COLLABORATIVE GOVERNANCE AND TECHNOLOGIES: A BIBLIOMETRIC ANALYSIS

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ABSTRACT

The present research provides a structured literature review of 80 papers on collaborative governance (CG) integration with technologies. The modern concept of CG appears strictly related to new technologies since allowing for more advanced and better communication to increase the efficiency of the activities implemented in the governance process. Although the relevant literature has increased scientific production on the topic, there is a gap in the updated framework describing the technologies that can enhance the deployment of CG. Therefore, the present study employs two distinct theoretical frameworks to analyse the results obtained by applying a rigorous method. The relevant results confirm the implementation of CG in different contexts, such as smart cities and healthcare. Consistent with classical theory, it analyses the role of stakeholders as public and private entities, such as companies, organizations, and citizens. In addition, the paper focuses on technologies and stakeholder relationships to implement actions to increase the public value of organizational capacity. Finally, the research proposes a future research agenda to contribute to the emerging argument that sees technologies adopted in the CG approach to support the Sustainable Development Goals (SDGs).

Keywords - Collaborative Governance, Technologies, Sustainable Development Goals, E-government, Urban governance, Bibliometric analysis.

INTRODUCTION

The concept of Collaborative Governance (CG) has developed over the last two decades (C. Ansell and Gash 2008). CG is a decision-making process and structure involving stakeholders from various sectors and levels intending to realise a public purpose (Emerson, Nabatchi, and Balogh 2012). CG is not only limited to formal arrangements initiated by the state but also addresses engagement between government and non-governmental stakeholders (Tando, Sudarmo, and Haryanti 2022). In this way, it is possible to create multi-stakeholder roundtables to collaborate on issues of common interest (Purdy 2012). The collaboration makes it possible to achieve high goals that stakeholders could not otherwise reach (Ulibarri 2015).

Information and Communication Technologies (ICTs) are changing stakeholder collaboration processes by improving connectivity and communication (Anthony Jnr. 2022). Indeed, ICT provides stakeholders with opportunities for constructive dialogue, information sharing, communication and shared decision-making on common issues and interests (Zeppel 2012). The adoption of ICT by organisations brings potential challenges in big data, artificial intelligence, industry 4.0, internet of things (Linkov et al. 2018).

In this vein, the number of studies linking CG and ICT is increasing strongly in the literature, particularly in the fields of public management, democratic theory, planning, health and welfare (Batory and Svensson 2019; Sørensen, Triantafillou, and Damgaard 2015). At the same time, Collaborative Governance received the attention also of the European Commission's activities because it is regarding the transformation of public administration within the borders of the European Union (EU) (Batory and Svensson 2019).

The need to introduce and define this concept emerged due to failures in implementing public administration actions toward citizens and other stakeholders (C. Ansell and Gash 2008). This concept and other collaborative approaches, like e-government and digital collaboration, aimed at policy-making are high on the agenda of most European governments (Cooper, Bryer, and Meek 2006). Some contexts that are applying CG are smart cities present in studies by Bolívar (2018) and Meijer and Bolívar (2016), in the healthcare context Scott (2011) and Weech-Maldonado and Merrill (2000), in the water sector with Kallis, Kiparsky, and Norgaard (2009) and tourism with the paper by Barandiarán, Restrepo, and Luna (2019). These studies demonstrate the relationship between CG and ICT, enabling better communication and relations between stakeholders and more efficient implementation of the actions.

Despite the interest in the topic from the world of literature, an in-depth analysis seems necessary. In fact, although the relationship between ICT and CG is manifested in most of the studies analysed in the present research, there is a lack of framework in the literature that relates them. The study considers two different frameworks, one for CG by C. Ansell and Gash (2008) and the other for technologies by Malodia et al. (2021). The research is based on the following research questions:

Q1: What is the global trend in scientific publications on CG and technology adoption?

Q2: What information emerges from this trend?

Q3: What are the future directions of research in this field?

In this sense, through a structured literature review (SLR), it was possible to identify the status quo of research on these topics and analyse the past and recent research trends (Massaro, Dumay, and Guthrie 2016; Secinaro et al., 2022). An SLR combines several research methods and approaches with a thorough research protocol and facilitates the replicability of results. In particular, this paper used a bibliometric review based on five rigorous steps identified by Zupic and Čater (2015). Furthermore, a bibliometric review is implemented using the "Bibliometrix" R package (Aria and Cuccurullo 2017). In this study, the research team adopted a structured keyword search methodology. This bibliometric analysis obtains the following objectives:

a. Provides bibliometric information on 80 scientific studies extracted from the Scopus database;
b. Uses the bibliometric package R and biblioshiny to obtain and record quantitative data on selected articles (Aria and Cuccurullo 2017);
c. Identify variables such as annual scientific production, most global cited documents, and most relevant words;
d. It analyses trends with Treemap, Topics dendrogram and Trend Topics to identify the evolution of scientific research trends over time.

The research's results show a substantial increase in the number of interests in the topic of CG and ICT, justified by the increase in the number of publications in the literature. Furthermore, the results show that ICT improved communication and relations between stakeholders and allowed the implementation of high utility services for the citizen. Furthermore, the results show that the contexts with the higher application of Collaborative Governance are smart cities, hospitals and energy.

From the point of view of theoretical implications, the study highlights different CG models and structures implemented in different contexts, such as the healthcare sector and smart cities. At the same time, these case studies can demonstrate how ICT is relevant to collaborative approaches.

Turning to the practical implications, given the solid technological development, it could be helpful for public and private managers to identify already implemented models and innovate them with new ICT. In this way, it will be possible to improve the effectiveness and efficiency of CG further.

Finally, the document is organised as follows. The following section provides a literature review on CG and e-government. In the third section, the researchers deepen the methodology. In the fourth section, the research team analyses the bibliometric analysis results. The last section discusses the main elements of CG in connection with technologies based on the analysis results and concludes the paper with future implications for research.

LITERATURE REVIEW

Collaborative Governance

Collaborative approaches to policy-making have been advocated to bridge a growing communication gap between government and citizens. These approaches allow government units to overcome organizational cleavages, thus providing citizens and other stakeholders with public services more efficiently (Batory and Svensson 2019). Among the different approaches to policy-making, there is collaborative governance (CG).

A relevant aspect is that public actors represent the main actors who take the initiative and subsequently involve private actors (Batory and Svensson 2019). Public actors can be identified as the governments of different nations, and private actors as the companies and corporations of the non-profit sector (Purdy 2012). Joint efforts, mutual expectations characterize these arrangements, and voluntary participation between formally autonomous entities from two or more sectors (public, for-profit and non-profit) to exploit each

stakeholder's strengths and resources (Hwang 2017; Ulibarri 2015). Decisions reached collaboratively are more likely to be implemented because stakeholders agree on what has been decided (Ulibarri 2015). At the same time, the responsibility arising from these decisions also affects all stakeholders (C. Ansell and Gash 2008).

To define and understand the meaning of CG, we will first elaborate on the term "Collaborative" and then move on to "Governance". "Collaborative" describes a process through which parties who see different aspects of a problem can constructively explore their differences and seek solutions (Mah and Hills 2014; Purdy 2012). "Governance" was first defined in 1992 by the World Bank and referred to as a decision-making process to implement new initiatives and resolve issues (Emerson, Nabatchi, and Balogh 2012; Kapucu 2010). At its basic level, it is possible to define CG as: "working with others in cross-boundary, multi-organizational arrangements, in which the actors determine their working structure and tasks, including negotiating and setting goals, developing plans, and taking actions to address a shared problem" (Sørensen, Triantafillou, and Damgaard 2015). In other words, CG is a governance arrangement in which one or more public agencies directly involve non-state stakeholders in a collective decision-making process that aims to implement and manage public policies or public goods (C. Ansell and Gash 2008). Stakeholders with different points of view may will have an adversarial relationship, but the ultimate goal must be to cooperate in implementing public policies (C. Ansell and Gash 2008; Cooper, Bryer, and Meek 2006).

