Les éléments essentiels du passage à l'échelle des initiatives de ville intelligente : Une revue systématique de la littérature et un programme pour l'avenir

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Résumé :

Les expérimentations de villes intelligentes (*smart cities*) se sont multipliées ces dernières années, et la question du passage à l'échelle de ces initiatives est désormais devenue cruciale pour les pouvoirs publics. Toutefois, à ce jour, cette problématique n'a reçu que peu d'attention dans la littérature académique, notamment en management public où un état de l'art sur cette question fait actuellement défaut. Dans cet article, nous avons procédé à une analyse systématique de la littérature existante afin d'identifier les différents facteurs qui conditionnent à la fois la généralisation et la transférabilité des expérimentations de villes intelligentes. Nos principaux résultats montrent notamment l'importance des technologies numériques et de l'innovation pour permettre le passage à l'échelle des différentes initiatives locales. Nous proposons par ailleurs un modèle intégrateur qui permet, en articulant les travaux existants, d'identifier les perspectives de recherche restants à développer pour la recherche en management public dans ce domaine.

Mots-clés : transformation numérique, upscaling, villes intelligentes, gestion, transformation urbaine

Getting Down to the Nit-Gritty of Upscaling Smart-City Initiatives: A Systematic Literature Review and a Future Agenda

INTRODUCTION

Smart cities have developed very significantly over the last thirty years. Statista (2022) reports a 148.88-billion-dollar market in 2022, and, without surprise, "the concept of smart cities has gained significant momentum in science and policy circles over the past decade" (Sharifi, Allam, Feizizadeh and Ghamari, 2021: 1). As early as 2014, it was even considered "a red-hot topic on the urban strategy agendas of governments worldwide" (Dameri et al. 2014). In spite of the diversity of definitions (Albino, Berardi and Dangelico, 2015; Lim, Cho and Kim, 2021), smart cities appear to be the lever of value creation in cities (Pereira, Macadar, Luciano, and Testa, 2017; Meijer, Gil-Garcia and Bolivar, 2016), enabling them to cope with issues such as sustainability, poverty, and economic development (Lim, Edelenbos and Gianoli, 2019). While such research outcomes on smart cities are striking, the introduction of upscaling from smart-city experiments and pilots has remained problematic across cities. Despite a variety of studies, the knowledge on the topic remains fragmented, and it receives scant attention in the management literature. This lack of a synthesis of our collective understanding of the topic impedes the field's advancement when multiple concepts and overlapping arguments are introduced. Integrating existing knowledge will enable future research to better identify and position the contribution of knowledge to smart city upscaling in the management literature. Therefore, this study conducted a systematic literature review (SLR) of existing research to identify what is known in the literature and what remains unknown regarding the scalability and transferability of smart-city initiatives.

To conduct the systematic literature review, we used a five-step approach to overview the field of research and identify the state of knowledge in upscaling smart-city initiatives drawing upon lessons learned from different authors (Denyer and Tranfield, 2009; Fisch and Block, 2018; Hiebl, 2021; Rousseau, Manning and Denyer, 2008; Short, 2009; Snyder, 2019; Tranfield, Denyer and Smart, 2003; Williams, Clark, Clark and Raffo, 2021). Performing searches using Dimensions, Scopus and Web of Science, we examine existing literature published until 26

August 2022, and identify four axes that emerged from SLR: definitions and concepts; factors affecting upscaling and specific conditions needed to scale up; benefits and hurdles of upscaling; and management process.

The findings show that innovations and new technologies are at the core of the strategies deployed by public managers when they implement smart city programs. Also, over the past few years, researchers are studying ways to move from experimentation to scalable solutions and from urban experiments to upscaling solutions, ranging from urban living laboratories (Bulkeley, Broto, Hodson and Marvin, 2019), logistics projects (Sista and De Giovani, 2021) and smart lighting projects (Talmar, Romes and Valkenburg, 2022), to infrastructure (Choudhuri, Srivastava and Gupta, 2021; James, Jonczyk, Smith, Harris, Komar, Bell, and Ranjan, 2022) and smart project alliances (Bresciani, Ferraris and Giudice, 2017). However, the more comprehensive implementation beyond pilot projects through upscaling has remained problematic (van den Buuse, van Winden and Schrama, 2021; van Winden and van den Buuse, 2017). A recurring challenge is understanding how to upscale successful projects and generate more impact (van den Buuse et al., 2021), particularly considering that many often suffer from significant problems in scaling up the initial try-outs (Talmar et al., 2022). Thus, it is not easy to repeat the solution in another city or district (Uspenskaia, Specht, Kondziella and Bruckner, 2021), especially if costs do not remain affordable (Ciuffoletti, 2018).

The gaps identified in the literature indicate that it is necessary to integrate better the conceptualization of upscaling smart-city initiatives. Also, there is still an open discussion about the "how" aspects of upscaling to make smart city initiatives scalable and transferable. It shows the diversity of analysis across fields and opens up disciplinary silos, broadening the knowledge base for Management Science researchers and positioning it among the different areas. Moreover, it demonstrates that the "how" aspects of upscaling and the influence of stakeholders and institutions are still to be better understood. Hence, it recognizes that literature on smart cities, although fragmented, has been instrumental in understanding how digital technologies are adopted to scale up smart-city initiatives and the key factors influencing their scalability and transferability. Due to the mentioned gaps, this paper provides an integrative framework to help advance future research on the topic and contributes three key takeaways to the theoretical, empirical and managerial significance of upscaling smart-city initiatives. First, the research contributes to advancing the literature on the topic considering different approaches in Management Science and other fields (urban studies, science and technology, among others). Second, it proposes a future research agenda, leading to new research streams on managing

digital transformation to make smart-city initiatives scalable and transferrable. Third, the research provides public managers with valuable insights into what a smart city means, why digital transformation matters to the scalability and transferability of smart initiatives, and how cities manage their digital transformation – or not – to upscale smart-city initiatives.

The paper is organized as follows. The underlying method of the review is presented in the next section, followed by the findings regarding various concepts of upscaling, factors affecting its process, its necessary conditions, its benefits and hurdles, and its management processes. Then, the implications of the findings and new directions for further developing the research are discussed. Finally, the conclusion presents the contributions and future research challenges.

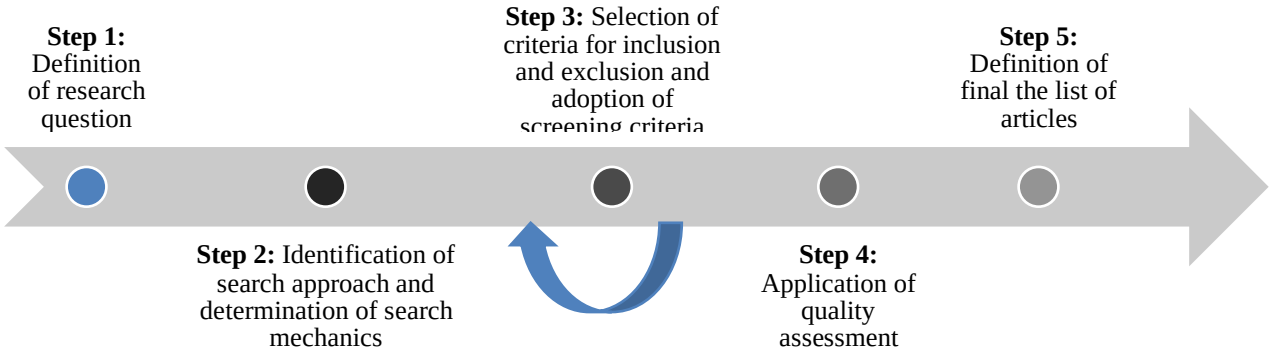
1.1. METHOD

In this section, we present the method of the systematic literature review (SLR) performed to understand the state of knowledge in upscaling smart city initiatives and identify opportunities for further research. An SLR provides a comprehensive overview of literature related to a research question and synthesizes previous work to strengthen a particular topic's foundation of knowledge (Williams et al., 2021). It also seeks to systematically identify, appraise and synthesize research evidence (Grant and Both, 2009). According to Snyder (2019), conducting a literature review is a systematic way to collect and synthesize previous research and aims to provide an overview of a particular issue or research problem. In addition, it creates a solid foundation for advancing knowledge and facilitating theory development (Webster and Watson, 2002). Furthermore, this method has been legitimated and widely used by relevant research especially in management (to mention a few examples: Farajpour, Hassanzadeh, Elahi and Ghazanfari, 2022; Guckenbiehl, Zubielqui and Lindsay, 2021; Kumar and Lee, 2022; Kumar, Sahoo, Lim and Dana, 2022; Piccarozzi, Silvestri, Aquilani and Silvestri, 2022).

