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Public-private partnerships in smart cities: A critical survey and research agenda

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ABSTRACT

Urbanization is recognized as one of the megatrends of our society, leading to substantial efforts to create effective and smart cities. The scale of this effort is unsuitable for a single player, instead necessitating joint efforts from multiple stakeholders. The global expansion of smart cities has subsequently led to increased research efforts toward building effective smart cities. In theory and practice, collaboration is pivotal for effective urban development, most often seen through the establishment of public-private partnership (PPP). Past research has explored these partnerships in smart city projects. Although PPP is considered to be an effective means to facilitate smart city development, the concept of smart cities remains rather vague and ideological. PPP for smart cities has been substantiated in several case studies; however, a thorough review is lacking. Therefore, to synthesize the existing literature, we carried out an in-depth integrative literature review. From this basis, we executed a content analysis and four key themes emerged: localness, stakeholder complexity, tension, and trust-building. These four themes form the basis of our proposed model and describe the key elements influencing PPP formation in smart city projects. We argue that the partnerships involved in smart city projects need further refinement to allow for transparency and involvement in various contexts. This paper provides timely contributions to smart city research by synthesizing the extant literature as well as laying the foundation for a future research agenda. Critical perspectives are also offered for future practitioners.

1. Introduction

More than half of the world's population currently lives in urban areas, and more than six billion people are expected to be city dwellers by 2050 (United Nations, 2019). Considering these fast-growing urban populations, cities are embracing opportunities as well as facing challenges. Cities that adopt digital technologies to solve urban problems are often called "smart cities," but the development of smart cities goes beyond the technical aspects of their evolution. The concept of smart cities has been evolving as a popular approach to mitigate urban problems and an arena for nourishing urban innovation (Han & Hawken, 2018; Praharaj, Han, & Hawken, 2018). However, no agreed-upon definition is seen of what a smart city entails – perhaps it can even be called a fad – though it comprises intertwining digital and physical aspects (Valverde, 2022). A smart city can be conceptualized as "an integrated and multi-dimensional system that aims to address urban challenges based on a multi-stakeholder partnership" (Fernandez-Anez, Fernández-Güell, & Giffinger, 2018, p. 6). Maye (2019) also argues that smart technology and social innovations should be combined to build smart cities. The rise of smart cities has seen a concomitant increase in research on the practice in the last decade. Extant case studies worldwide on smart cities demonstrate their diversity of forms, objectives, and embedded complex power relations between stakeholders (Miller, Ward, Burns, Fast, & Levenda, 2021).

The development of a smart city requires vast resources, which makes it difficult for any player to supply all the necessary resources single-handedly. For example, past research has found that only 16% of cities in the world can self-fund smart city projects (Fishman & Flynn, 2018). The development of a smart city is usually divided into several projects, such as e-government portals, bicycle-sharing platforms, and open data initiatives. In addition, a smart city project can be described as a challenging technology diffusion project operating between the public sector and the private market in a dynamic space (Clark, 2020). Thus, a commonly used approach in smart city development is to bring the private sector into play to supply complementary expertise, share risks, and provide innovative solutions for the public sector. For instance, studies have highlighted using public procurement as a policy tool to spark innovation (Uyarra, Zabala-Iturriagagoitia, Flanagan, & Magro, 2020). Moreover,

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Siokas, Kelaidi, and Tsakanikas (2022) demonstrate that partnerships with private and public entities provide a means to achieve the initial goal and therefore lead to the completion of smart city projects. In such a partnership, the public and private sectors cooperate and "share resources, risks, responsibilities and rewards with each other for the achievement of joint objectives" (Kwak, Chih, & Ibbs, 2009, p. 52).

Although a range of conceptions of public-private partnership (PPP) exist, Hodge and Greve (2017) suggest five levels when considering PPP performance—individual project, project or organizational delivery form, policy or symbol of private sector role in economy, governance tool or style, and local/historical context of what constitutes "public" and "private" in a given society. Past research contributions have explored collaborations between public and private actors in smart city projects. While the smart city concept has been springing up around the globe, newer research suggests that there is a cooling down in government-deployed smart city projects worldwide (Mathis & Kanik, 2021). Nevertheless, urban problems such as crowding, income inequality, and housing still exist and are even exacerbated (Rodríguez-Pose, 2018). The COVID-19 pandemic painfully revealed the vulnerability of cities (Florida, Rodríguez-Pose, & Storper, 2021; Nathan, 2020) and the importance of cross-sector collaboration in solving grand challenges (McGahan, Bogers, Chesbrough, & Holgersson, 2021).