The present study considers Ansell and Gash's (2008) framework for CG analysis.

Figure 1: A model of Collaborative Governance
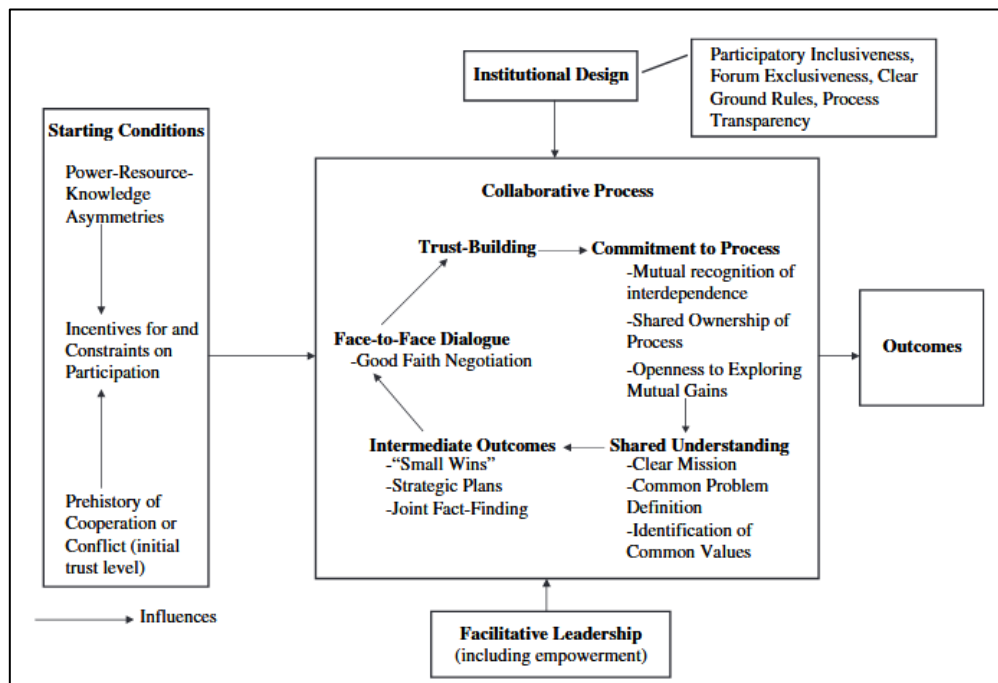
Source: adapted from C. Ansell and Gash (2008)

The following model allows us to simplify the representation of critical variables and their relationships as much as possible. Four variables are: starting conditions, institutional design, facilitative leadership, and collaborative process. The critical point is the collaborative process variable, while the other three represent the collaborative process context.

The first variable is the starting conditions, which refers to the level of trust, conflict and social capital transformed into resources or liabilities during the collaborative process. The starting conditions are: Power-Resource-Knowledge Asymmetries; Incentives for and Constraints on Participation; Prehistory of Cooperation or Conflict (C. Ansell and Gash 2008). Power-Resource-Knowledge Asymmetries means that the different stakeholders must be parity concerning capabilities, status, and resources to avoid manipulation by more vital actors (Warner 2006). The meaning of Incentives for and Constraints on Participation among them means that the willingness and participation of different stakeholders are influenced by power and resource imbalances (Imperial 2005). The greater the divergence between the parties, the lower the interest in collaboration. Prehistory of Cooperation or Conflict significantly impacts new CG projects (Andranovich 1995). Previous conflict situations create a vicious circle of suspicion, distrust, and stereotypes. On the other hand, a history of successes achieved through collaboration can increase the willingness to collaborate. Power-Resource-Knowledge Asymmetries and Prehistory of Cooperation or Conflict affect Incentives for and Constraints on Participation (C. Ansell and Gash 2008).

The second variable concerns institutional design. The variable institutional design refers to those basic protocols and rules for the correct collaborative process between the different stakeholders (Lasker and Weiss 2003). Achieving successful collaboration must be broadly inclusive (Chrislip and Larson 1994).

The third variable in this framework is facilitative leadership. Facilitative leadership must enable stakeholders to come together and collaborate despite the difficulties they will encounter in implementing this process (Gunton and Day 2003; Pine, Warsh, and Maluccio 1998). Leadership is crucial to empower and involve all stakeholders to mobilise them towards collaboration (Vangen and Huxham 2003a).

The fourth and central variable of the model is the collaborative process. It can be defined as highly iterative and non-linear. For its simplification, it is represented by Ansell and Gash (2008) as a cycle. The variable depends on a virtuous cycle between communication, trust, commitment, understanding and results (Imperial 2005). The different elements of the virtuous cycle are Face-to-Face Dialogue, Trust-Building, Commitment to Process, Shared Understanding, and Intermediate Outcomes. Starting with Face-to-Face Dialogue, all CG is based on a face-to-face dialogue between stakeholders. This way, parties can confront each other and identify opportunities of mutual interest (C. Ansell and Gash 2008). At the same time, it is also possible that differences in status and antagonism will increase through dialogue. In any case, it is not very easy to think of effective collaboration without face-to-face dialogue. Trust-Building is fundamental to a proper collaborative process between the parties involved (Brinkerhoff 1999). This element is especially relevant when stakeholders have had negative situations in previous collaborations.

Commitment to Process is a critical variable that is very decisive for the success or failure of the collaboration (Gunton and Day 2003). Commitment is highly related to the initial motivation that led the stakeholder to the decision to participate in the project collaboratively. Strong stakeholder commitment significantly reduces the risks of ineffective collaborative governance. Trust is an essential element of collaboration, and commitment depends on the trust that other stakeholders will respect your perspectives and interests (C. Ansell and Gash 2008). Unlike other governance in a CG process, stakeholders are no longer mere critics of the process but now collectively have ownership of the decision-making process with other stakeholders (Weech-Maldonado and Merrill 2000). Shared Understanding is a moment in the collaborative process when different stakeholders develop a shared understanding of the problem to be solved, the goals they can achieve together and identify the values they have in common (North 2000). Intermediate Outcomes can be described as the benefit derived from achieving micro objectives. These intermediate successes increase the collaborative process between the parties by nurturing the virtuous circle with increased trust and commitment. Consequently, there will be a greater propensity for effective collaboration between the stakeholders because they are more confident of achieving the final goals (Chrislip and Larson 1994). Joint fact-finding may also not be good, especially when stakeholders have more ambitious goals that cannot be broken down into intermediate goals (Vangen and Huxham 2003b).

One of the challenges associated with the new century and technological advancement is the relationship between CG and technology adoption (Gilman 2017; Rogers and Weber 2010). The processes of globalisation and technological development, such as information and communication technology (ICT), have provided the basis for transformations in management and governance (Kapucu 2010). This process is also emphasised in the articles by Criado and Guevara-Gómez (2021) and Hwang (2017), who state that new technologies are crucial for developing effective CG processes. ICT, global public policy, and decentralisation processes have visibly changed the face of governance in the 21st century (Kapucu 2010). However, there are currently no frameworks in the literature on CG in connection with new technologies.

The issue of CG has been linked to climate change in Australian tourism in Zeppel (2012) paper. In particular, CG has been more widely implemented in those states where there are more climate change policies or where there are destinations vulnerable to climate impacts. Collaboration between state tourism agencies, green business programmes, and carbon consultants in delivering low-carbon enables climate change information, industry awareness and tourism planning. ICT allows for greater involvement and discussion between stakeholders as in the other application areas.

