 2016). ICT reshapes organizational boundaries, collaboration frameworks, and power dynamics, offering new opportunities for collaboration. Institutional design, a cornerstone of collaborative

governance (Emerson et al., 2012; Ansell and Gash, 2008), supports trust-building processes (Bryson et al., 2006; Ostrom, 1990). Yet, technological advancements redefine traditional governance by creating new spaces and dynamics for collaboration.

Is collaborative governance inherently a socio-technical concept? The creation of "spaces" for collaboration aligns with the opportunities brought by ICT, particularly in scaling knowledge-sharing and redefining leadership and authority lines. However, the reviewed literature emphasizes that human relationships, not technological tools, drive coordinated actions. ICT developments alone cannot transform social relations or overcome cognitive biases in decision-making (Kahneman, 2012). If machine-to-machine processes dominate in the future, data integration might yield more automated decisions, but the genesis and outcomes of collaboration will remain rooted in human interaction.

The socio-technical debates of the 1970s, revisited by Mischen (2015), continue to resonate with today's advancements in AI and other technologies. Fifty years later, the controversy endures: while technology transforms tools and processes, human relationships remain at the core of collaborative governance. Addressing wicked problems demands a nuanced integration of ICT with socio-political strategies, ensuring that technological innovations serve as enablers rather than substitutes for human collaboration.

How can governments operationalize the sociotechnical synergies in real-world governance? A unified model of collaborative governance and ICT

Given the state-of-the-art debate on ICT and collaborative governance, it is necessary to advance the design, implementation, and evaluation of collaborative governance arrangements to address wicked problems. The following integrative model offers a normative baseline in the context of collaborative governance viewed as a sociotechnical endeavor. It was built considering the "Integrative Framework for Collaborative Governance" proposed by Emerson et al. (2012, p. 6). In their model, ICT is a contextual influence and not part of the inner workings of collaboration. Collaboration in Emerson et al. (2012) model is an interaction between shared motivation (mutual trust and understanding, internal legitimacy, and shared commitment), principled engagement (discovery, definition, deliberation, and determination), and capacity for joint action (procedural/institutional arrangements, leadership, knowledge, resources).

ICT developments have changed the landscape from just being a contextual influence on collaborative governance to detaching as a non-human element capable of having the capacity for joint action in a sociotechnical interaction and even machine-to-machine. Recent debates on AI even speculate on the capacity for self-consciousness, which would mean collaboration due to shared motivation or mutual commitment between human-machine and machine-machine, but this is not included in the model. This means that the initiative for collaboration still depends on human decisions. Regarding "Principled Engagement" or in the rough synthesis of Emerson et al. (2012, p. 10-13), the workings of participants' engagement aligned with principles such as open and inclusive communications. "Principled Engagement" also relates to the process of collaboration and it "is generated and sustained by the interactive processes of discovery, definition, deliberation, and determination" (Emerson et al., 2012). In this ICT plays a contextual and supportive role, extensively indicated in the reviewed studies. ICT tools such as data, information, and platforms inform or sustain collaboration. ICT also reduces time and space, flattens networks, and allows the abiding of principles such as openness, transparency, and inclusion.

The recent developments in ICT enable and sustain collaborative governance interactions and acquire the role of a non-human action-only participant bringing knowledge and resources for the “Capacity for joint action” mechanism. In this, ICT assumes responsibilities usually performed by humans, such as advisory, administrative tasks, and managerial activities. The recent concepts and practices of cybernetic governance (Meijer et al., 2018); the use of artificial intelligence to predict problems (Liu, 2021); the concept of netzen and blockchain to trace information (Chen & Liu, 2022); outside-in platforms (Klievink, Bharosa, & Tan, 2016), smart collaboration (Viale et al. 2017) grasp this new role of ICT where ICT is part of the socio-technical system where nature, society, economy, and technology define human dynamics (Chen et al. 2021).

However, in the proposed model, ICT does not perform leadership roles although it can reconfigure leadership capacity. Collaborative leadership is time, resource, and skill-intensive (Huxham & Vangen, 2000; Ansell & Gash, 2007). Technological tools can support the leader's information organization and sharing. Murals, message exchange history, dashboards, and data repositories, among others, are facilitating tools that leaders can use to approximate and level existing disparities among participants.