Among the methods available to analyze and synthesize findings from a review (Ward et al., 2009), we applied a state-of-art analysis combined with a thematic analysis, defined as a method for identifying, analyzing and reporting patterns in the form of themes within a text (Braun and Clarke, 2006; Snyder, 2019). A Systematic Literature Review provides a "comprehensive overview of literature related to a research question and synthesizes previous work to strengthen a particular topic's foundation of knowledge, while adhering to the concepts of transparency and bias reduction". (Williams Jr. et al, 2021). It allowed this review to be more than a list of papers, providing a coherent lens to make sense of the knowledge (Webster and Watson, 2002) of upscaling smart cities. To structure this review and avoid bias on transparency, the procedure

involved five steps (Figure 1) based on methodological works on reviews in management research (Denyer and Tranfield, 2009; Fisch and Block, 2018; Hiebl, 2021; Rousseau et al., 2008; Short, 2009; Snyder, 2019; Tranfield et al., 2003; Williams Jr. et al., 2021).

FIGURE 1. Five steps adopted to conduct the Systematic Literature Review (SLR)



Source: Based on Denyer and Tranfield, 2009; Fisch and Block, 2018; Hiebl, 2021; Rousseau et al., 2008; Short, 2009; Snyder, 2019; Tranfield et al., 2003; Williams Jr. et al., 2021.

First, the focus of the review was determined and restricted by clearly stating the research question to be answered by this review, as follows: *What is the understanding of the needed processes to upscale smart-city initiatives, and what do we need to know to upscale efficiently across cities?*

Second, based on a database-driven approach, we decided to use Dimensions, Scopus and Web of Science, multi-publisher databases that cover the material by many publishers, which is aligned with the guiding research question. This choice of databases is in line with the proposed review's guiding research question (Thielen et al, 2016). Moreover, these databases have significantly different journal coverage: whereas Scopus has a wider coverage of journals, Web of Science is the most selective, and Dimensions is the most exhaustive (Singh, Singh, Karmakar, Leta and Mayr, 2021). It is also commensurate with the overall median and number of databases used, amounting to three (Hiebl, 2021). In this step, the search mechanics were established by defining the search terms to identify potential literature to be used based on the second step above. The search for content that fits with the research question (Hiebl, 2021; Williams Jr. et al., 2020) was in the title, abstract and author-provided keywords fields. The selected keywords and the Boolean search used are described in Table 1. The initial search in the three databases resulted in 1838 documents, including articles, conference papers, book and book chapters, reviews, among others.

TABLE 1. Selected keywords and Boolean search information

Database	Search Date	Keywords	Boolean search information
Dimensions (D)	25 Aug 2022	smart city, upscaling, scaling up, exploitation, experimentation, generalization, replication, roll-out, Pilot Project and their variations.	("smart cit*") AND ("upscal*" OR "scal* up" OR "exploitation" OR "experimentation" OR "generalization" OR "replication" OR "roll* out" OR "Pilot Project") searched in all fields
Scopus (S)	26 Aug 2022		(TITLE-ABS-KEY ("smart cit*") AND TITLE-ABS-KEY ("upscal*" OR "scal* up" OR "exploitation" OR "experimentation" OR "generalization" OR "replication" OR "roll* out" OR "Pilot Project"))
Web of Science (W)	25 Aug 2022		ALL= (("smart city" OR "smart cities") and ("upscal*" OR "scal* up" OR "exploitation" OR "experimentation" OR "generalization" OR "replication" OR "roll* out" OR "Pilot Project"))
			AB= (("smart city" OR "smart cities") and ("upscal*" OR "scal* up" OR "exploitation" OR "experimentation" OR "generalization" OR "replication" OR "roll* out" OR "Pilot Project") TI = (("smart city" OR "smart cities") and ("upscal*" OR "scal* up" OR "exploitation" OR "experimentation" OR "generalization" OR "replication" OR "roll* out" OR "Pilot Project"))
			AK= (("smart city" OR "smart cities") and ("upscal*" OR "scal* up" OR "exploitation" OR "experimentation" OR "generalization" OR "replication" OR "roll* out" OR "Pilot Project"))

Third, the criteria for inclusion and exclusion were established followed by the adoption of a screening criteria. The inclusion criteria were based on studies that reported evidence of analysis of the upscaling of smart-city initiatives. From the first search, all duplicates were excluded (536) by verifying titles and double-checking DOI references. This resulted in 1302 documents. Then, only articles, reviews and the ten most cited conference papers were included considering the selected keywords present in title, abstract or keywords, resulting in 557 documents. This choice considers limitations imposed by grey literature, in which various forms pose challenges for data management, extraction and synthesis, and the fact that it has rarely been through a peer review process, raising questions of quality (Adams, Smart and Huff,

2017). Although using this material could limit publication bias and make this research more comprehensive, the decision to use a database-driven approach to most articles published in journals has the advantage that this search can be reported as more transparent and traceable. To guarantee that a lack of transparency and traceability did not limit the database approach, the keywords, the exact search strings and the chosen filters (search query) available for the individual databases were shared, overpassing a limitation of database-driven approaches noticed by Hiebl (2021) that a transparent and traceable reporting of the search operations in the individual databases is not often seen among the reviewed articles. In addition to overcoming any potential gaps within the research and supplementing the search, all references mentioned in the selected sample were checked to verify if any mentioned study could contribute further with additional insights not mentioned by the papers analyzed.

No boundaries (time restriction) or type of research (non-empirical and empirical) criteria were used to limit the literature further. However, articles published after 26 August 2022, were not considered. Also, only one article was excluded based on language due to the impossibility of translating its entire content However, the abstract showed that its main focus was not related to the core topic of this research, with potential minor contributions. This contributed to avoiding introducing bias into the results as did by many review authors who omit articles printed in languages other than English (King, Davidson, Chitiyo and Apple, 2020).

The screening procedure adopted to analyze the 557 documents, initially, skimmed the research item's title for content fit only, moving into analyzing abstracts and keywords where a content fit could not be assessed (Hiebl, 2021). Next, all titles and abstracts were considered for relevance, and those not meeting the inclusion criteria were removed. This process was repeated to double-check the results. In total, the screening resulted in 147 documents to be screened manually. For these 147 results, a skim or complete reading of the full text was adopted (Hiebl, 2021; Iqbal, Akbar and Budhwar, 2015; Wilson, Arshed, Shaw and Pret, 2017) against the outlined inclusion criteria. The only exclusion criteria adopted was non-English language study that could not be translated using Google Translate or Deepl. Only one article was excluded using this criterion. The screening procedures resulted in a list of 77 articles.

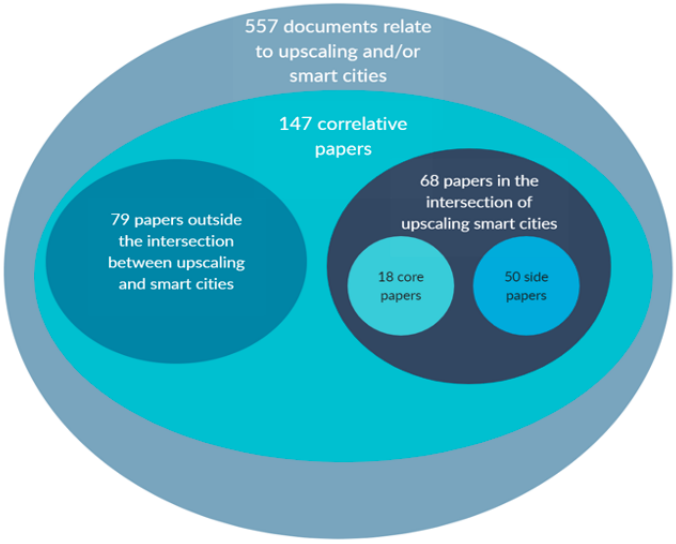
Fourth, a quality assessment was applied to evaluate the quality of the literature selected in the fifth step. According to Tranfield et al. (2003), within the management field, for instance, it may be possible to conduct a quality assessment of the research articles by evaluating the fit between research methodology and research questions. Based on Briner and Denier (2017), a checklist assessment was prepared with three main questions. Only articles that had positive

answers to questions ("yes") for the three questions were included in the sample. After this, 9 articles were excluded due to the checklist assessment. The procedure involved a checklist with three questions (yes/no):

- Is the study linked to the research question, even if upscaling is addressed as a peripheral issue?
- Has the study adequately described the discipline and theory being used?
- Are there clear findings identified by the study?