Despite numerous attempts at defining PPP (Hodge & Greve, 2017), a PPP for a smart city is a vague term that has frequently been used as an umbrella term for various arrangements. As Valverde (2022, p. 1) argues, 'PPP' is one of those highly ideological and vague terms – like 'democracy' or 'the rule of law' – that appear to refer to something specific but are so vague that much space is provided for authorities of various sorts including private ones to carry out all manner of diverse activities.

Garvin and Bosso (2008, p. 163) define PPP as "a long-term contractual arrangement between the public and private sectors where mutual benefits are sought and where ultimately (a) the private sector provides management and operating services and/or (b) puts private finance at risk." Although the profit motives of private partners can be considered to ensure financial risks are mitigated, "no similar set of incentives tending to mitigate accountability risks" governed the Waterfront Toronto initiative, as Valverde and Flynn (2018) argue, "especially when the public partner is not an elected government, but an obscure agency run by an appointed board" (p. 123).

Despite its popularity, the PPP concept and its successes remain contested (Hodge & Greve, 2017). Thus, given the ideological nature and vagueness of what defines both smart cities and PPP, it is timely to clarify what knowledge can be obtained from the substantial body of recent literature, which mostly focuses on cases. This study examines (1) the current state of empirical research on PPP in smart cities, and (2) assesses emerging themes of interest for smart city research and practice. A synthesized overview is provided addressing these two questions in a rigorous literature review followed by in-depth content analysis of empirical studies. On this basis, we develop an emerging model. This study offers an analysis of PPP in smart city projects in practice to enhance the understanding of smart city development and cross-sector collaboration. Though recognizing that smart cities are dependent on context, we aim to synthesize convergent trends and lessons from existing practice.

Our findings contribute to academic literature and smart city practice. Based on the literature review and content analysis, we propose a model that highlights several themes for consideration in smart city development. Following Torraco (2005), we aim to provide critical analysis of the extant literature, synthesize new knowledge about PPP in smart cities, and highlight its practical implications for smart city practitioners. We provide a discussion of the findings and propose a conceptual framework. Finally, we present our conclusions and offer recommendations for future research agendas.

2. Methodology

2.1. Research design

To form new perspectives and suggest future research directions, this study reviews, critiques, and synthesizes representative literature on PPP in smart cities through an integrative literature review (Torraco, 2005; Whittemore & Knafl, 2005). An integrative literature review is designed to help "define the state of the art in a research topic and identify both progress and important gaps in the emerging literature" (Elsbach & van Knippenberg, 2020, p. 1284).

Following the integrative review guidelines from Torraco (2005), we created a replicable search strategy and conducted a broad search for existing literature on PPP in smart cities through a multidisciplinary approach. The review was limited to peer-reviewed journal articles published in English prior to June 2022. The search query was first conducted in July 2020, updated in October 2020, and updated again in June 2022 for review purposes.

To conduct a broad, multidisciplinary review, we used seven databases covering multiple disciplines: Academic Search Ultimate, Business Source Complete, EconLit with full text, Science Direct, SAGE, Web of Science, and Scopus. The following keywords were used for searches in all seven databases: "Public-Private Sector Partnership" OR "Public-Private Partnerships" OR "Private-Public Sector Cooperation" OR "Private-Public Partnership*" OR "Partnership Public-Private Sector" OR "Public-Private Sector Cooperation" OR "Public-Private Partnership" OR "PPP") AND ("smart cit*" OR "smart city". The searches revealed that the first article on PPP & smart city appeared in 2006, while the first scholarly (peer-reviewed) article appeared five years later in 2011. Most of the scholarly publications found were from the last seven years. Therefore, the time frame of the literature search was set by the search results, from 2011 to June 2022.

2.2. Data collection and analysis

The initial search in allowed the keywords to appear "anywhere" within the text, generating 227 journal articles for review. However, after screening the abstracts, it became apparent that many of the studies were not relevant to studying PPP in smart cities. Therefore, the search criteria were refined to extract the most relevant academic articles. Following Shuck (2011), the search criteria were limited to keywords appearing in the abstract, keywords, subject terms, and title to enable the extraction of the most relevant studies. With these refined search criteria, we gathered 140 academic articles published prior to June 2022. After removing duplicates, 77 unique academic articles were identified. All unique studies were screened for relevance by examining each abstract and article structure to ensure that the selected works covered some aspect of PPP in smart cities. This relevancy screening filtered out 24 studies, leaving 53 relevant articles. When we carefully examined the 53 articles, a paper on the iconic PPP project Sidewalk Toronto emerged, which was included in further analysis. Therefore, we have a set of 54 articles contained multiple types of studies, including empirical studies, review articles, and other types. Fig. 1 shows the literature search process in detail.