Another example of CG is included in the study by Sørensen, Triantafillou, and Damgaard (2015). In this study, CG allows a public problem to be solved locally on the endangered status of salmon populations. In this way, different stakeholders acted as a collaborative platform to improve the quality of watersheds and salmon populations. This application of CG comprises a framework of bottom-up collaborative approaches that bring solutions to the central state. Following this application field, policymakers in the state of Oregon have used CG not only in the field of natural resources and economic development but also in education, public safety, and health (Sørensen, Triantafillou, and Damgaard 2015).

Also, using different collaboration platforms between stakeholders from different policy areas and jurisdictions, Oregon is defined by the authors as an ideal context for examining CG. Specifically, between 2018 and 2019, 241 CG application cases were identified using 13 different platforms in five policy areas in the state of Oregon.

Through the case study of Harbi et al. (2020), it is possible to infer how CG enables solutions to reduce emissions from deforestation and forest degradation and to demonstrate how CG is influenced by stakeholder culture and customs. In particular, this study analysed how the culture of local communities influences CG's actions in reducing deforestation on Kalimantan Island.

Big data, understood as both big data and ICT's computational power enables improved public governance decision-making (Misuraca, Mureddu, and Osimo 2014). Application examples of the use of ICT in the public sector include: predicting people's location using smartphones (Hotz 2011); big data can enable better personalised and preventive healthcare (Groves et al. 2013); ICTs can enable better care and revitalisation of urban areas most used by citizens (Misuraca, Mureddu, and Osimo 2014; Castanhari et al. 2016); and ICTs can enable public administrations to analyse environmental conditions in order to make decisions and implement policies while safeguarding sustainability (Kalakota 2012; Gabrys, Pritchard, and Barratt 2016).

However, despite the facilitation enabled by ICTs in involving citizens in CG policies, trust and collaboration are at an all-time low (Davies and Procter 2020). For instance, the study by Simon, Bass, and Boelman (2017) demonstrates low citizen participation in the 'Decide Madrid' platform for several reasons. The platform aims to promote more direct democracy, accountability and transparency in local decision-making. The reasons for low participation are a lack of knowledge of the platform, a lack of interest from citizens, and little trust in the process of change sought by public administrations. In addition, the population participating in the CG process through ICTs are highly educated people with a higher salary and aged between 36 and 55 (Simon, Bass, and Boelman 2017). The problem of this participation bias does not also highlight other pressing issues concerning underrepresented groups. In this sense, Duan et al. (2020) show how, contrary to what one might think, people's trust in high GDP countries is declining and reaching very low levels. At the same time, (Kim 2010) justifies this decline in public trust as the presence of government inattention to CG.

E-government and collaborative governance

The authors considered the framework defined in Malodia et al. (2021), as it defines the relationship between e-government, citizen and other actors with an impact on processes and relationships oriented toward the growth of the local context. It is possible to define e-government as a discipline that declined through socially inclusive and hyper-integrated ICT platforms built as an evolutionary systems architecture to ensure the efficient delivery of government services with transparency, reliability, and accountability (Malodia et al. 2021). E-government can be defined as the use of ICT to support public administrations, governments, and decision-makers and has been recorded for more than 20 years (Charalabidis 2012).

Some recent studies, such as Bannister and Connolly (2015), have suggested conceptualising e-government according to the multidimensional and multi-level framework. Accordingly, this framework has a comprehensive view that incorporates the perspectives of multiple stakeholders present within e-government, e.g. policymakers, citizens and various implementation partners (Malodia et al. 2021).

Figure 2: E-government: conceptual framework
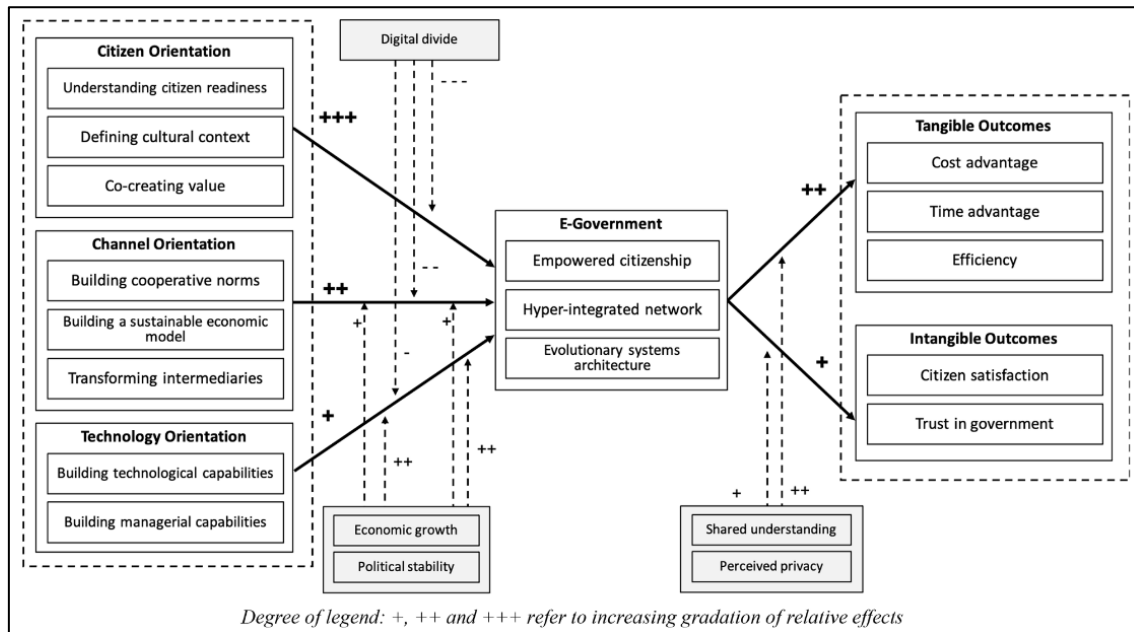
Source: adapted from Malodia et al. (2021)

E-government encompasses empowered citizenship, hyper-integrated networks, and evolutionary system architecture.

First, through empowered citizenship, e-government has the long-term goal of shifting the locus of governance from the government to communities and individual citizens (Flak and Rose 2005; Skelcher and Smith 2015). This category allows citizens free access to both information and decision-making. As citizens are stakeholders, they have the right to influence and participate in the decision-making process (Box 1999). Three fundamental aspects of empowered citizenship are inclusiveness, free availability of information and allowing them to participate in and influence decision-making.

Second, the hyper-integrated network is an integrated platform that allows governments to collect and disseminate information and provide services through a single window (Mali and Gil-Garcia 2017). This platform allows the government to perform its tasks efficiently and transparently by interacting with citizens and businesses (Ebrahim and Irani 2005).

Third, the evolutionary system architecture is a modular system that, through constant evolutions in the ICT world, allows e-government to transform how government and citizens interact (West 2004). The starting point of e-government was sharing information between governments and citizens, while the future goal may be to move as close as possible to a platform for self-government (Malodia et al. 2021).

To provide an enabling environment for the formulation of successful e-government projects, the three fundamental factors that have different influences are citizen orientation, channel orientation, and technology orientation.

The first factor is citizen orientation, which comprises three dimensions: understanding citizens' readiness, defining cultural context, and co-creating value. Through e-government, governments try to adopt a more citizen-oriented approach to provide services more transparently and cost-effectively (Aberbach and Christensen 2005).