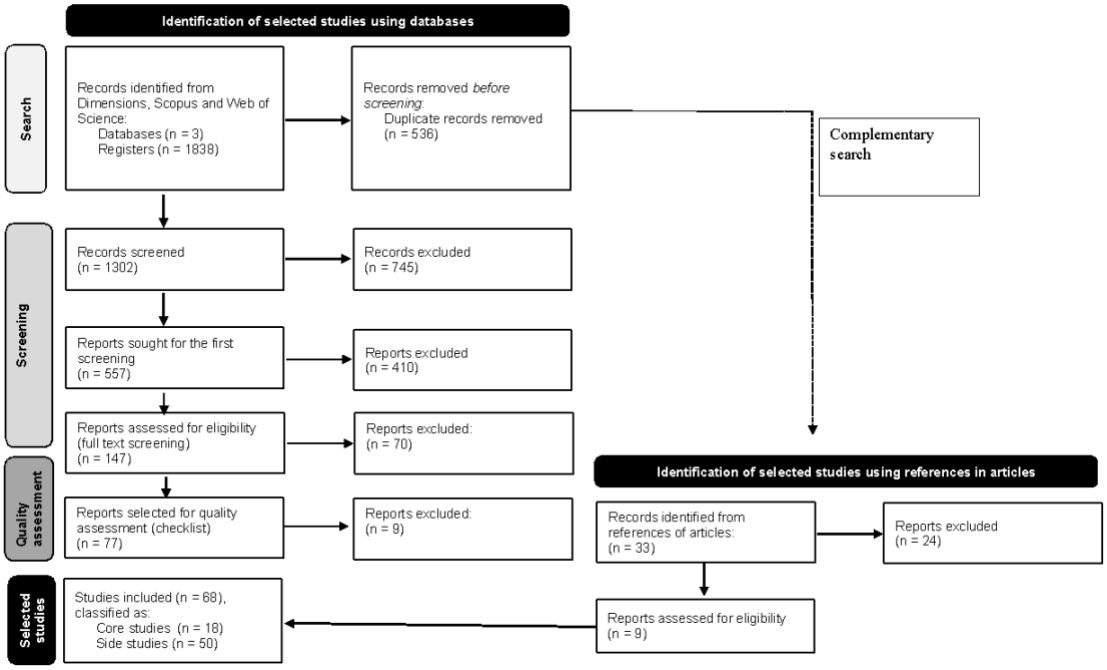
Fifth, since the aim of this study is to explore the concept of upscaling smart-city initiatives which lies at the intersection of these search terms, the overlapping literature was identified (Bejjani, Gocke and Menter, 2023). Therefore, we created a final list of the selected documents with 68 articles to process the data analysis (Figure 2), of which 18 were determined as core studies (directed related to the research question) and 50 were considered as side studies (peripheral contribution to the research question. We adopted this classification regarding core and side studies to refine the analysis of the results and better identify the core issues addressed by previous research on upscaling. Based on a focused coding method (Saldaña, 2015), we identified four axes of categories with significant or frequent codes that emerged from the initial coding: definitions and concepts; factors affecting upscaling and specific conditions needed to scale up; benefits and hurdles of upscaling; and management process. To develop and validate the coding, we first applied provisional and tentative codes and did a code trial with 5 specific articles. After that, the coding was then used to offer descriptive on the entirety of the sample of articles, and wherever patterns and relationships between categories could be identified, they are reported in the findings (Hiebl, 2021).

Figure 2. Selected literature



All essential studies searched were included to pursue the right balance between breadth and depth, but only those relevant to this review were selected (Figure 3). It is essential to note that this review strategy focused on prior works that have been central or pivotal to upscaling smart-city initiatives in order to search the literature and make decisions about the suitability of material to be considered (Paré, Trudel, Jaan and Kitsiou, 2015).

FIGURE 3. Identification of selected articles



The selected articles were published in 55 different journals. Considering it is an emerging field of research and we needed to cross disciplinary boundaries to take stock of the literature, it was important not to eliminate non-ranked peer-review journals. This allowed us to verify that the main research areas of journals with more than one publication relate to urban studies and engineering. Nevertheless, management science and co-related research area of business and economics show a positive and increasing result among the identified areas, considering the core papers (Table 2). Also, 13 out of the 55 journals are listed in the Association Journal Guide (AJG) list 2021 (24% of the sampling), demonstrating an increasing interest in journals stretching across fields that are central or salient to business and management studies. In terms of database, the relevance of the adopted approach is demonstrated by its results. More documents of the selected articles were found on Scopus (84%) than on Web of Science (71%) and Dimensions (69%). However, only 49% of all selected articles were found in the three databases in addition to 15% in both Scopus and Web of Science, 2% in both Dimensions and

Web of Science, 8% in both Dimensions and Scopus. Also, 25% of the selected results were found only in a singular database, having Dimensions contributed with 8%, Scopus with 12% and Web of Science with 5% individually.

TABLE 2. List of selected core papers

Authors	Title	Year	Source	Research Areas (WoS)	Citations		
					D	S	W
Brynskov M., Heijnen A., Balestrini M., Raetzsch C.	Experimentation at scale: challenges for making urban informatics work	2018	Smart and Sustainable Built Environment	Science & Technology - Other Topics	NA	7	5
Bundgaard L., Borrás S.	City-wide scale-up of smart city pilot projects: Governance conditions	2021	Technological Forecasting and Social Change	Business & Economics; Public Administration	1	1	1
Calzada I.	Replicating smart cities: The city-to-city learning programme in the replicate EC-H2020-SCC project	2020	Smart Cities	Engineering; Urban Studies	15	12	9
Choudhuri, B; Srivastava, PR; Gupta, S; Kumar, A; Bag, S	Determinants of Smart Digital Infrastructure Diffusion for Urban Public Services	2021	Journal of Global Information Management	Information Science & Library Science	1		1
Ciuffoletti A.	Low-cost IoT: A holistic approach	2018	Journal of Sensor and Actuator Networks	Telecommunications	NA	12	7
Cugurullo F.	Exposing smart cities and eco-cities: Frankenstein urbanism and the sustainability challenges of the experimental city	2018	Environment and Planning A	Environmental Sciences & Ecology; Geography	161	131	NA
van den Buuse D., van Winden W.,	Balancing Exploration and Exploitation in Sustainable Urban Innovation: An	2021	Journal of Urban Technology	Urban Studies	8	6	4

Schrama W.	Ambidexterity Perspective toward Smart Cities						
Ferraris A., Santoro G., Bresciani S., Carayannis E.G.	HR practices for explorative and exploitative alliances in smart cities: Evidences from smart city managers' perspective	2018	Management Decision	Business & Economics	37	35	31
James P., Jonczyk J., Smith L., Harris N., Komar T., Bell D., Ranjan R.	Realizing Smart City Infrastructure at Scale, in the Wild: A Case Study	2022	Frontiers in Sustainable Cities	Science & Technology - Other Topics; Environmental Sciences & Ecology; Urban Studies	0	0	NA
Kuguoglu B.K., van der Voort H., Janssen M.	The giant leap for smart cities: Scaling up smart city artificial intelligence of things (AIoT) initiatives	2021	Sustainability (Switzerland)	Sustainability and sustainable development *	3	2	2
Leminen, S; Rajahonka, M; Westerlund, M	Towards Third-Generation Living Lab Networks in Cities	2017	Technology Innovation Management Review	Business & Economics	NA	NA	29
Mendes, Claudia	Replicating European smart cities? The replication rationale in European Union mission statements and in practice.	2021	TATuP - Zeitschrift für Technikfolgenabschätzung in Theorie und Praxis / Journal for Technology Assessment in Theory and Practice	Technology assessment*	0	NA	NA
Nelson A., Toth G., Linders D., Nguyen C., Rhee S.	Replication of Smart-City Internet of Things Assets in a Municipal Deployment	2019	IEEE Internet of Things Journal	Computer Science; EngineeringTelecommunications	8	3	3

Okwechime E., Duncan P., Edgar D.	Big data and smart cities: a public sector organizational learning perspective	2018	Information Systems and e-Business Management	Business & Economics	22	25	22
Sista E., De Giovanni P.	Scaling up smart city logistics projects: The case of the smooth project	2021	Smart Cities	Engineering; Urban Studies	3	2	2
Talmar M., Romme A.G.L., Valkenburg R.	Enhancing the Replication Potential of Smart Lighting Projects	2022	Smart Cities	Engineering; Urban Studies	0	0	0
Uspenskaia D., Specht K., Kondziella H., Bruckner T.	Challenges and barriers for net-zero/positive energy buildings and districts—empirical evidence from the smart city project sparks	2021	Buildings	Construction & Building Technology; Engineering	8	7	7
van Winden W., van den Buuse D.	Smart City Pilot Projects: Exploring the Dimensions and Conditions of Scaling Up	2017	Journal of Urban Technology	Urban Studies	77	78	67

Note: D - Dimensions; S -Scopus; W – Web of Science. *Research area checked at the journal (not available at W).

Regarding the identified authors in the core papers of the sampling, only three articles did not register citation records in any of the three databases. (Table 2). The "citation" field in the table displays the number of times other items from Dimensions, Scopus, and Web of Science cited the record. Duplicate records across the citation indexes are usually only counted once. However, a record of a document can appear in multiple databases. Regarding the nature of the studies, all core papers were empirical research; on the method, all core papers were qualitative studies. Particularly, special attention should be driven to the core chosen papers. The results demonstrate a wide use of the case study method (Table 3). In terms of cases, the results also shed light on a high geographic concentration of analysis taking place in Europe and North America, although there is some balance among the choice between single and multiple case studies approach.