Out of the 54 relevant articles stemming from the literature search, 13 empirical studies focused on the process of PPP in smart city projects. This literature review focuses explicitly on emerging themes of interest in PPP in smart city projects. Therefore, empirical reality is instrumental in finding emerging themes of interest for smart city research and practice, helping "illustrate patterns and themes across states" (Drapalova & Wegrich, 2020, p. 674). Based on the need to disentangle how a PPP unfolds in practice, we included the 13 empirical studies in the content analysis to synthesize qualitative evidence. All 13 empirical studies were carefully read and organized in NVivo for coding and contrasting to allow for analysis and synthesis. We also used other relevant studies for context as additional supporting material, such as

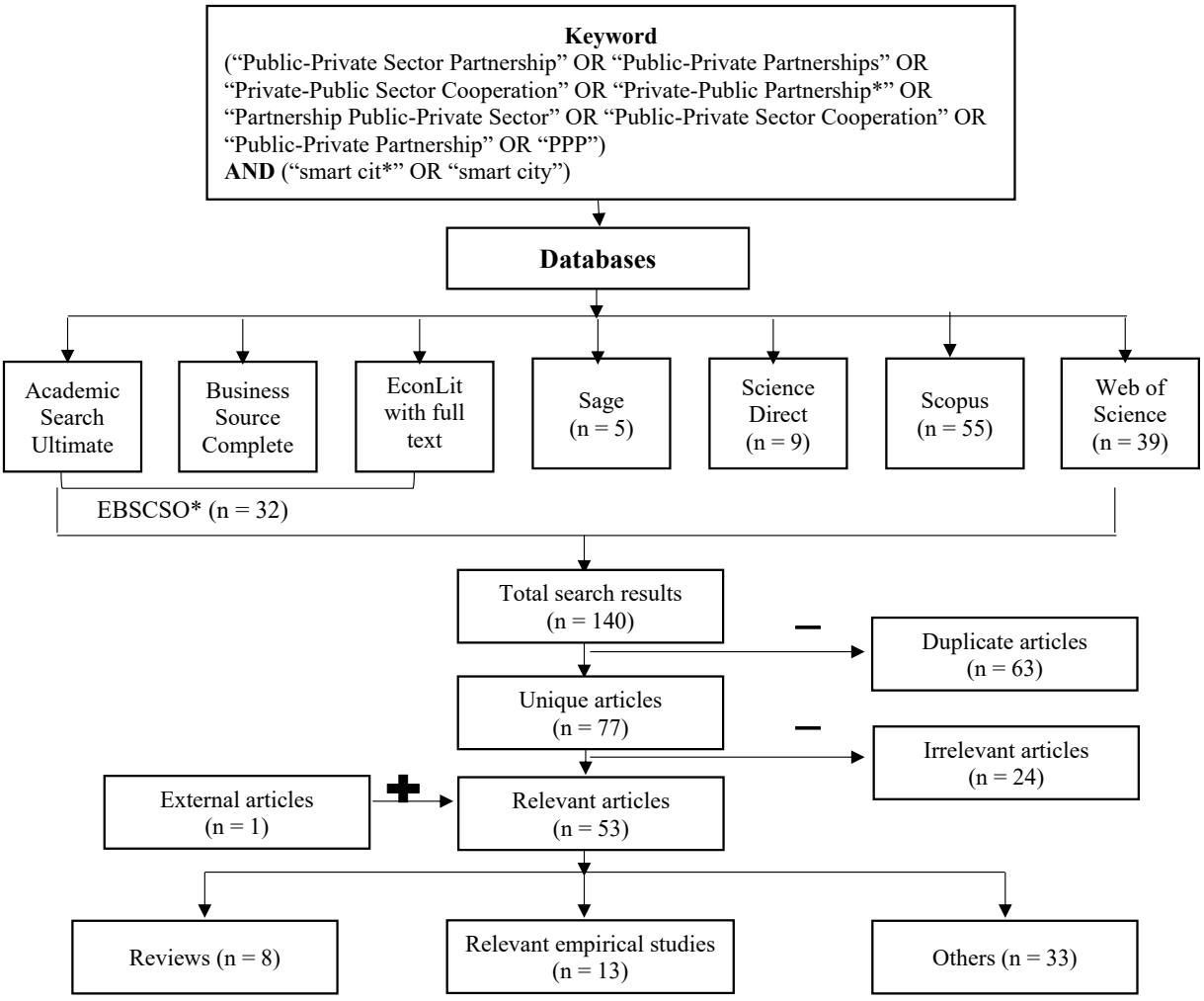

Fig. 1. Visualization of the conducted literature research process.