The second factor is channel orientation, which comprises three dimensions: cooperative building norms, building a sustainable economic model and transforming intermediaries. This factor concerns intermediaries that facilitate the connection between citizens and governments. In this way, they enable intelligent information intermediation, i.e. helping citizens understand what information they need and access it themselves (Al-Sobhi, Weerakkody, and Al-Busaidy 2010).

The third factor is technology orientation, consisting of two elements: building technological and managerial capabilities. Successful e-government requires a solid strategic orientation towards R&D, ICT procurement and subsequent use, and stakeholder training (Zhou, Yim, and Tse 2005).

Governments have a responsibility to provide public services and create public value. The services and value created through e-government can be divided into tangible and intangible (Malodia et al. 2021). The tangible results are improved efficiency, automation, and cost and time advantage (Alford and O'Flynn 2009). On the other hand, e-government also achieves intangible outcomes such as citizen satisfaction and increased trust in government.

Through ICT and its continuous updates, E-government allows the citizen to improve the quality of interactions, simplify the communication interface, and increase the accessibility of the required information (Welch, Hinnant, and Moon 2005). The citizen will be more satisfied with the performance of the governance system and have greater trust in it. Although good e-government can produce tangible and intangible results, the primary objective must be to generate tangible results, while intangible results will be achieved accordingly (Malodia et al. 2021).

Concluding this framework regarding e-government is the moderating factor. The identified moderating factors influencing the link between initial aspects and e-government are the digital divide, economic growth, and political stability. In contrast, shared understanding and perceived privacy influence the link between e-government and outcomes (Malodia et al. 2021). These effects either positively or negatively affect the relationships between the different factors. The digital divide negatively affects by complicating the application of efficient e-government and refers to people's low computer literacy concerning technology (Zhao and Khan 2013). Economic growth positively affects the adoption of effective e-government because a country with good economic conditions will have more resources to invest in infrastructure and ICT (Nour, AbdelRahman, and Fadlalla 2008). Political stability is important because adopting an e-government approach is complex and time-consuming. Political stability can improve intergovernmental relations and facilitate coordination with third parties (Malodia et al. 2021). Turning the moderating

factor that influences the link between e-government and outcomes is perceived privacy. In particular, this factor has a positive effect when citizens believe that the collection, use and disclosure of their private information is protected (Chellappa 2008). Finally, the last moderating factor is shared understanding. It is defined as the individual and collective ownership of e-government projects across departments (Heeks 2003). Shared understanding will positively affect citizens if e-government services are available to citizens cohesively and seamlessly.

METHODOLOGY

This paper conducts a structured literature review (SLR) (Massaro, Dumay, and Guthrie 2016). There are several SLR methodologies in the literature with different research step levels. Among these methodologies are the bibliometric approaches that allow certain variables to be analysed. The observed variables include keywords, authors, bibliography and citations (Secinaro et al. 2020; Campra et al., 2022). The analysis comprises five rigorous steps: (01) study design, (02) data collection, (03) data analysis, (04) data visualisation, and (05) interpretation (Zupic and Čater 2015). The first three steps of the research will be elaborated on below. Later in the results and discussion, steps 04 and 05 will be dealt with.

The keywords identified on the Scopus database for data collection are: 'Collaborative governance' and 'Tecnolog*'. By placing an asterisk on the ending of the second keyword, it is possible to retrieve studies that include both the words "technology" and "technologies". Using these two keywords, 'Collaborative governance' and 'Tecnolog*' can conduct a micro-level analysis (G. Chen and Xiao 2016). The search on Scopus by keywords will select the relationship between the two words. In this first step, the search returned 144 results. The following search step was to consider only peer-reviewed scientific articles. This criterion allows only articles with good quality and scientific language to be selected from the sample (Kelly, Sadeghieh, and Adeli 2014). The authors used Scopus's Document Type filter, allowing only articles to be selected. A further filter used on Scopus is Language, which allows selecting only articles written in English were selected. The sample includes 86 results. The researchers decided not to limit the search in terms of time. In addition, to further define the search sample, the authors performed a search by title, abstract and Keywords to assess the relevance of our objectives to the results obtained. At the end of this step, we eliminated six papers. Consequently, the researchers eliminated them from the sample for more correct results. The final sample consists of 80 results.

The second step is the (02) Data Collection, in which we will use the open-source statistical programme R to analyse CG and technologies. This research phase includes creating the .bib file for the third phase, is the (03) Data Analysis.

Figure 3: Main Methodology's phases
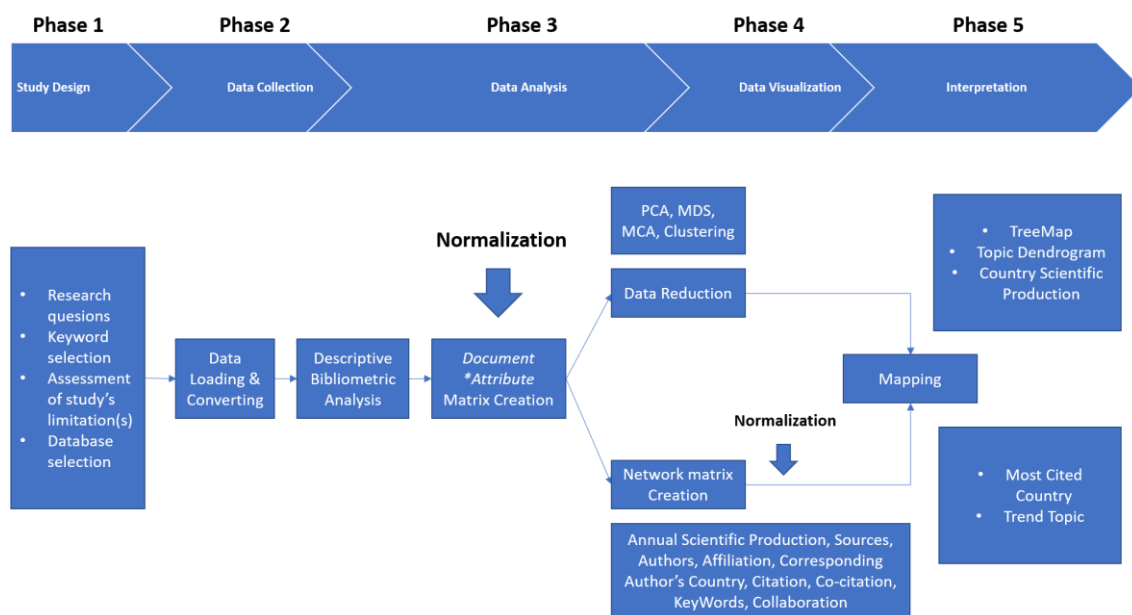
Source: adapted from Aria and Cuccurullo (2017)

RESULTS

In this section, step (04), the data visualisation of the research steps of Zupic and Čater (2015), will be carried out. The analysis of the bibliometric results begins with a description of the more general statistics of the final sample, annual scientific production. This analysis is followed by papers with the most citations and relevant keywords. In the final part of the bibliometrics, to identify research strands, the research team analysed the Treemap, the topic dendrogram, and the trending topic. In addition, there are other results in Appendix A.

Table 1 shows the primary information of the final sample used for bibliometrics following the steps described in the methodology. The publication time horizon of the 80 selected papers is from 2009 to 2022, belonging to 70 different journals/journals. The growth rate of scientific production is 13.18%. The average seniority of the papers within the sample is 3.56 years. This information means that the scientific production produced on this topic is very recent. The average citation per paper is 23.71 citations. Turning to the Document Contents part, there are 231 Keywords Plus (IDs) in this bibliometric. A total of 222 authors participated in this scientific production. Most papers participating in the scientific production on the topic (204 articles) were written by at least two authors, while single authors wrote only 18 articles. A Regarding collaboration between the different authors, it can be noted that the average number of co-authors per Doc is 2.9. The level of international co-authorship is 7.5%.