TABLE 3. Research elements identified in the core studies

Authors	Research question	Theoretical framework	Geographic location and number of case studies
Brynskov et al. (2018)	How experimentation with open Internet of Things data can be institutionalised in an inclusive manner at scale	Experimental cities (based on Evans et al., 2016)	Europe (2)
Bundgaard and Borrás (2021)	Under what combinations of governance conditions do smart city pilot projects scale-up from innovative experiments on a few streets into city-wide solutions?	Smart cities, innovation, knowledge management, and governance	North America (8), Europe (7) and Asia (2)
Calzada (2020)	Why might replication not be happening among smart cities as a unidirectional, hierarchical, mechanistic, solutionist, and technocratic process?	Social innovation perspective	Europe (5) and Africa (1)
Choudhuri et al. (2021)	What are the technical and non-technical determinants of successful smart digital infrastructure roll out in urban public services in India	Diffusion of Innovation theory (based on Rogers, 2003)	Asia**
Ciuffoletti (2018)	How a smart village can launch an IoT project with a limited initial investment and little or no external funding	Conceptual framework to cost evaluation	NA *** (3)
Cugurullo (2018)	No specific research question: it focuses on the implementation of the master plan and, more specifically, the extent to which so-called smart and eco-cities are built by methodically following a comprehensive plan of action, as their developers claim.	Concept of Frankenstein urbanism - Mary Shelley's novel metaphor	Asia (1) and Middle East (1)
van den Buuse et al. (2021)	Two interrelated research questions: how do firms manage exploration and exploitation activities in their technological innovation processes? to what extent can these insights be applied by city governments and other urban stakeholders who experience difficulties in scaling up technological innovations beyond an experimental setting?	Ambidextrous approach	Europe (1)

Ferraris et al. (2018)	How ambidextrous work in smart city work is supported through HRM systems? what does it mean to follow an ambidextrous strategy for managers, and how can HRM systems support this work? How can HRM systems be calibrated and deployed for ambidextrous work in contexts where different employees engage in either explorative or exploitative work? If the organization follows an ambidextrous strategy, collaborative work within and beyond the boundaries of the organization seems essential; in such a scenario, what are the implications for HRM systems?	Ambidextrous approach	Europe (7)
James et al. (2022)	What do the challenges and opportunities that realizing "smart city" concepts at scale present?	Organisation studies	Europe (1)
Kuguoglu et al. (2021)	Why most smart city applications that rely on AI or IoT, let alone AIoT, fail to scale up	Business strategy literature	NA****
Leminen et al. (2017)	What are collaborative innovation networks and their roles in cities? How can cities exploit such collaborative innovation networks?	Open innovation networks	Europe (6)
Mendes (2021)	What does the appropriation of the concept of 'replication' in the Strategic Implementation Plan tell us about the way cities and Europe are (re-)conceptualized? To what ends and to who is replication work of value, and who/what gets excluded? And how can the analysis of replication efforts help us understand the processes of urban development and European governance at stake?	Science and Technology Studies (STS)	Europe (1)
Nelson (2019)	How do we make it easier and more efficient to replicate Smart-City solutions from one city to another?	Innovation Action Research	North America (1)
Okwechime et al. (2018)	How public sector organisations deploy and integrate this new form of technology (big data) to another fast moving and relatively new concept (smart city)	Crossan et al's (Acad Manag Rev 24(3): 522–537, 1999) 4I model on organizational learning	Europe (2)
Sista and De Giovanni (2021)	Which factors influence the scalability potential of the SMOOTh Smart City Logistics pilot project?	Definition of smart and key scalability limited to factors related to expansion and roll-out.	Europe (1)

Talmar et al. (2022)	What are the mechanisms that facilitate the spread of innovative Smart Lighting (and more broadly smart city) solutions in public urban spaces	Organisation studies and transition studies	Europe (1*****)
Uspenskaia et al. (2021)	What are the common trends in technologies and replication strategies for positive energy buildings or districts in smart city projects	Three models: 1) van Winden's model (replication model); Morgenstadt Framework (replication model); and A. Radecki economic model (describing costs and benefits of a single smart city solution)	Europe (1)
van Winden and van den Buuse (2017)	No clear research question, but informed that the objective was to refine and unravel the rather broad concept of scaling and intended to better understand the conditions and requirements that drive or hinder upscaling processes in various types of smart city projects, enhancing insights in scaling processes	Interdisciplinary theoretical framework	Europe (3)

Note: C-conceptual; E- Empirical; *Conceptual approach with two case studies; **Study focused on India that follows inductive exploratory method, combining grounded theory and text mining for primary data analysis; ***The case study is based on Arduino, WiFi, and ThingSpeak; ****Interview with practitioners and researchers, but no specific case study.

1.2. FINDINGS

Table 3 highlights research elements from the selected core papers, including relevant information on the research questions, the nature of the research, number of cases and the geographic location. Four axes emerged from the articles. The findings show that the literature on smart cities has been instrumental in understanding how digital technologies are adopted to shape urban environments and how technological innovation can create economic, environmental and social value for cities and their citizens by, among others, addressing persistent sustainability challenges.

1.2.1. The conceptualization of "scaling up" and its different typologies

The analyzed literature provides the conceptual evolution of upscaling smart-city initiatives, capturing the same conceptual domain space and expanding the knowledge about existing concepts, typologies, patterns and paths (Table 4). Still, the findings confirm the previous findings from van Winden and van den Buuse (2017) that "there is no single or agreed definition

of upscaling" (van Winden and van den Buuse, 2017: 53). This may also be a reflection of the fact that there is no consensus on the definition of smart city (Allam and Newman, 2018), which can be understood as "cities that leverage digitalization and engage stakeholders to improve people's well-being and build more inclusive, sustainable and resilient societies" (OECD, 2021: 9). In an effort to capture the different definitions, these authors proposed a typology that includes three steps (roll-out, expansion and replication) for scaling up a smart city. This proposed typology will be further explored by Sista and De Giovanni (2021) who argued that "the process of scaling up, which is articulated as expansion, roll-out, and replication, is defined as the ability of a system to improve its scale by aiming to meet the increasing volume demand" (Sista and De Giovanni: 1337). Uspenskaiaet al. (2021) also used the model developed by Winden and van den Buuse (2017) to "deepen the understanding of processes of scaling up the smart city solutions and to provide a common background for establishing a collaboration between the cities" (Uspenskaia et al., 2021: 4), but not without considering different definitions of upscaling and replication and analysing other replication and economic models.

Talmar et al. (2022) also further developed the concepts of upscaling and replication to introduce the construct of "embedded replication potential", defined by the authors as the capacity of an original project to be either scaled up locally or replicated elsewhere" (Talmar et al., 2022: 608). Kuguoglu, van der Voort and Jansesen (2021) define scaling as "the industrialization of IoT-enabled AI solutions whereby, following the proof-of-concept and the pilot experiments, these technologies are routinized into industrial practices on a large scale" (Kuguoglu et al., 2021: 2). More related to the concept of spontaneous diffusion, Bundgaard and Borrás (2021) defined the scale-up of smart city pilot projects as a "specific form of city-wide diffusion through the generalization of an innovative technological solution for the whole city" (Bundgaard and Borrás, 2021: 172). The state of the art of the conceptualization of scaling up smart-city initiatives reinforces the fragmentation of conceptual definitions that may puzzle scientific progress. This fragmentation may result in the overlapping and inconsistent use of terminology. Also, we need to consider the fact that scholars are from diverse disciplinary areas using different theoretical frameworks (Table 3) and different definitions to conceptualise upscaling smart cities (Table 4), which makes them focus on different facets of the same phenomenon. Another reason for this fragmentation may raise from the young age of this body of literature which was demonstrated by the fact that most publications on the topic has no more than 15 years.

TABLE 4. Conceptualization of upscaling smart cities in core papers

Authors	Definition of upscaling smart cities
Brynskov et al. (2018)	Designing infrastructures for scalability—through and beyond their immediate technical setup—means to anticipate not just increases in usage but to foster the emergence of entirely new ways of relating devices, users and issues. This implication of scale suggests benefits for social, economic and political ends, although the terminology explicitly evokes concepts from information, network and code design (Kitchin and Perng, 2016).
Bundgaard and Borrás (2021)	We define the object of our study, the scale-up of smart city pilot projects, as a specific form of city-wide diffusion through the generalization of an innovative technological solution for the whole city. Our definition corresponds to, "city-wide scaling up," as defined by authors in the field of urban innovation (von Wirth et al., 2019). We consider these smart city projects to be examples of transformative innovation at the urban level because they experiment with new technologies (usually digital), relying on state-of-the-art knowledge and hence on knowledge management (Appio et al., 2019). These innovations aspire to be transformative because they aim to change sociotechnical systems at the urban level to achieve sustainable public goals (Zhang and Li, 2018).
Calzada (2020)	Replication is defined as "the possibility of transporting or copying results from a pilot case to other geographical areas, albeit potentially different boundary conditions," thus slightly recommending that "if a pilot was proven to work in one community or region, it could be exported to other communities or regions (indigenously or abroad), but taking into account that the boundary conditions could be quite different from those in piloted community or region." (in the EC-H2020-SCC policy framework (p. 8))
van den Buuse et al. (2021)	Two key contexts for exploration (i.e., internal development and external collaboration) and three pathways for exploitation (i.e., roll-out, expansion, and replication). a firm scales up the developed product or service once it comes out of exploration activities by introducing it to existing or new markets. When exploitation occurs through expansion, a firm scales up a smart city solution (such as digital platforms and networks) by refining, adding functionalities, and/or enlarging the geographical area, thereby increasing the economic, environmental, and/or social value of the solution. In exploitation via replication, smart city solution that has been developed as part of exploration activities in one specific context is replicated in another urban context by the firm, potentially building on lessons learned from the original pilot context.
Ferraris et al. (2018)	Aalanced scanning of external sources of knowledge can enhance both internal efficiency (exploitation) and the firm's ability to recognize opportunities and technological trajectories (exploration) (Rothaermel and Alexandre, 2009). This is because both exploitation and exploration involve accessing different knowledge-based sources and establishing different kinds of collaborative ties (Li et al., 2008). In fact, on the one side, explorative alliances are usually established to explore new technological opportunities (technology search). By contrast, exploitative alliances have the objective to use complementary competencies that reside in the alliance partners with commercialization intents and exploiting the technology obtained through exploration.