Valverde (2022) and Montero and Baiocchi (2022).

3. Findings – major themes, tensions, and key constructs

An in-depth content analysis was conducted on the 13 empirical studies identified in the literature search (see overview in Table 1). Based on this content analysis, four key themes emerged, including "localness," "stakeholder complexity," "tension," and "trust-building." We discuss these themes in this section.

3.1. Localness

Unsurprisingly, the studies in this literature review illuminate the role local context plays in smart city projects. Neirotti, De Marco, Cagliano, Mangano, and Scorrano (2014) study trends in smart city initiatives, revealing that local context factors have considerable influence on the evolution patterns of a smart city. Paper 6 reveals that it is essential for firms to gain "knowledge on [the] local market and institutions through a relational approach" (Sandulli, Ferraris, & Bresciani, 2017, p. 616). Local context is widely discussed across the 13 studies and is a vital factor for consideration in smart city development.

Several success stories highlight the favorable local context for smart city projects. Paper 2 notes that the Barcelona City Council has been providing detailed information about the municipality to its citizens since 1995. This long tradition of transparency has contributed to the open data initiative. In paper 4, the authors highlight that Aarhus, Denmark, is well-suited for smart city experiments because of its young population with a high educational background. Paper 10 emphasizes that Toronto is a city with a rapidly booming technology industry, which made the city favorable for frontline smart city experiments. A few studies also discuss the institutionalization of smart cities at the local level. In paper 5, the authors discover that political instability and a lack of institutionalization are major risk factors for PPP in smart cities in Pakistan and Bangladesh. In paper 12, Pianezzi, Mori, and Uddin (2021) also emphasize the effect of cultural and historical conditions in the context of smart cities, highlighting that PPP in smart cities is based on the traditional samurai ethos in Japan.

Local firms are often considered to have deep knowledge of the local environment. With the critical role of localness, international corporations often partner with regional firms because of the multinationals' dependency on local knowledge to meet regional needs. Paper 2 argues that collaboration should extend beyond PPP to inter-firm collaboration. The authors affirm that "collaboration across firms is more likely to involve firms that offer complementary options for municipalities or local companies with deep knowledge of local markets" (Berrone, Ricart, & Carrasco, 2016, p. 62). For instance, an empirical case study in paper 6 demonstrates that allying with local partners can help multinationals efficiently absorb local knowledge.

3.2. Stakeholder complexity

Smart city development is not only a technical or economic issue but also involves the overall social system (Dameri & Benevolo, 2015). PPP in smart cities is dependent on the engagement of several stakeholders,

Table 1
Summary of selected empirical studies on PPP in smart cities.

No.	Authors & Year	Location	Methods	Purpose
1.	Dupont, Morel, and Guidat (2015)	France	Multi-case study	Discusses the key role of universities in generating a smart city.
2.	Berrone, Ricart, and Carrasco (2016)	Barcelona, Spain	Single case study	Proposes a five-step framework for open data initiatives in the city context based on Barcelona's success story.
3.	Dameri and Benevolo (2015)	Italy	Literature analysis, survey	Demonstrates that there is no universal smart city governance framework.
4.	Snow, Håkonsson, and Obel (2016)	Aarhus, Denmark	Single case study	Illustrates a set of lessons learned from the implementation of Smart Aarhus initiatives.
5.	Anwar, Xiao, Akter, and Rehman (2017)	Dhaka, Bangladesh, Lahore, Pakistan	Mixed methods (meta-review, questionnaire)	Examines major risk factors for the sustainable establishment of PPP projects in developing nations, focusing on Bangladesh and Pakistan.
6.	Sandulli, Ferraris, and Bresciani (2017)	International	Multi-case study	Explores how firms select the right city to test, develop, or sell smart technologies and identifies three aspects of successful partner selection.
7.	Ferraris, Santoroa, and Papa (2018)	International	Multi-case study	Discusses how firms manage open innovation with public partners in a smart city project and summarizes two distinct strategies.
8.	Karsten (2018)	Germany	Single case study	Shows how different stakeholders' goals and perspectives are united and therefore generate win-win situations.
9.	Lam and Yang (2020)	Hong Kong	Questionnaire survey and focus-group meeting	Examines 14 criteria identified from the literature review for city managers to assess the suitability of PPP in smart city development and then tested with evidence from Hong Kong.
10.	Morgan and Webb (2020)	Canada	Single case study	Explains ongoing smart city experiments and proposes that disruptive urban innovations are being contested by the city's civil society.
11.	Pittaway and Montazemi (2020)	Canada	Multi-case study	Identifies the know-how that local government managers require to lead digital transformation.
12.	Pianezzi, Mori, and Uddin (2021)	Japan	Single case study	Focuses on historically and culturally embedded partnerships between government and businesses.
13.	Jayasena, Chan, Kumaraswamy, and Saka (2022)	Hong Kong	Single case study	States that managing stakeholders, a citizen-centric approach, and maintaining transparency throughout the PPP project are keys to success.

which is highlighted in the content analysis herein. The content analysis reveals that the term "stakeholder" is broadly defined and refers to citizens, firms, governments, academic institutions, and agencies that may exert influence on smart city projects. Our analysis demonstrates that stakeholder complexity, and in particular the handling of stakeholder complexity by governments and private players, is a critical issue echoed throughout the studies.