It must be noted that the inclusion of ICT as a non-human participant significantly redefines the “Capacity for joint action” to the point where its development can enhance its potential to *“also strengthen or improve the engagement and shared motivation cycles and, in synergy, assure more effective actions and impacts,”* previously noticed by Emerson et al. (2012, p. 14-15). The larger scale and richer access to knowledge and resources can potentially redefine human mental capacity in a singularity process (Kurzweil, 2024) – although it can be for good and bad purposes. In this sense, ICT can also redefine how trust is built. The revised studies indicated that trust is mainly built with face-to-face communication, long-term interactions, or referral by a trusted third party. ICT can act as a third party, and, more specifically, generative artificial intelligence which may impact human values and culture, transforming the landscape for trust-building.

The inclusion of ICT as a non-human participant in collaborative governance impacts governments. The first impact is the potential of decreasing government jobs in health, security, administrative tasks, and managerial tasks such as auditing, law advisory, and monitoring. The second impact is the demand for new competencies for leadership in collaborative governance that can comprehend artificial intelligence outputs and risks. On the positive side, ICT, as a non-human participant, scales actions up and reduces bureaucracy in license and permit emissions, monitoring actions and outcomes, and enforcing compliance. It also brings knowledge that is untied to political interests, uninterested, and technically impartial. However, there are questions on, for example, algorithms' impartiality, and data use and leakage concerns.

Figure 5. consist of a partial adaptation of the collaborative governance model proposed by Emerson et al. (2012). The proposed model, as above argued, includes ICT as a non-human participant in the “Collaboration Dynamics” cube, upgrading its role not only as a contextual influence as previously designed.

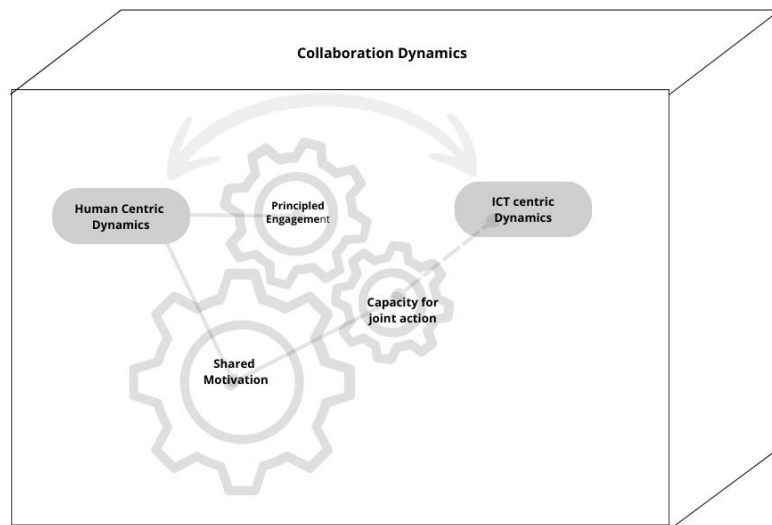


Figure 5. Integrating ICT in collaborative governance dynamics.
Source: Own adaptation of “The Integrative Framework for Collaborative Governance”
(Emerson et al., 2012, p. 6).

Conclusion

Applying a metaphor, the slug's shell (ICT) grows stronger daily in an increasingly complex environment. Is the slug, or us human beings, responding also? Social inequality is rising, and the challenges of social, economic, and environmental crises demand transformation. Collaborative governance is a promising approach where governments reset their hierarchical and bureaucratic way of doing things. This demands profound transformations where ICT has an essential role. Still, not to repeat history, the fuzz on technology, or in the “shell,” can not suppress the comprehension that it performs a function for humans and humanity. The focus on face-to-face communication, institutions, and the individual leadership role by mainstream “collaborative governance” literature was probably a response to the overemphasis on technology widespread with the rise of the internet. Therefore, the lack of citing the word “technology” in most reviewed papers may reflect some kind of rejection of the sociotechnical approaches, which reflects scholarship divides. However, this review indicated that planning, implementing, and analyzing collaborative governance without ICT is incomplete. Therefore, this study builds an adaptation of the classic “Integrative Framework for Collaborative Governance” proposed by Emerson et al. (2012), including ICT as a non-human participant that redefines the “Capacity for joint action.” Scalability, diffusion, exponentiality, and integration are important mechanisms brought within ICT and are needed to address wicked problems and create public value. However, we must not forget to evolve ourselves as humans too.

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