Table 1: Descriptive bibliometric analysis

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	2009-2022
Sources (Journals, Books, etc)	70
Documents	80
Annual Growth Rate %	13.18
Document Average Age	3.56
Average citations per doc	23.71
References	104
DOCUMENT CONTENTS	
Keywords Plus (ID)	231
Author's Keywords (DE)	291
AUTHORS	
Authors	222
Authors of single-authored docs	18
AUTHORS COLLABORATION	
Single-authored docs	18
Co-Authors per Doc	2.9
International co-authorships %	7.5
DOCUMENT TYPES	
Article	80

Source: Authors' elaboration using the bibliometrix R-package

Figure 4 shows the annual breakdown of the scientific production of the 80 articles included in the sample to conduct this bibliometric analysis. It can be seen that until 2013, interest in CG and technologies was very low, with two publications per year from 2009 to 2011. The first concepts of CG were defined before 2009 but were not connected with technologies (Kallis, Kiparsky, and Norgaard 2009). From 2013 for the next three years, there was a sharp increase in the number of articles published, rising from 0 to 5 in 2016. Just in 2016, World Vision International and the Partnering Institute wrote: "If the bold (and welcome) vision of Agenda 2030 is to be realised, multistakeholder collaborations, and the platforms that can catalyse them, need to expand more rapidly than at present" (Chris Ansell and Gash 2018; The General Assembly - United Nations 2015). Following this statement in 2016 and creating the 2030 Agenda, there has been a sharp increase in scientific production in the following years. The scientific production covers 13 years, but the highest peak occurred in 2020 and 2021, with 15 publications. In 2022, only the first scientific production contributions are present, but they suggest the continuity of the topic's development. Thanks to the scientific contributions published in early 2022 alone, this year's scientific production are already almost at the level of 2018.

*Figure 4: Annual Scientific Production*
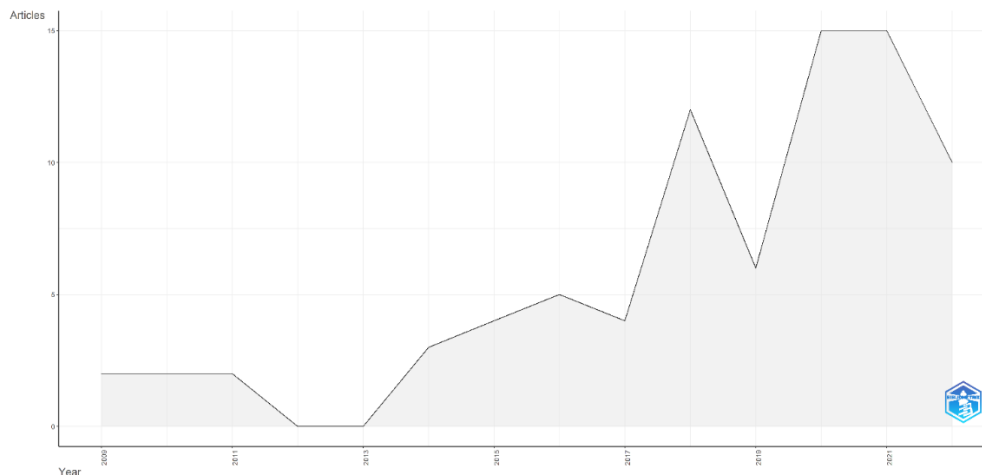
Source: Authors' elaboration using the bibliometrix R-package

Figure 5 represents the ten papers that received the most citations worldwide. The paper 'Governing the smart city: a review of the literature on smart urban governance' by (Meijer and Bolívar 2016) is the one that received the most citations (601). The authors, in their conclusions, state that smart city governance is about creating new forms of human collaboration through ICT to achieve better outcomes and more open governance processes (Meijer and Bolívar 2016).

The second most cited paper is by Gerlak and Heikkila (2011), with 140 citations globally. This paper states that the most challenging problems for society to solve, such as public problems spanning multiple policies and jurisdictional boundaries, could be overcome through collaborative arrangements. In particular, Gerlak and Heikkila (2011) identify that the capacity for collective learning can play a critical role in overcoming these problems. With 131 citations globally, there are two papers, Andonova (2010) and Kallis, Kiparsky, and Norgaard (2009). The first study examines policies and models of public-private partnerships for the environment in the multilateral system. In particular, the study focuses on why there has been an increase in this type of partnership. The two main reasons are: the fragmentation of environmental regimes and the increase in non-state actors (L. Andonova 2010). The study also points out that public-private partnerships do not represent a shift in power or marginal governance.

The second study explores how CG improves mutual understanding between different stakeholders and can be a source of innovation. However, it seems inappropriate to solve the distributional dilemmas at the heart of environmental conflicts on its own (Kallis, Kiparsky, and Norgaard 2009). This problem happens because CG alone does not have the potential to overcome these kinds of conflicts. However, new technologies and ICT platforms can achieve ambitious goals (Malodia et al. 2021).

Figure 5: Most Global Cited Documents
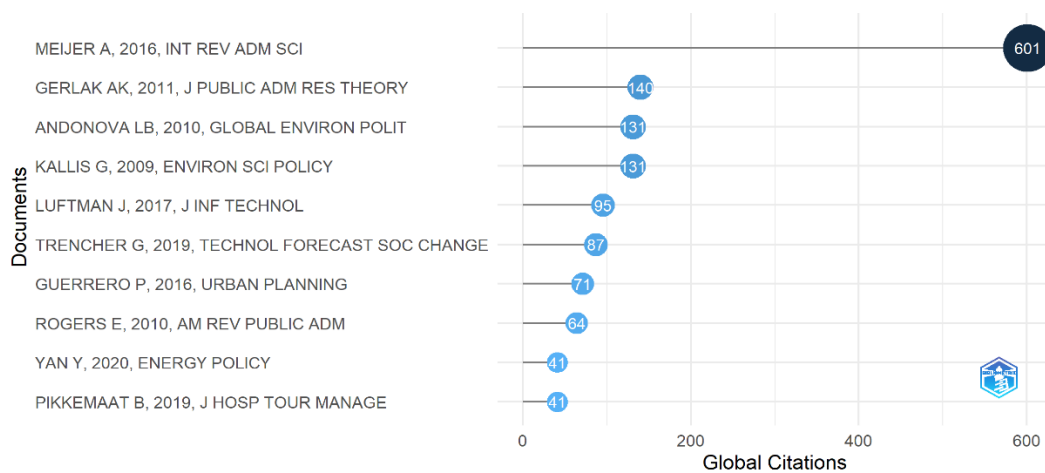
Source: Authors' elaboration using the bibliometrix R-package

Table 2 shows the 10 most used keywords by the authors on the topic of CG and Technologies. In these 80 published articles, the two keywords that were most frequently used were "governance" 8 times and "collaboration" 7 times. The other topics touched upon with the other keywords are 'smart cities' (5), 'e-government' (4) and 'urban governance' (3) (Bernardi and Diamantini 2018; Bolívar 2018; T. Liu, Yang, and Zheng 2020). The papers in which these keywords are present talk about: smart cities in connection with CG and how citizen engagement can lead to benefits through the use of ICTs (Gordon et al. 2021); e-government as the application of public-private partnerships, and the use of ICTs to improve and increase the application of CG in different contexts (T. Liu, Yang, and Zheng 2020); urban governance is used when talking about the sharing economy and the benefits it could bring to cities (Meijer and Bolívar 2016).