Kuguoglu et al. (2021)	We define scaling as "the industrialization of IoT-enabled AI solutions whereby, following the proof-of-concept and the pilot experiments, these technologies are routinized into industrial practices on a large scale"
Leminen et al. (2017)	The scaling mechanism of the mode postulates learning and understanding of the principles of living labs by sharing and transferring knowledge regarding experiences of innovation activities between humans rather than formulating knowledge in manuals as the activities of living labs are at different maturity levels. (…)The city scales processes by providing guidebooks while companies and research institutes gather information, test, develop, and co-create products, services, and systems.
Mendes (2021)	"Smart solutions can be replicated by adapting the original idea to a new context [...]. There are two important aspects [...]: i) determine transferrable units, and ii) find the window of opportunity. Transferrable units refers to viewing the project as the sum of its parts and determining which of those parts are able to be transferred directly, and which need to be adapted. These parts could then be repackaged as a new solution customized to the new location, with a higher chance of success." (Garcia-Fuentes et al. 2019, p. 9)
Sista and De Giovanni (2021)	The process of scaling up, which is articulated as expansion, roll-out, and replication, is defined as the ability of a system to improve its scale by aiming to meet the increasing volume demand.
Talmar et al. (2022)	We introduce the construct of *embedded replication potential*, defined as the capacity of an original project to be either scaled up locally or replicated elsewhere.
Uspenskaia et al. (2021)	The definition given by the EU Parliament's Committee describes the replication process in the best way highlighting that this process is more about "matching the aggregate characteristics" and "creating the similar portfolio" rather than "copying results from a pilot case". The definition prepared for the European Parliament's Committee on Industry, Research and Energy is the following: "Replication essentially means repeating successful Smart City initiatives in another locale or replicating the same type of Smart City in other cities. These replicas would be based on matching the aggregate characteristics (population, income distribution, local economic characteristics, socio-economic outcomes), and deliberately creating a similar strategic vision and portfolio of (locally relevant) initiatives."
van Winden and van den Buuse (2017)	Based on definitions of upscaling of international organizations[1], and building on the classifications of scaling identified by Cooley and Kohl (2005), we propose three types of scaling for smart city solutions: roll-out, expansion, and replication. We speak of roll-out when one of the pilot project partners uses the pilot's test results to scale up the developed product, service, or solution (market roll-out), or apply the lessons of the experiment within their own organization

[1] "The World Bank (2005:16) notes in relation to upscaling that "implicit in the concept of scaling up is the need to go beyond business as usual, to embrace new technologies, new institutional arrange ments, and new approaches." Upscaling in this respect includes spatial dimensions (geo graphically enlarging projects, practices, or programs, and reproducing benefits from onelocal context more broadly); intertemporal dimensions (deepening the impact of projectsor programs by expanding their duration and continuity); and dimensions related to influ encing the (inter)national institutional environment to accommodate upscaling processes (World Bank, 2005). Hartmann and Linn (2008: 8) adopt a broad definition for upscalingin line with the World Bank, and define it as "expanding, adapting, and sustaining success ful policies, programs, or projects in different places and over time

	(organizational roll-out). This type of scaling applies to manufactured smart city products or service innovations. We define expansion as the type of scaling that happens when the pilot project is not closed or dissolved, but is rather expanded with new partners or users to the project, or by enlarging the geographical area in which the project operates. This type of scaling is relevant for smart city projects such as mobility platforms, tourist smart cards, energy exchanges, online neighborhood communities. The third type of upscaling that we identify is replication, the most complex type, which can apply to all types of smart city solutions that are tested and developed in pilot projects. With replication, the solution that has been developed in a pilot project is replicated in another context, which can be in another organization or part of the city, as well as in another city altogether. Hence, replication can be done by the original pilot partnership but also by others, and the replication can be exact or by proxy.

All of these definitions have the idea of scaling up or reproducing effective smart city solutions, which can involve different processes and phases, including internal creation, external collaboration, roll-out, expansion, and replication. More specifically, the ability of an original project to be either scaled up locally or copied elsewhere is referred to as embedded replication potential. Furthermore, replication is described as "matching the aggregate characteristics" and "creating the similar portfolio" rather than "copying results from a pilot case." Finally, knowledge management is suggested as a mechanism for businesses to access various knowledge-based sources and create various forms of collaborative ties to ease both exploitation and exploration when scaling.

Taken together, the concepts emphasize the significance of anticipating novel relationships between tools, users, and problems, testing out novel technologies to meet long-term societal objectives, and translating or adapting outcomes to novel geographic or contextual situations. The specifics of the difficulties and solutions for scaling up smart cities, such as the requirement for stakeholder participation, interoperability, data protection, and governance frameworks, are nonetheless missing. It is important to note that the definition of scaling smart cities should also highlight the significance of sustainability, inclusivity, and citizen-centricity in the scaling process. Upscaling smart cities should also take into account the ethical issues, such as data security and privacy, social responsibility, and fairness.

to reach a greaternumber of people."In the context of health services, the W.H.O. (2009: 1) describes upscaling as "deliberateefforts to increase the impact of health service innovations successfully tested in pilot orexperimental projects so as to benefit more people and to foster policy and program devel opment on a lasting basis," which are "backed by locally generated evidence of program matic effectiveness and feasibility obtained through pilot demonstration or experimental projects". Although this W.H.O. definition is developed specifically in relation to healthservices, the element of local development and testing of solutions in pilot projects,before scaling them up beyond this local context, is also relevant for other domains".

1.2.2. Main factors affecting upscaling and the specific conditions needed to scale up

While literature demonstrates that experimentation with digital technologies has become widespread across cities globally, their more comprehensive implementation beyond pilot projects through upscaling has remained problematic (van den Buuse et al., 2021; van Winden and van den Buuse, 2017). Still, city governments face several challenges regarding factors affecting upscaling and main conditions to scale solutions up, ranging from the broader dissemination of proven technologies beyond an experimental phase in managing their exploration activities (i.e., developing, testing and experimenting with technologies) to exploitation activities (i.e., embedding proven technologies in their core systems and processes).

For instance, Bundgaard and Borrás (2021) identify in the theoretical literature five key governance conditions for scaling up: Collaboration Intensity among partners, the Capable Municipality, the Articulation of Public Needs, Social Legitimacy, and Perceived Technological Uncertainty". In addition, Kugluogu et al. (2021) present a set of factors affecting AioT scale-up processes, including those related to management, such as top management support, business models, organizational elements (culture, agility, structure, resources, size), firm network orientation, skilled staff and expertise, alignment between departments, competing investment opportunities, data elements (quality, availability, governance, security and privacy, analytics capabilities), standardization, among others. Ciuffoletti (2018), for instance, argues that the critical factors for a successful smart-city project are its initial cost and scalability, as upscaling takes place only if the cost remains affordable. This is reinforced by the economic, regulatory and technological conditions that influence the potential for upscaling as demonstrated by van Winden and van den Buuse (2017) and van den Buuse et al (2021).

Moreover, on the factors and conditions affecting scaling, van Winden and van den Buusee (2017) identified the "drivers and enabling conditions: prospects for economies of scale, the management of ambidexterity, knowledge transfer mechanisms and incentives, regulatory and policy frameworks, data exchange and system interoperability, and (lack of) standards to measure return on investment of smart city projects" (van Winden and van den Buusee (2017: 55). Sista and De Giovanni (2021) on their hand, redefined key factors provided by the literature and categorized them into technical, economic, organizational and stakeholder-related factors. Still, Talmar et al. (2022) identified that "the resources and capabilities of the municipalities appear to be an important limiting factor, since several municipalities had major difficulties in

facilitating the meaningful inclusion of residents". Indeed, this corroborates the fact that Ferraris et al. (2018) had already raised when sharing that "all smart city manager interviewed stressed that internal capabilities of firms are also critical because often local governments do not have knowledge and management capabilities in this new and complex context, as the smart city one" (Ferraris et al., 2018: 1189). Brynskov, Heijnen, Balestrini and Raetzsch (2018) acknowledge the need to "foster digital and data literacy programs to develop skills and allow citizens to participate in smart city development (capacity building)" and the fact that "the scalability of urban innovation processes crucially depends on developing systemic capabilities to experiment within cities and in collaborations between cities to establish best practices, standards and ecosystems between actors and institutions" (Brynskov et al., 2018: 159). In the same issue of capability, Okwechime, Duncan and Edgar (2018: 618) also noticed that "as public sector organizations duly realize that they do not have the capabilities to carry out some needed tasks to address their problems, then deploy the services of private sector firms". A potential solution to this issue, argued by the authors, is the creation of a learning ecosystem to enable a continuous learning process in the implementation and post-evaluative phases of an initiative" (Okwechime et al., 2018: 618).