Several studies in the review highlight the importance of identifying the stakeholders in both municipalities and firms involved in smart city projects. Moreover, early stakeholder engagement was raised as a pivotal element in the development of successful smart city projects. Paper 2 describes the success story of the open data initiative in Barcelona, Spain, suggesting that stakeholders may influence multiple dimensions (Berrone et al., 2016). Paper 4 extends this view, noting that one of the reasons leading to the favorable environment for developing a smart city in Denmark is the "long tradition of involving many different stakeholders in its decision and planning processes regarding urban development and environmentalism" (Snow, Håkonsson, & Obel, 2016, p. 93). Echoing the lessons learned from Smart Aarhus in Denmark, the implementation experience from the T-City initiative in Friedrichshafen, Germany, in paper 8 shows that "the goals and perspectives of different stakeholders can be united and that win-win situations can be generated" (Karsten, 2018, p. 2).

Furthermore, a few studies acknowledge the negative impact of improper stakeholder management. Paper 10 describes the secretiveness of the partnership between Sidewalk Labs and Waterfront Toronto and the lack of citizen engagement from the beginning of the project (Morgan & Webb, 2020). The authors further argue that this lack of transparency weakens the connection between local government and citizens in Toronto and that many Torontonians urged Waterfront Toronto to reject the business deal with Sidewalk Labs. The case involves resistance from civic society. A data collection proposal in the Sidewalk Toronto project gained the most public attention and consequently, Sidewalk Labs developed a data trust proposal. Leaving the data aside, Flynn and Valverde studied the legal aspects of this infrastructure as well as the role of the public partners. As highlighted in a recent book, Valverde argues that when a study was executed to investigate the legal documents that comprised the Sidewalk Labs deal, there was only one legal document to be found and "Sidewalk Toronto" even did not have legal existence (Valverde, 2022). After all, the latest development of Sidewalk Toronto demonstrates the termination of the whole project (Jacobs, 2022). Evidence from Hong Kong presented in paper 9 reveals similar issues (Lam & Yang, 2020). In this case, however, the local government in Hong Kong tried to mitigate citizens' concerns about privacy issues concerning 5G and Wi-Fi services before the private sector's involvement in projects based on such technologies.

3.3. Tensions among actors

In addition to stakeholder complexity, another theme arising from the content analysis is tension among actors. Several studies included reported tensions among various actors, such as paper 3, which indicates that there is still no mature governance practice at least in Italian cities (Dameri & Benevolo, 2015). Tensions between the public and private sector and techno- and citizen-centric smart cities are commonly discussed.

PPP in smart cities is embedded in a complex, volatile network involving various actors with divergent opinions. Several studies in this literature review underline the different standpoints of the public and private sectors regarding collaboration in smart city projects. Paper 9 notes that "fairness and accountability" are essential for the public sector, while "profit, business growth, and risk averseness" are critical to private-sector issues (Lam & Yang, 2020). The implementation experience of Sidewalk Labs in Waterfront Toronto also reveals tension between the public and private sectors. In paper 10, Morgan and Webb (2020) state that Sidewalk Labs made it clear that they were only interested in the project if there were public funding or incentives. From a corporate strategy point of view, Paper 7 affirms that the public sector's financial commitment to smart city projects is critical to increasing the success of collaboration (Ferraris, Santoro, & Papa, 2018).

In addition to tension between the public and private sectors, the collision between technology and citizens is a recurring subject in several of the empirical studies analyzed. A smart city project is a technology diffusion challenge, and with the rapid advancement of digital technology, governments are today in an ideal position to integrate data from citizens, private parties, and governments to create

mutual benefits (Pittaway & Montazemi, 2020). However, citizens have concerns about privacy issues, such as what happens to their data. For example, both papers 9 and 10 report privacy concerns from citizens regarding PPP projects (Lam & Yang, 2020; Morgan & Webb, 2020). In Toronto, Sidewalk Labs faced resistance from civil society and citizens launched the Block Sidewalk campaign to fight against the project (Flynn & Valverde, 2019; Valverde & Flynn, 2018).