Table 2: Most Relevant Words

Author Keywords (Top 10)	Articles
governance	8
collaboration	7
smart city	5
e-government	4
urban governance	3
cities	2
co-production	2
covid-19	2
data sharing	2
digital government	2

Source: Authors' elaboration using the bibliometrix R-package

From this point onwards, phase (05), of the interpretation of the research steps of Zupic and Čater (2015) begins. The graphical tools used to interpret the data are the Treemap, the Topic Dendrogram and others. The Treemap depicted in Figure 6 combines possible keywords in CG and Technologies. The keyword "Collaborative Governance" is closely

related to both the keyword "governance" and "collaboration". Within the studies discussing Collaborative Governance, this new mode of governance and collaboration between different (public-private) stakeholders is mentioned (Barandiarán, Restrepo, and Luna 2019; Xue, Zheng, and Hu 2022; Yang 2018). Regarding the link between "Collaborative Governance" and "Smart City" in some studies, such as Bolívar (2018) and Gordon et al. (2021), the two topics are strongly related to each other, as occurs in Figure 6. In numerous studies, CG is seen as a process to implement and create environmentally, socially and economically sustainable cities. As Malodia et al. (2021) identified, ICT enables public partners' effective and transparent implementation of governance actions. Turning to the relationship between "governance" and "e-government", studies discuss how ICT can and should revolutionise traditional governance in order to achieve better efficiency, transparency and more ambitious goals (T. Liu, Yang, and Zheng 2020; Malodia et al. 2021; Park and Kim 2022). In turn, "e-government" is closely related to both technological aspects such as "data sharing", "information technology", and "digital government" as well as application context aspects such as "urban governance" and "cities" (Lee, Park, and Lee 2019; Meijer and Bolívar 2016). Returning to the keyword "Collaboration" is in connection to the benefits it can bring, such as "energy efficiency", "green technology innovation", "sharing economy", and "social innovation" (Kou et al. 2021; Sun, Zhang, and Liu 2022; Yan et al. 2020; Yi et al. 2022).

Figure 6: Treemap
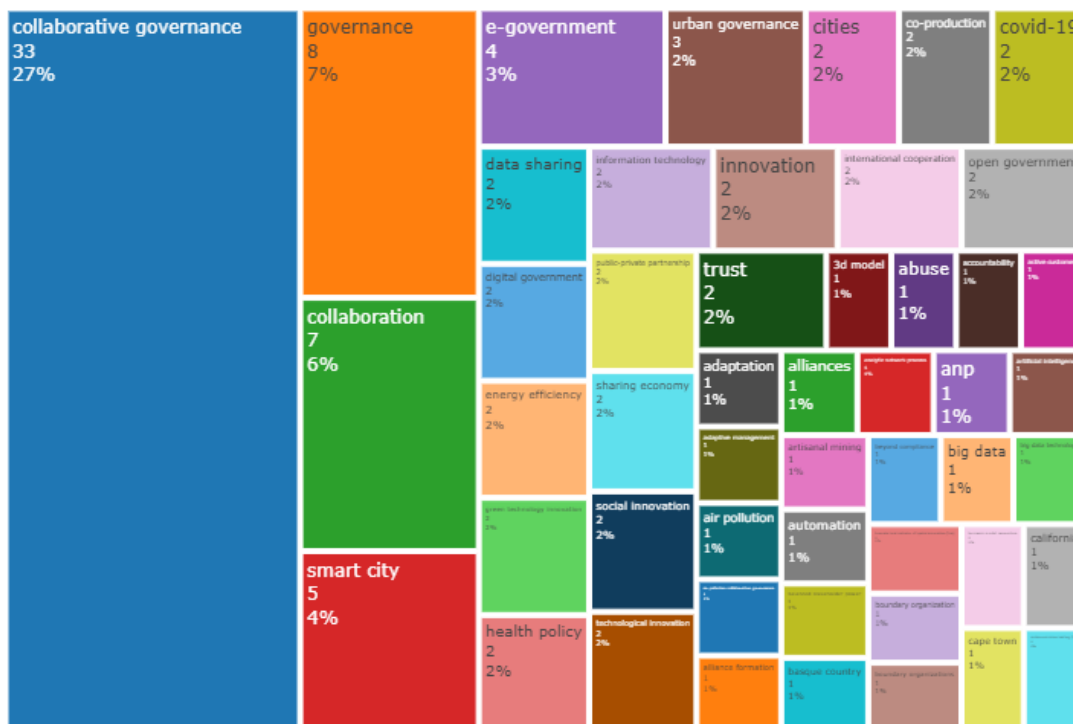
Source: Authors' elaboration using the bibliometrix R-package

The Topic Dendrogram (Figure 7) makes it possible to graphically represent the hierarchical order and relationship between the different topics addressed and identified by the

authors by representing the keywords grouped by the clusters (Andrews 2003). In this regard, Figure 7 identifies two macro clusters.

The red cluster contains keywords related to the application context of Collaborative Governance, i.e. smart cities and urban governance (Guerrero et al. 2016; T. Liu, Yang, and Zheng 2020; Meijer and Bolívar 2016). The following cluster is more related to application aspects inherent in the e-government and Collaborative Governance frameworks. Under urban governance, sharing economy and social innovation are present to bring additional benefits to citizens.

Turning to the blue cluster, which has the most divisions and developments, we can define several areas of interest and connection. The first division of the blue cluster is easily visible and interpretable because it compares aspects of information technology and innovation with aspects of CG (Y.-C. Chen and Lee 2018; Meijer and Thaens 2018). Delving deeper into the CG cluster, one notices a further branching out between aspects inherent to CG and aspects of e-government. Here is the division between the two frameworks taken as a reference. The red cluster can be traced back to the model of Ansell and Gash (2008), while in the cluster on the right, to the model of Malodia et al. (2021). Malodia et al. (2021). Underlying CG issues include digital government, open government, international cooperation, and co-production (Nurlybaeva 2021; Rogers and Weber 2010). On the other hand, underlying e-government is technological innovation, public-private partnership, governance, and collaboration (T. Liu, Yang, and Zheng 2020; Park and Kim 2022). These collaborative themes are closely related to technological ones because the latter can bring about considerable improvements in effectiveness and transparency.

Figure 7: Topic Dendrogram
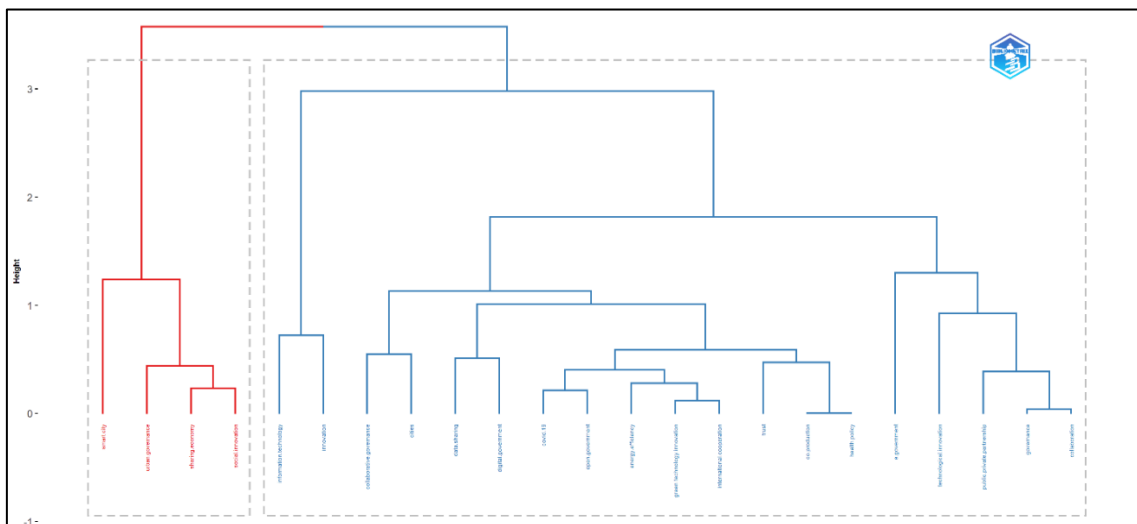
Source: Authors' elaboration using the bibliometrix R-package

Through Figure 8, it is possible to view the trending research topics during the entire analysis period from 2009 to 2022.