1.2.3. Benefits and hurdles of upscaling

Upscaling from smart-city experiments and pilots is central to achieving more sustainable urban development and creating economic, environmental and social value from technological innovation for cities and their citizens (van Winden and van den Buuse, 2017), but the benefits and hurdles of upscaling smart-city initiatives are not often clear. Talmar et al. (2022), for instance, explain that "the most common goals of municipalities in adopting new technologies are increased economic efficiency, reduced carbon footprint, enhanced public safety and improved social and cultural cohesion of neighborhoods" (Talmar et al., 2022: 612).

In the same sense, Sista and De Giovanni (2021) presented six requirements for performing a successful scaling process: "(1) the prospect of reaching economies-of-scale; (2) the presence of knowledge transfer mechanisms and incentives; (3) the management of ambidexterity in exploration–exploitation activities; (4) the presence of enabling regulatory, legal, and policy frameworks; (5) the interoperability between systems, data, and standards; (6) the inclusion of standards to measure returns on an investment" (Sista and De Giovanni, 2021: 1344). In addition, van den Buuse et al. (2021: 188) highlighted that "the learning effects from the exploration phase should lead to new regulation and to mainstreaming new practices in the municipal operation, so that the technology can be applied elsewhere in the city as well".

We also consider what Brynskov et al. (2018: 158) argued when stating that "successful scaling of experimentation requires a combination of stakeholder diversity and engagement, governance and interoperable technical infrastructures to yield sustainable benefits in urban innovation". In the same sense, Sista and De Giovanni (2021: 1354) mentioned that "being able to communicate the potential benefits to different actors is a necessary step to ensure successful upscaling". However, Kuguoglu et al. (2021) highlighted some challenges in the literature that calls for attention, such as "lack of comprehensive strategy, limited skilled talent pool as well as the attracting of one, training and retaining talent, lack of standardization, lack of financial resources, data security and cyber risks, integration with other technologies and legacy systems, siloed organizational structure and lack of cooperation among departments, organizational resistance to change and lack of organizational support" (Kuguoglu et al., 2021: 5)

1.2.4. Management processes

The literature helps to better understand how cities struggle to manage the process of upscaling smart-city initiatives through digital transformation. Kuguoglu et al (2021), for example, argued that some issues relate to a "lack of comprehensive strategy, limited skilled talent pool as well as the attracting of one, training and retaining talent, lack of standardization, lack of financial resources, data security and cyber risks, integration with other technologies and legacy systems, siloed organizational structure and lack of cooperation among departments, organizational resistance to change, and lack of organizational support" (Kuguoglu et al., 2021: 5).

Moreover, another aspect regards to governance. The combination of governance conditions under which smart city pilot projects scaled up to an entire city led Bundgaard et al. (2021) to conclude that smart city pilot projects could scale up to a whole city through different paths. Van den Buuse et all (2021) focused on the innovation process, including the approach of the firm to managing experimentation (i.e., exploration) and upscaling (i.e., exploitation), and how both processes are embedded in the organizational structure of the firm" (van den Buuse et al., 2021: 183).

The findings demonstrate, however, a need to better analyze the management of cities' digital transformation considering both institutions' and stakeholders' prominent roles in advancing the scalability and transferability of smart-city initiatives. This is highlighted, for instance, by van den Buuse et al. (2021) as a needed for future research. The authors propose that, "given the increasingly important role that firms, and other urban stakeholders have in sustainable urban development, it would be interesting to further examine which modes of collaborative urban governance could be adopted beyond experimentation in pilot projects" (van den Buuse et al.,

2021: 192). Also, cities may accelerate their learning by moving from experimentation via pilot projects to scaling up validated products, platforms and systems. Doing so might also increase digital technologies' broader economic and environmental impact on sustainable urban development (van den Buuse et al., 2021). Still, in the spirit of Lewis Mumford, we should also consider and better understand if the impact of new technologies and their associated benefits at urban scale may either exacerbate existing urban compositions or create new ones.

Another challenging in this puzzle of upscaling relates to the capacity of institutions to attract and retain talents needed to scale up smart-city initiatives. Several authors in the core studies discuss the issue of capability and skills (Talmar et al., 2022; Ferraris et al., 2018; Brynskov et al., 2018; Okwechime et al., 2018). For instance, Sista and De Giovanni (2021) recognize that "the managers' and workers' culture and training are key ingredients for success in a smart city project, which go beyond the simple infrastructure and assets" (Sista and De Giovanni, 2021: 1340). However, only two out of the eighteen core studies (Choudhuri et al., 2021; and Kuguoglu et al., 2021) namely mentioned the relevance of talents to the topic, particularly highlighting the difficulty of attracting, retaining, and training talent (Kuguoglu et al., 2021: 4). Still, there is a gap on how cities identify the existing and missing skills and how do they manage to attract and retain the necessary talents to upscaling.

Although the literature reviewed expands knowledge about management, the results indicate that most research is not rooted in management science. This can be explained not only by how the field folded and analyzed the smart city, but also by the topical novelty presented in the results. This is particularly highlighted by the fact that most of the articles selected were published between his 2017 and 2022 (81%). These factors may explain why management science lags behind in the study of this particular phenomenon. However, some "how" aspects of upscaling still need further research.

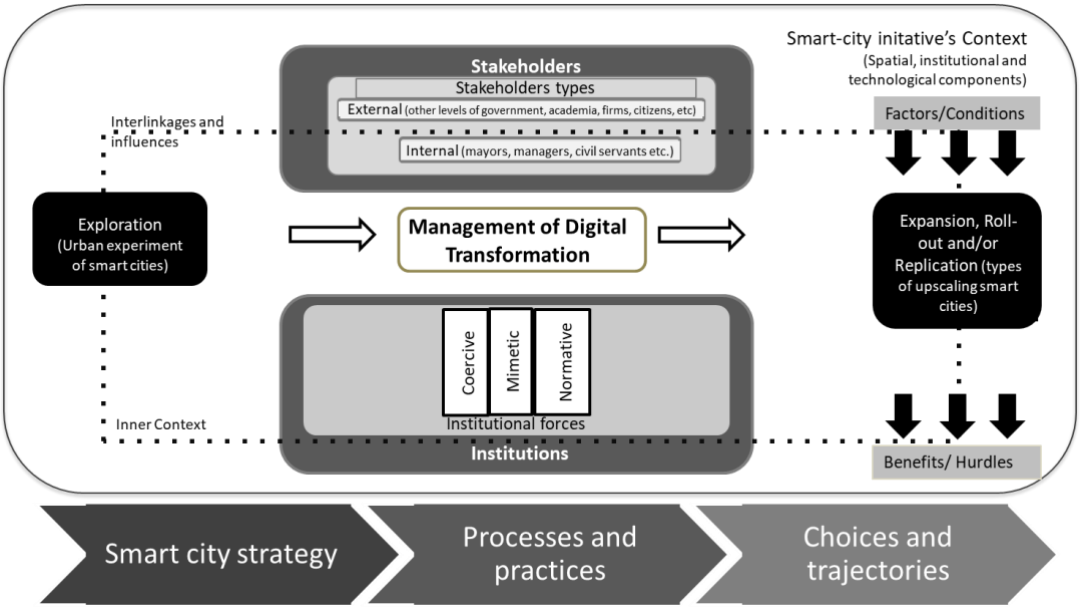
1.3. DISCUSSION

The findings demonstrate key elements of research on upscaling smart-city initiatives, including four main axes that have received attention from the academic community to date. Firstly, the findings underline the conceptual significance of upscaling smart cities. Secondly, they highlight the factors and conditions necessary to upscale, including a variety of elements, such as technology, funding, governance, institutional setups, and the social and political backdrop. Thirdly, scaling up smart cities offers advantages including better quality of life, higher sustainability, increased efficiency, lower costs, and the opportunity to draw in business and investment. Lastly, the findings also envisions the process on how complex upscaling,

considering a favorable policy and governance framework, accessibility to cutting-edge technology, and efficient stakeholder involvement are necessary elements for success.However, the need for funding, encouraging interdisciplinary cooperation, and addressing privacy and security issues are still problems.

Based on these elements, in this section, we will highlight the implications of the findings, particularly on management research. We consider gaps and limitations in prior literature and highlight two theoretical streams where management research may have a comparative advantage in studying upscaling. Therefore, we propose an integrative framework (Figure 3) to help future research to identify the how aspects of upscaling better and explore the role of the institutional context and stakeholders in shaping the configuration of smart city governance.