When tension between stakeholders occurs, governments could be in an ideal position to mitigate the conflict. Several reports feature the beneficial use of dialogue between local governments and citizens, as well as highlighting expectations that the public partner is transparent and held accountable. For example, in paper 2, the authors examine open data initiatives in Barcelona, claiming that "open data then serve as a tool for citizens to monitor government performance" (Berrone et al., 2016, p. 41). In papers 4 and 8, empirical cases demonstrate ways for citizens to express their opinions (Karsten, 2018; Snow et al., 2016). For example, Smart Aarhus leaders launched Internet Week Denmark, which showcased digital products from companies and invited citizens to see which activities engage them (paper 4). As paper 3 summarizes from previous studies, "citizens' participation and private-public partnerships are fundamental to formulating an innovative smart city strategy" (Dameri & Benevolo, 2015, p. 697). Although citizens' participation appears beneficial, it does not always occur in practice. Upon reflection, and as demonstrated in several studies in the literature, the key principles are "accountability" and "transparency." The Sidewalk Labs deal was criticized for lacking these elements, as Valverde and Flynn (2018) reported: "After attending several events, and poring over documents and articles, we still do not know who is in charge, who benefits, who is accountable to whom" (p. 120).

3.4. Trust-building

Ten out of the 13 empirical studies reviewed acknowledged the crucial role of trust-building for PPP projects in a smart city. For example, paper 1 demonstrates that it is necessary to build trust and confidence with other collaborators (Dupont, Morel, & Guidat, 2015). Paper 11 also suggests that "a shared vision, trust and extrinsic incentives can counteract barriers" to interorganizational knowledge transfer (Pittaway & Montazemi, 2020, p. 9).

The content analysis reveals that it is beneficial for firms to build trust mechanisms at an early stage of a smart city project to ensure a smooth partnership with local governments. Paper 2 suggests that in an open data initiative, the most crucial activity for a firm is to build trust with the leadership group of the project at an early stage (Berrone et al., 2016). The study discloses that firms involved during early stages might be in a better position to participate at the value creation stage, after trust and collaboration have been achieved (Berrone et al., 2016). Similarly, empirical evidence from paper 6 indicates that it takes time to build trust mechanisms and stresses the significance of developing trust in firms. Paper 6 remarks that "firms need to develop strong relational capabilities in order to build the trust that facilitates more flexible and less bureaucratic relationships with the city" (Sandulli et al., 2017, p. 616). "Relational capability" refers to a firm's ability "to select the right partners, and to establish and maintain relationships with other firms" (Lechner & Dowling, 2003, p. 4). In the context of a smart city, strong relational capabilities can help firms foster trust with local governments and thus ensure smooth project delivery. Further highlighting the importance of trust-building, paper 7 emphasizes the role of trust in allowing the scalability of projects (Ferraris et al., 2018). Moreover, political stability has an impact on trust-building for PPP projects in a smart city. Paper 2 notes that political leaders can be instrumental in "creating the trust necessary to foster collaboration at the interorganizational level" (Berrone et al., 2016, p. 50). Similarly, paper 5 concludes that political instability can hinder trust among the actors, causing the project to fail (Anwar, Xiao, Akter, & Rehman, 2017).

In addition to trust-building between firms and local government, fostering citizens' trust concerning transparency is reported to be essential. Paper 8 recognizes that "it is important to address fears and worries and a generous portion of distrust towards new technologies" (Karsten, 2018, p. 11). In paper 12, Jayasena, Chan, Kumaraswamy, and Saka (2022) express that many citizens have lost trust in the selection of the private sector for smart infrastructure projects. In paper 9, the authors note that citizens may have misgivings about sharing personal data using technology.

Thus, trust-building among various stakeholders can generate direct and indirect benefits to PPP projects in smart cities, providing opportunities for firms and mitigating public concerns. In some contexts, local government can play an intermediary role in building trust between firms and citizens. For instance, Pianezzi et al. (2021) highlight that citizens think the government is more trustworthy than private corporations in a Japanese context (see "localness" highlighted as the first theme above). Meanwhile, much remains to be done to foster trust among actors, particularly between firms and governments as well as citizens' trust in data privacy. For example, Flynn and Valverde (2019, p. 1) found that a "muti-government agency, Waterfront Toronto, had transparency and accountability deficiencies, and failed to consistently defend the public interest from the beginning." In addition, "the public partner in the proposed 'deal' was not, as it usually is the case in smart city projects, a municipal corporation" (Flynn & Valverde, 2019, p. 1), which impacted the development of the Sidewalk Lab. Thus, transparency and accountability should be considered when developing smart city projects and focusing on trust-building.