From 2012 to 2016, the relevant and constant reference topic was 'environmental management'. In particular, during this period, it can be defined as the management of the

environment, specifically aimed at counteracting the climate changes already occuring. (Yang and Li 2015).

From 2015 to 2018, with the peak of publications in 2017, the 'governance approach' was a trending topic. This topic can comprise its two main strands. The first strand concerns the government's approach toward a topic like environmental one related to climate change (Ziervogel, Pasquini, and Haiden 2017). The second concerns the multistakeholder government approach, i.e. public-private-partnership to achieve specific objectives (Mah and Hills 2014), closely related to Malodia et al. (2021).

Another trending topic is 'smart cities' from 2017 to 2018. Smart cities are defined as cities needing to build structures based on the involvement of multiple public and private actors to create public value (Bolívar 2018). In this quote, the way is perhaps opened for the first time for a substantial change in the management of cities and the need to create new forms of innovative governance based on the concept of network governance (Bolívar 2018). Smart cities may be the most obvious context for applying CG processes connected with ICT (Ansell and Gash 2008; Malodia et al. 2021).

The peak of the topic 'innovation', which occurred from 2017 to 2020, was in 2019. It is possible to define 'innovation' as intense trial-and-error learning processes to pursue global competitiveness (Mah and Hills 2014). Moving on to the topic "decision making", present only in 2020 in Figure 8, it refers to processes, decision-making and management structures in which one or more people confront each other and make a decision in public, private and civic spheres (Ziervogel, Pasquini, and Haiden 2017).

Finally, the last trend topic represented in Figure 8 that runs from 2019 to 2021 with a peak in 2020 is "collaborative governance". CG was already defined before this period, although it was not the main topic (Ansell and Gash 2008). What changes in this period is applying this now well-defined concept to the context. For example, one area of application is bicycle sharing in China (Z. Liu et al. 2020), in the tourism sector (Barandiarán, Restrepo, and Luna 2019) or in health and technology policy (Lang 2019). This topic will probably also be the trending topic in the years to come. There will be more and more cases of the application of CG through ICT. Even 2022 started with this trend connected with new technologies, as in the study by Sun, Zhang, and Liu (2022); J. Liu et al. (2022).

Figure 8: Trend Topics
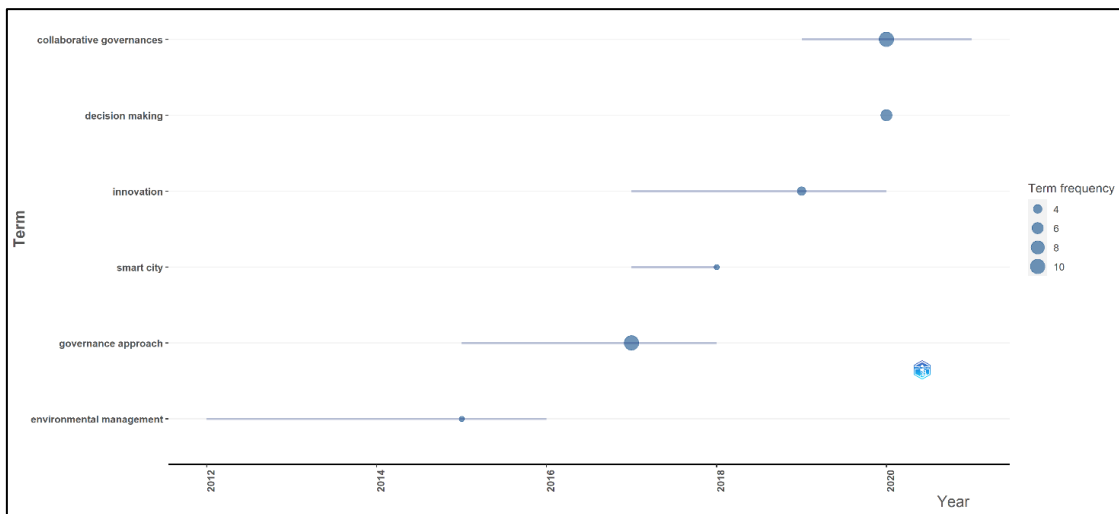
Source: Authors' elaboration using the bibliometrix R-package

DISCUSSION AND CONCLUSIONS

This section aims to conclude this study by providing insights, criticism and implications relating to the research strand analysed.

Using a scientific workflow and multiple research questions (Q1, Q2, Q3), we analysed the trend of scientific production inherent to the topic, any gaps within the literature, and the trend topics that occurred during this analysis period (2009-2022). To answer these multiple research questions, a bibliometric analysis was conducted using the open-source software R, particularly the R-package bibliometrix. This research provides a comprehensive analysis and understanding of the most relevant bibliometric variables inherent to CG and technologies, thus contributing to the advancement of scientific research in this field. This literature review highlights the lack of an unambiguous framework inherent to the link between CG and technologies. Consequently, future research could focus on determining and conceptualising this new theoretical framework.

This bibliometric analysis focused on determining research trends in publications done by authors, the number of citations and trend topics with CG and technologies as a reference theme. The most frequently used keywords are "Governance" (8 times) and "Collaboration" (7). Articles with the keyword "Governance" are often related to Collaborative Governance. These papers deal with cases where certain decisions need to be taken to manage better the context of reference, which can be the city context (Hwang 2017) of the sharing economy in Chinese cities (Z. Liu et al. 2020) or the health sector (Lang 2019). The articles with "Collaboration" as a keyword deal with collaboration between several stakeholders who have the will and purpose of achieving a common goal to improve the lives of citizens. In particular, in many studies, when it comes to Collaboration and co-production, it is strongly linked to the aspect of technologies because these enable significant changes in the relationships between stakeholders.

An example can be the paper by Friedman et al. (2009), which delves into the dissemination and adoption of health IT focusing on public-private collaboration. In addition, three areas where collaboration is a top priority were identified: security of health data, development of effective strategies to ensure acceptance of IT tools by health professionals, and interoperability. Another example can be the paper by Molnár and Svensson (2022), which shows how the introduction of new ICT did not lead to changes in formal structures or procedures but impacted attitudes towards data sharing and collaborative practices. The other words in succession to this order concern different aspects of CG but in each of them, the importance of the presence of ICT is highlighted. In fact, in these studies where the keywords "smart city" (5), "e-government" (4) and "urban governance" (3) are present, technologies are seen as fundamental to the proper implementation of these aspects with collaborative governmental processes. In papers with 'smart cities' as a keyword, they are often used as a context for applying CG (Meijer and Bolívar 2016). In addition, as in the paper by Bolívar (2018), an attempt is also made to analyse the use of new technologies by municipal administrations in smart cities to improve citizen participation. Another study taken as a reference can be that of Gordon et al. (2021), which analyses an attempt at collaborative smart city governance in the city of Boston in which specific areas were governed by residents and entrepreneurs, who decided whether, where and why to install technologies in the public environment temporarily. When the word 'e-government' is analysed, it is found in papers where technologies have been adopted or the public sector considers the importance of public-private partnerships (T. Liu, Yang, and Zheng 2020). Other studies focus on what factors determine citizens' use of government technologies to enjoy the benefits of e-government (Lee, Park, and Lee 2019). The keyword 'urban governance' is related to smart cities because it is through this type of governance that change within cities is possible by making them smarter, an example being the city of Amsterdam (Meijer and Bolívar 2016). The city can produce better wealth, health, and sustainability results through smart urban governance.