FIGURE 3. Integrative framework



Source: Based on DiMaggio and Powell (1983); Jiang et al. (2020); Mitchell et al. (1997); Scott (2014); and van den Buuse et al. (2021).

We also identify new streams of work to chart pathways to upscale smart-city initiatives by better understanding the management of the digital transformation of cities. When identifying the gaps to propose new streams of research and the integrative framework, we also considered the key unanswered questions identified in the specific subset of core papers focusing on upscaling (Table 5).

TABLE 5. Future agenda proposed in the core studies

Authors	Future agenda
Brynskov et al. (2018)	To reveal the relation between translocal standards and infrastructures and their individual adoption in cities, their role in shaping actors' practices around IoT data and community engagement as well as the larger digital transition that affects governance structures across city spaces.
Bundgaard and Borrás (2021)	To investigate two dimensions: (1) the input of Social Legitimacy in smart city projects, focusing on the changing relationship between the municipality and the society; (2) the output of Social Legitimacy in terms of the ability of smart city projects to resolve pressing urban challenges. To study when smart city projects generate public value, and if so, what public value they generate, contributing to bring the study of smart cities closer to the study of transformative innovation, solving the grand challenges associated with urban sustainability.
Calzada (2020)	To consider the significant room for manoeuvre for local stakeholders in their ability to pick and choose, adapt, and prototype between innumerable intervention models and networks, particularly their capacity to produce insightful narratives while learning from each other.
Choudhuri et al. (2021)	Recommend a bigger and heterogeneous sample with alternate methodology and theoretical background, particularly covering the integrated application of emergent innovations like IoT and Analytics, Cloud and Blockchain in building connected digital society in India. To pursue a similar approach of the authors enriching Actor Network Theory (Walsham, 1997) and Social Cognitive Theory (Bandura, 2011) in context of business ecosystem and digital literacy aspect of digital India.
Ciuffoletti (2018)	Test the ground with small scale, sustainable deployments.
Cugurullo (2018)	Not specified
van den Buuse et al. (2021)	Extend the analysis to multiple firms or other types of stakeholders, to gain insight into scaling mechanisms from a wider range of case studies. Further examine which modes of collaborative urban governance could be adopted beyond experimentation in pilot projects. Demonstrate how digital technologies could be employed to address local, persistent challenges to urban sustainability, showing how different types of stakeholders can collaborate with local government to effectively scale those technologies.
Ferraris et al. (2018)	Encourage successful examples to be documented, involving new firms' experiences of managing exploration and exploitation alliances with heterogeneous partners in smart city and different HRM practices used in these projects.
James et al. (2022)	Focus on systems and enable to interrogate how these social, infrastructural, and environmental systems interweave and interact to capture intended and unintended consequences, analysing systems is the next step in smart city evolution.

Kuguoglu et al. (2021)	Not specified, but it mentions limitations that could open new streams of research: environmental factors, such as regulations, external shocks, and cultural differences, were not investigated; the interviewees in the study were disproportionately from the consulting field; the number of academic experts that could potentially enrich the point of discussion with their theoretical perspective; investigation only of the phenomenon in the context of large organizations lacking other settings, applicability of the potential strategies for the initiatives of smaller organizations; the list of factors is neither definite nor conclusive, leaving room for the unknown.
Leminen et al. (2017)	Propose more research on how different stakeholders should be motivated in order to be engaged in the development and innovation processes in collaborative innovation networks, and on what actions are necessary to keep stakeholders engaged. Propose the importance of studying the relations of different collaborative and open innovation networks. Suggest a need for additional research on the characteristics in open and collaborative innovation networks, calling for further analyses of specific cases, eventually including how different stakeholders employ collaborative and open innovation networks in cities. Call for more research on collaborative innovation networks, the third-generation networks.
Mendes (2021)	Not specified
Nelson (2019)	Verify if the framework is replicable with an additional deployment within a different jurisdiction was created and is in operation.
Okwechime et al. (2018)	Develop a multilevel longitudinal study that would unearth far-reaching conclusions on the impacts of big data as an organizational tool.
Sista and De Giovanni (2021)	Conduct studies in different contexts or cultures to increase the generalizability of the results, particularly a comparative study analysing different smart city logistics projects around the world. Use machine learning techniques to support scaling up projects. Better understand the implications of the results with further studies addressing the SMOOTh project, or alternatively analyze the smart city projects which already perform upscaling. A longitudinal study would enrich and lend support to the present research.
Talmar et al. (2022)	Adopt methods such as controlled experiments and simulation models to develop a more robust body of knowledge on the replication potential of SL and other smart city solutions.
Uspenskaia et al. (2021)	Recommend planning and modelling the replication of a smart city project at the very early stage as it is important to find tailor-made solutions that fit the spatial, legislative, socio-economic conditions and historical growth of the cities
van Winden and van den Buuse (2017)	Specific attention to upscaling potential and achieving longer-term impact beyond the pilot project presents an important opportunity for future research on smart city projects. Further empirical research in different geographic contexts beyond Amsterdam would further enhance understanding of upscaling processes in smart city pilot projects, given the substantial degree of context sensitivity in the upscaling of smart city pilot projects.

Note: 1. NA – Not available; 2. The full dataset with the analysis of 68 documents in this review may be made available upon request to the authors.

Over the past few years, researchers have been studying the ways to move from experimentation to scalable solutions and from urban experiments to upscaling smart-city initiatives. However, there continues to be an open discussion in the literature regarding what the management of digital transformation entails and how it is to be defined to make smart-city initiatives scalable and transferable. This is to say that upscaling solutions should also involve other perspectives associated with the different roles of the institutions and stakeholders involved in implementing smart-city initiatives to solve societal issues. This resonates, for instance, with Sharifi et al. (2021) findings that concluded the essential need to "do more research on the implementation of smart cities and actual and/or potential contributions of smart cities to solving societal issues". For instance, there is scant research on innovation in management and policy, particularly on how smart-city governance may vary considerably across cities due to the influence of the institutional setting and stakeholder involvement. Although this may infer that the concept of upscaling smart-city initiatives is closely related to management, this aspect would need an in-depth analysis to understand the relationships and after-effects better.

Indeed, there is a need to better organize the conceptualization of upscaling smart-city initiatives. Although van Winden and van den Buuse (2017) made an effort to "refine and unravel the rather broad concept of scaling", the findings demonstrate a problem of construct proliferation ranging from different concepts of upscaling smart cities, types of upscaling (expansion, roll-out, spontaneous diffusion, replication) and paths (horizontal, vertical). Podsakoff, MacKenzie and Podsakoff (2016) already noted that "it may obscure the pattern of findings in the literature, resulting in the development of multiple or conflicting measures of the concept, and impede theoretical progress" (Podsakoff et al., 2016: 172). This problem of different names capturing the same conceptual domain (concept proliferation) is also reflected in the number of selected keywords used to search the articles in the SLR. Kuguolu et al. (2021) already proposed a new taxonomy that classifies the factors that influence "scaling up of AIoT initiatives, but it does not shed much light on the time dependency of such factors, nor can this be considered to be a general smart city framework" (Kuguoglu et al., 2021:9). Combining previous research, even from different thematic areas, could inspire researchers on how to better conceptualize the topic. Sharifi and Allam (2021), for example, proposed a taxonomy of smart city indicators and their alignment with sustainability and resilience, while Van Doreen et al. (2016), for instance, proposed a taxonomy on the concept of scaling up, considering low-carbon urban initiatives (LCUIs). To avoid being cast in a wide net, we propose to refine the conceptual

definition of upscaling smart-city initiatives and what it entails, reducing the ambiguity and the jargon that exists. Based on the analysis of previous research, we understand that "upscaling smart-city initiatives refers to the process of expanding and enhancing the implementation of technology and data-driven solutions in urban areas to improve the quality of life for citizens and create more efficient and sustainable cities". This can involve better improving existing infrastructure or expanding the use of technologies, further increasing citizen engagement, and ensuring management and maintenance of these initiatives in the long-term to deliver the expected outputs to citizens.

Indeed, the optimization of resource utilization and effective management of digital transformation is crucial to upscale smart-city initiatives, particularly considering the need to ensure that resources are used efficiently. This is to say that, to effectively manage digital transformation in smart cities and facilitate their scalability, it is important to consider smart cities as policy and the administrative reform processes (Drapalova and Wegrich, 2020); who governs the smart city and with what impact will vary across contexts and settings (Lombardi and Vanolo, 2015). For instance, local governments expect that the employment of various smart ICTs can significantly improve operational and managerial efficiency, citizen engagement in service co-production, and quality of life (Jiang et al., 2020). Services, resources, opportunities, knowledge, and social relations are increasingly migrating into the digital realm (Ragnedda et al., 2018). However, the simple possession of infrastructure and communication technologies (ICTs) or access to the Internet, though vital, has become insufficient (Ragnedda and Muschert 2013).