4. Discussion

The literature review and subsequent content analysis have identified four essential cross-cutting themes for PPP in smart cities. As mentioned above, the themes are localness, stakeholder complexity, tension among actors, and trust-building. Based on these four key themes, we created an emerging model among the themes (see Fig. 2). The model describes key elements emerging from our integrative literature review that influence PPP formation in smart city projects.

The key theme that emerged from the analysis is **localness**, which points to the importance of context and suggests that, in line with (Kitchin, 2015), there is no one-size-fits-all smart city solution. When standardized technology meets local needs, the complex and uneven city infrastructure inevitably leads to various solutions as the technology is adapted to local contexts. For example, data collection in PPP projects has long been a critical but sensitive issue within smart city development. Data protection measures must also consider the local context.

Moreover, the practical implementation of smart city projects is impacted by localness, as the local environment strongly influences the way the PPP rolls out in smart cities. Unlike multinationals, local firms have expertise in the regions in which they operate and are well-positioned to adapt standard technology to local needs (Caragliu & Del Bo, 2019). However, small and medium-sized enterprises (SMEs) have little presence in the existing literature on PPP in smart cities. For instance, existing case studies often examine the experiences of multinationals and large IT providers (Morgan & Webb, 2020; Sandulli et al., 2017; Valverde & Flynn, 2018). Thus, collaboration between multinationals and local firms has been discussed in previous studies but merits further exploration.

Stakeholder complexity is highlighted in smart city research as smart city projects comprise and engage various groups and institutions within the broader ecosystem. The process of establishing PPP in smart cities encourages and is dependent on the interaction of different components within this ecosystem. As Fernandez-Anez et al. (2018) argue, stakeholder involvement is key to developing an integrated governance framework in smart city project implementation. This interaction of various stakeholders is spurred by smart city development that addresses multidisciplinary and global challenges requiring the engagement of actors from different fields.

In the content analysis employed in our literature review, stakeholder complexity has emerged as a key topic throughout the studies, receiving in-depth analysis. Stakeholder complexity in smart cities stems from the dynamics of broader ecosystems, which are "special types of systems in that their elements are intelligent, autonomous, adaptive agents that often form communities and also because of the way they adapt to elements being added or removed" (Gretzel, Werthner, Koo, & Lamsfus, 2015, p. 558). In ecosystems, groups of single actors establish relationships to enhance individual benefits and achieve shared goals (Boley & Chang, 2007). A city can be viewed as an ecosystem in which several subsystems interact with one another (Boley & Chang, 2007; Gretzel et al., 2015; Schiavone, Paolone, & Mancini, 2019; Walravens, 2015).

Despite the need to engage a broad group of stakeholders in smart city development and inciting a broader ecosystem, smart city literature and practice have tended to focus either on citizens or on other stakeholder groups (Marrone & Hammerle, 2018). Our review demonstrates the need for smart city research and practice to go beyond the mere acknowledgment that stakeholder complexity exists and further investigate this complexity and the underlying mechanisms involved in smart city projects. As Marrone and Hammerle (2018, p. 199) remark, "[C]ritical attempts to understand the perspectives of diverse stakeholder groups is lacking in the literature on smart cities." Smart city development is not only a technical or economic issue but also involves the overall social system (Dameri & Benevolo, 2015). Furthermore, engaging with stakeholder complexity and the legal aspects of smart city ecosystems is encouraged (Valverde, 2022).

The other themes that emerged from the content analysis were tension and trust-building. **Tension** is a natural consequence of stakeholder complexity and can occur when engaging a diverse set of actors such as those involved in PPP in smart city projects, where actors with different institutional logics meet and collaborate.

The tension reported in our findings refers to the strained relationship between the collaborative partners (that is, between the public and private sectors) as well as the tension between the public sector and citizens. Dupont et al. (2015) highlight that smart cities must listen to citizens' needs carefully and consider them in the development of smart cities. The consideration of public sentiment has crucial implications for the public-sector side of PPP. Similarly, lessons from Smart Aarhus (paper 4) emphasize the long tradition of engaging various stakeholders in decision-making. For example, Smart Aarhus has held various hackathons and workshops to gather contributions from all interested parties (Snow et al., 2016).

Particularly relevant for smart city projects is the tension arising between the technical and human sides of such projects (Caragliu, Del Bo, & Nijkamp, 2011). In our content analysis, this conflict is highlighted in citizens' concerns about privacy issues and data handling and storage in smart city PPP projects (see papers 9 and 10). A significant technique to mitigate this tension has been the use of dialogue between local governments and citizens. Through dialogue, trust between the government and citizens determines citizens' willingness to share personal data for service development (Economist Intelligence Unit, 2016).