The importance of ICT for successfully implementing CG, highlighted by the most frequently used keywords, underlines the lack of a theoretical reference framework. The same underlining can also be inferred from the Treemap analysed within the results section. Here, too, ICTs are seen as a tool to revolutionise traditional governance. ICT must enable improved communication and relations between stakeholders and allow the implementation of high utility services for the citizen. Moving to the application areas of Collaborative Governance, it will be possible to create collaborative processes within cities, making them smart through urban governance and other sectors such as wind and health (Lang 2019; Mah and Hills 2014). In the Treemap, technological aspects are also among the most relevant keywords, such as 'data sharing', 'information technology', 'digital government' and 'sharing economy'. These keywords are related to Malodia et al. (2021) framework, which states that digital technology orientation can benefit stakeholders' actions.

Within the bibliometric analysis, the Topic dendrogram was used. The two main strands concern: the application areas in which CG processes can be implemented between different stakeholders; the characteristics an excellent CG process must have. In particular, also in this analysis, as seen above, the context in which CG has been most adopted is

smart cities. The second strand concerns the characteristics that a good CG process must include. In particular, this second aspect is linked to the two frameworks taken as reference inherent to CG and e-government. There is a solid references to the benefits that technologies bring for communication between stakeholders and for implementing of actions conceived by the collaborative and co-production Malodia et al. (2021). Regarding aspects inherent to Ansell and Gash's (2008) framework, the importance of trust, collaboration and co-production is highlighted. From this analysis of the topic dendrogram, it is possible to confirm the necessity and importance of the determination at the conceptual level of a framework linking CG and technologies.

Furthermore, the Research Topic Trends analysis shows this trend towards an increase in the interest and number of publications on innovation and Collaborative Governance. The Annual Scientific Production and the Trend Topic analysis show how the number of publications and research topics has changed over time. From 2012 to 2016, the trending topic was environmental management, with few publications. The first publications were related to these topics because CG was seen as a process for solving environmental problems, as mentioned in the study by Kallis, Kiparsky, and Norgaard (2009). Since 2015, the trending topic has been smart cities and innovation, resulting in increased scientific production. This increase has also occurred due to the World Vision International and the Partnering Institute's affirmation of the 2030 Agenda. This statement underlines the importance of expanding multi-stakeholder collaborations compared to today's levels. While in the previous period, the context of reference was overcoming environmental problems, since 2015, smart cities have had a more significant application. Subsequently, since 2020 there has been a relationship between innovation and Collaborative Governance, leading to a further increase in scientific production. In particular, the term innovation is associated in numerous studies with technological innovation (Hwang 2017; Sun, Zhang, and Liu 2022; Yi et al. 2022). This makes it possible to emphasise how the relationship between CG and technologies is also visible in the analysis of trend topics. Numerous Chinese, Dutch and Italian studies within bibliometrics highlight the necessity of effectively using technologies to implement Collaborative Governance. In this case, creating a common theoretical framework within the literature could enable the achievement of remarkable results for both the literature and the stakeholders and citizens who will benefit from new public value through a new governance process.

Like any research, the present study also has limitations. Firstly, only the Scopus database was used to perform the bibliometric analysis of the literature. Secondly, not all sources discussing the topic are indexed on bibliometric databases such as Scopus databases and consequently, their studies were not considered. Thirdly, a further limitation of the conducted research concerns the data collection and analysis period. Another limitation concerns the sample, which comprises only academic studies and does not focus on the evidence provided by professionals in non-scientific journals. Consequently, there are no papers published by public and private bodies concerning the implementation of CG processes and technology adoption.

Some possible future lines of research are also to conduct qualitative interviews with public administration bodies and private companies to understand best practices and study them from a theoretical perspective. In addition, in this way, it will be possible which

variables and aspects will enable an increase in the probability of success in the implementation of CG. Since numerous studies have emphasised the importance of technologies as an element of communication and sharing, these qualitative studies could be used to analyse which ones are best. Given the limitation of the digital divide, which is present in some of the studies analysed above and in the framework of Malodia et al. (2021), it could be interesting to define a minimum level of IT skills that institutions must have. Another limitation to an efficient adoption of CG is the incompatibility between the technologies used. It might be interesting to identify which technologies are most effective for communicating and sharing data and, simultaneously, which are not compatible. In this way, it will be possible to avoid such issues for stakeholders after the start of the collaboration. CG must find the right mix between governance and accountability on the one hand and flexibility, creativity and adaptability on the other. Defining the most appropriate mix through a qualitative study that identifies and analyses best practices could be interesting. It is interesting to compare realities in which CG and technology adoption are high versus countries that do not have widespread technology adoption. This comparison aims to see how powerful the technologies are for the level of adoption of Collaborative Governance. Further future research could concern the application study of CG processes in cities with less than 100,000 inhabitants, as the studies analysed only concern large cities. This research should understand whether the best practices of large cities are replicable in small cities. The same objective of comparison could be achieved with in-depth studies concerning states with fewer local authorities' actions aimed at citizen involvement. A further research focus for researchers is understanding how Covid-19 has impacted CG's implementation or future implementations concerning technologies in specific contexts. In particular, given the social distancing, whether the Covid-19 pandemic has enabled a breakthrough in the use of technologies to communicate and share information or slowed down collaborative processes between stakeholders.

The theoretical and practical implications are listed below. The theoretical implications of the study highlight some CG models implemented in different contexts, such as smart cities, the sharing economy and the health sector. These examples of collaboration between different stakeholders could be helpful to understanding on a theoretical level how the models were structured, which ICTs were used and which policies were adopted to regulate the different aspects. From a theoretical point of view, these application cases can demonstrate how relevant ICT is to succeed in different cases. At the same time, the bibliometrics provides insight into the average level of complexity and numerosity of the different CG approaches in the contexts in which it was applied.

The practical implications of this bibliometric analysis allow managers to study case studies adopted and implemented in different contexts by identifying relevant information that may allow replicability in other contexts. At the same time, as ICTs are evolving rapidly in this last period, managers could identify new ICTs that allow further development of CG processes by improving effectiveness and efficiency. At the same time, workers in public organisations could understand and analyse successful CG cases and replicate others in their context by structuring similar collaboration processes.

A future research trend concerns the analysis of whether there is a relationship between the country's technological development and the implementation of CG approaches. In

this sense, it will be possible to understand whether the greater implementation of CG in China in different contexts, such as smart cities and renewable energy, compared to other states, is justified. The bibliometric analysis suggests another possible research to be conducted in the future. In particular, it might be interesting to investigate whether there is a relationship between the successful implementation of CG processes and the average level of education in the target country. Regarding the technological aspect, some future research might concern a relationship between the development of new ICT and the adoption of new CG processes by other institutions. As a further avenue of research, one could investigate within the academic world whether some successful CG processes have been taken as a reference for implementing CG processes in other contexts. At the level of qualitative research, it would be original to analyse the average number of collaborating stakeholders in CG processes that have been implemented over time. In this way, it might be possible to identify a trade-off between the number of stakeholders involved and coordination complexity, as highlighted in the framework of Malodia et al. (2021).

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