Nonetheless, according to Ramaprasad et al. (2017), if cities are adequately managed, there could be enormous benefits as a result of the economies of scale by upscaling solutions and sharing amenities such as transportation, sport and entertainment facilities, business services, and broadband access, among others (Swinney, 2014). Therefore, upscaling from experiments and pilots is central to achieving a more sustainable urban development and create economic, environmental, and social value from technological innovation for cities and its citizens (van Winden and van den Buuse, 2017; Turnheim et al., 2018). However, managing digital transformation is not only about institutions to gain in efficiency but also to create value with new services to stakeholders. As Barns (2018) noted, the ideals of the smart city in seeking to benefit from digital services necessitate a "reinvention of governance", and, for Schaffers et al. (2011) cities provide a potentially attractive testing and validating environment, in which

common resources can be shared among different types of stakeholders in an open innovation environment.

Therefore, better understanding the influence of stakeholders and the institutional context could reveal the context-contingent nature of smart-city governance and how it may vary across cities due to the influence of an institutional setting (Tomor, Przeybilovicz and Leleux, 2021) and stakeholder involvement (Granath, 2016). This is supported by the findings of Israilidis, Odusanya, and Mazhar (2019), indicating the need for innovative, theoretical smart-city research that integrates the multiple stakeholders involved in enabling smart cities. Additionally, Visvizi and Lytras (2018) call for interdisciplinary perspectives in the smart-city literature, relating to the gap analysis of institutions in managing smart-city initiatives to improve scalability and transferability through identifying necessary conditions, similarities, and differences in their processes.

We find that institutions' role in shaping the configuration of governance for smart cities has yet to be systematically examined in the literature. The findings show that there has been little focus on institutional context theory, meaning the lack of analysis of the institutional factors that influence smart-city governance on different urban scales, particularly when managing the digital transformation of cities. Institutional scholarship has consistently trended upwards for over three decades. Attention has moved from one emphasis to another to understand further how and why organizations respond differently to seemingly similar institutional demands (Forgues, Greenwood, Martí, Monin and Walgenbach, 2012). In recent years, institutional theory has significantly impacted research in various fields within the social sciences, including economics, sociology, political science, organizational theory, public administration and accounting. More specifically, institutional theorists are advancing the research on the role and impact of digitalization and how new technologies can rearrange institutionalization mechanisms (Deephouse, Bundy, Tost and Suchman, 2017; Hinings, Gegenhuber and Greenwood, 2018; Hinings and Meyer, 2018; Tolbert and Zucker, 1999). However, institutional theory has not been widely used to understand how the new institutional theory explains (or fails to explain) the role of institutions in managing the digital transformation of cities.

Drawing from New Institutional Theory and inspired by Hussain and Hoque (2002), adopting a broader, multi-dimensional approach to New Institutional Theory might be useful when examining issues of external (macro) and internal (micro) organizational contexts (DiMaggio and Powell, 1983; Scott, 2014) in upscaling smart-city initiatives. The new institutionalism in organization theory and sociology "comprises a rejection of rational-actor models, an interest

in institutions as independent variables, a turn toward cognitive and cultural explanations, and an interest in properties of supraindividual units of analysis that cannot be reduced to aggregations or direct consequences of individuals' attributes or motives" (DiMaggio and Powell, 1991: 8). It has contributed significantly to understanding the relationship between organizational structures and the broader social environment organizations are situated in (Hussan and Hoque, 2002). It could be instrumental to understanding the processes of managing digital transformation for upscaling smart-city initiatives, by which socially constructed expectations and practices become disseminated and reproduced (Greenwood, Suddaby and Hinings, 2002; Scott, 2014). The concept of the organizational field is key to institutional theory (Greenwood et al., 2002) and understanding how institutional change occurs is still a central challenge.

Understanding the structuring of organizations (Mintzberg,1983) and the institutionalization of the organization field and the interplay between existing and new institutional arrangements (Hinings et al., 2018; Hargadon and Douglas, 2001; Vermeulen, Büch, Greenwood, 2007), therefore, can be essential to advancing the agenda on smart cities. For instance, new institutional arrangements adopted by a city to manage digital transformation while implementing a smart-city initiative might replace or complement existing ones. In the same way, existing institutions might enable new ones, creating a novel form of organizing services. For this reason, there is still a need to analyze whether institutional strengths and actors' interests (DiMaggio, 1988) favor homogenization in managing the digital transformation of cities to upscale smart-city initiatives.

Another key argument is that organizations cannot be understood independently of stakeholder influence. There are examples in Granath (2016) of new institutional scholars (Czarniawska and Sevón, 1996; Lawrence and Suddaby, 2006; Meyer and Höllerer, 2010) recognizing the individual's power to innovate, to act strategically and thus contribute to institutional change. Using stakeholder theory, which originates in management (Mitroff, 1983; Freeman and Reed, 1983), in combination with new institutional theory, could advance the understanding of the role of stakeholders in managing cities' digital transformation.

Therefore, stakeholder theory could be further analyzed on issues related to the role of stakeholders in upscaling smart cities through managing digital transformation. By better understanding the role of stakeholders, we can advance the knowledge of how digital transformation is managed (or not) in practice in cities. The need for better collaboration within the public sector in smart-city developments (Dawes, Cresswell and Pardo, 2009) puts

additional pressure on management to co-ordinate actors with different values and norms and, likely, interests in digitalization (Granath, 2016). Based on Freeman's definition of stakeholders (Freeman, 1983), Granath (2016) argues that stakeholders should not only be considered as those who can affect how digitalization is played out in a city, but also, in the smart-city context, as critical success factors (Chourabi et al., 2012).

Mitchell, Agle and Wood (1997) developed a comprehensive typology of stakeholders based on the normative assumption that three attributes of stakeholders (their power to influence; the legitimacy of their relationship; and the urgency of their claim) define the field of stakeholders: those entities to whom managers should pay attention (Mitchell et al., 1997). Furthermore, the notion of legitimacy also unites stakeholder theory with institutional theory. In the latter, legitimacy refers to common perceptions of how to act in social contexts, thus corresponding to normative and cultural-cognitive elements in the environment (Granath, 2016; Scott, 2014). According to Frischknecht, Schedler and Guenduez (2020), creating and sustaining legitimacy is a key issue for organizations in their organizational field (Meyer and Rowan, 1977) and, without legitimacy, organizations lose access to resources and credibility (Deephouse and Suchman, 2008).

All these elements can advance the understanding of how institutions and stakeholders (and their relations) evolve and change over time in smart-city initiatives, either by identifying and analyzing individuals, groups and organizations, or their saliences, and stakes in managing the digital transformation of cities. Therefore, advancing the current knowledge with future research using an interdisciplinary lens to integrate knowledge and methods from different disciplines can contribute to a better understanding of the issues associated with upscaling smart-city solutions and shed light on the inside of this topic in Management Science.

CONCLUSION

The findings and discussion demonstrate that it continues to be an open discussion in the literature regarding the "how" aspects of upscaling smart solutions by managing digital transformation and the necessary processes to make smart-city initiatives scalable and transferable. Also, although research on the definitions and concepts, factors and conditions, and benefits and hurdles of upscaling smart-city initiatives have advanced, the conceptualization of upscaling smart-city initiatives still remains problematic. To address these gaps, this article explored several issues and possible strategies that are future oriented and could be employed. There are three key contributions to the theoretical, empirical and managerial significance of upscaling smart-city initiatives that we can draw on insights from

this systematic literature review. Firstly, the research contributes to advancing the current literature on the diversity of approaches in Management Science and other fields (urban studies, science and technology, etc.). It also provides a straightforward procedure for a systematic literature review with clear steps. Moving forward, future research may develop critical literature review, specifically on state of the art in the management field, contributing, in particular, with additional theoretical significance to the topic. In addition, this review also did not focus on using widely grey literature or unpublished material. Future work could also consider other publication types as scholars are increasingly recognizing instances where it seems appropriate to broaden the evidence search beyond the limits of academic journals (Adams et al. 2015; Sharma et al. 2015). Further research could also explore how the digital transformation of cities, while not exclusively dependent on context, can be influenced by place-specific attributes based on the interlinkages between spatial and institutional components.

Second, the research recognizes the theoretical significance of Management Science by proposing a future research agenda combining the application of new institutional theory and stakeholder theory. These two theoretical perspectives round each other off in the proposed integrative framework designed to analyze the processes and trajectories of managing digital transformation in upscaling smart cities. This future research could support empirical studies on how to move from experimentation to upscaling smart-city initiatives through digital transformation management. By considering the interlinkages between different actors and institutions as drivers of managing digital transformation in a city, future empirical research may attempt to understand the various institutional arrangements and stakeholders involved in managing cities' digital transformation by developing tailored case studies to identify the scalability and transferability of different smart-city initiatives.

Third and finally, the research provides smart-city managers with valuable insights into what a smart city means, why digital transformation matters to the scalability and transferability of smart initiatives, and how cities manage their digital transformation – or not – to upscale smart-city initiatives. Future managerial contributions can explore the dialogue between the theoretical and empirical research to identify both how cities are complex and dynamic policy issues in their digital transformation to move from policy experimentation to up scalable and transferable solutions. Additional research could also explore whether there is a scaling-down effect on smart-city initiatives, what has worked (and not worked) and what can be repeated and transferred to upscale smart-city initiatives, even in different contexts.

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