Trust-building has been emphasized as vital in smart cities (Keymolen & Voorwinden, 2020; Kundu, 2019) as well as in PPP formation (Ferraris et al., 2018; Sandulli et al., 2017). Kundu (2019, p. 62) notes that "trust in a smart city is fundamental to its transparency, the participation of its people in governance, entrepreneurial initiatives, trade, commerce and hence the growth of its economy." Building citizens' trust in technology can accelerate smart city development (Goldsmith & Leger, 2019). For firms, papers 6 and 7 point out the significance of early-stage trust-building in forming successful PPP in smart city projects. We argue that trust-building is a key factor mitigating the tension arising from stakeholder complexity in PPP (see Fig. 2). Additionally, the role of localness must be considered to enable this successfully.

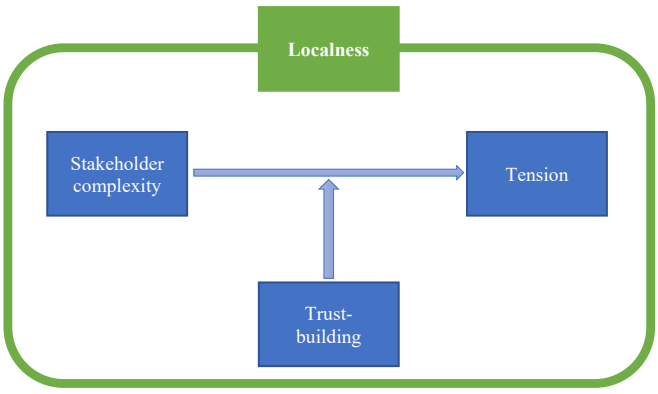

Fig. 2. Emerging model among the key themes.

5. Concluding remarks and recommendations for future research

In this paper, we conducted an in-depth empirical evidence synthesis to enhance our understanding of PPP in smart cities, which was distilled into four cross-cutting themes encompassing the fragmented and varied body of literature on the topic. Our attempt was not to find a universal solution in agreement with Kitchin (2015), but rather to synthesize and critically assess PPP and smart cities across the existing body of literature. The themes that surfaced from the in-depth content analysis were localness, stakeholder complexity, tension, and trust-building. These themes are interconnected within the smart city development process.

For future research, we identify several valuable pathways to pursue.

First, we suggest a requirement for further refinement of PPP and a more overarching view of how to assess PPP in smart city projects. This need became apparent in terms of stakeholder complexity, tension, and particularly, trust-building. To contextualize our argument with a specific example that might illuminate the need for public trust, we highlighted the case of Sidewalk Labs in Toronto, which received significant attention on data mining and privacy issues while the governance implications of the project were largely ignored (Flynn & Valverde, 2019). We therefore argue that future research should investigate PPP in smart cities using a diversity of resources or viewpoints to assess the project. One such example is the work by Valverde (2022) focusing on infrastructure and the legal contracts formed or missing in such projects. Interdisciplinary work disentangling these relationships from a variety of perspectives might be particularly useful. Moreover, a valuable pathway for future research would be to see whether a legal and constitutional framework in PPP initiatives affects the tension and trust-building within the projects. Moreover, as suggested by Hodge and Greve (2017), further understanding of what is meant by a successful PPP (and for whom), which is in line with our analysis, would be valuable in future analysis.

Second, the literature on PPP in smart cities large derives from case studies focusing on specific projects in one or more cities. Thus, another interesting avenue for research would be to delve into the potential for reformatted urban comparativism (Montero & Baiocchi, 2022). Moreover, Montero and Baiocchi (2022) argue in favor of focusing on urban processes rather than on cities. Considering our findings and our proposed emerging model, such a focus would allow researchers to understand the processes within PPP formation and execution in smart city projects. Moreover, our research lends support to Montero and Baiocchi's (2022) call for focusing on repeated instances rather than controlling for differences as we aim to synthesize the findings from existing smart city projects.

Third, further research is needed examining various trust-building activities as tension-reduction and collaboration-building measures. Our content analysis has highlighted the need for careful consideration of the context in which a smart city is embedded (given the points about

localness raised in this article). Smart city development often begins with standard technology; thus, another promising research direction would examine how multinationals respond to local needs and collaborate with local firms. This analysis would allow for a critical assessment and comparison of various processes, providing interesting pathways for future research.

CRediT authorship contribution statement

Xiangyu Quan: Conceptualization, Methodology, Investigation, Writing – original draft, Writing – review & editing. **Marte C.W. Solheim:** Validation, Writing – review & editing, Supervision.

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