Éditorial

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Dans Systèmes d'information & management 2021/4 (Volume 26), pages 3 à 18
Éditions ESKA

ISSN 1260-4984
ISBN 9782747232944
DOI 10.3917/sim.214.0003

Éditorial

Information technologies, knowledge and innovation in smart cities: current and future trends for management research

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According to the UN Department of Economic and Social Affairs (UN, 2018a), between 1950 and 2018, the world's urban population grew more than four-fold, from an estimated 0.8 billion to 4.2 billion. By 2050, the less developed regions will account for more than 85 per cent of the total world population and over 80 per cent of the world's urban population.

This global urbanization process is expected to continue for several decades as the number and size of cities continue to grow in line with the rising share of city-dwelling populations. All class of urban settlements including cities (500K-1 million people), large cities (5-10 million people) and megacities (more than 10 million people) are increasing in number. To cope with these patterns of urbanization, and effectively respond to critical challenges of city development, there is a need to provide efficient delivery of services for the well-being of citizens. In order to ensure sustainable urban growth and economic development, cities are increasingly using digital and information technologies (ITs) to innovate their services and governance models. In doing so, it gives rise to a new model of city that is commonly referred to as a "*smart city*."

So far, in the field of management sciences, smart cities have been primarily explored through two main questions: (i) how a city becomes smart and (ii) what strategies are adopted to carry out such a project (Ben Letaifa, 2015). The associated political processes and choices essentially reflect economic, social and societal challenges of which IT is only the support. Consequently, smart city players tend to position themselves on different key questions such as: the choice of data governance emerging from complex ecosystems (Gupta *et al.*, 2020); the nature of the intelligence to be promoted (rational, emotional, collective, participative); the

https://doi.org/10.54695/sim.026.04.003018

dimensions to be taken into account in the trajectories of smart cities (Camboim *et al.*, 2019); the levels of transparency and control over the choices made when combining algorithms and/or human beings.

These key questions underpin the future trends in the development of a smart city, on the one hand; and on the other hand, they open avenues for future research on smart cities. In this editorial we discuss and present the current and future trends of research on smart cities in management science. In section 1 we position smart cities in the current challenging context. In section 2, we present a bibliometric analysis on IT and the smart city. In section 3 we explore three research directions. Finally, by considering the convergence of elements that constitute a smart city, we conclude this editorial and introduce the papers published in this special issue. Finally, we conclude on the convergence of elements that constitute a smart city and introduce the papesr published in this special issue.

1. EMERGENCE OF SMART CITIES AND ACTUAL CHALLENGES

A smart city is a city that connects physical, social and economic infrastructure with information technology (IT) to improve the collective intelligence of a city (Harrison *et al.*, 2010) and the quality of services delivered to citizens. It is therefore characterized by a high level of community engagement for making the city economically dynamic and efficient (TM Forum, 2019), socially stable, inclusive and attractive, and operationally sustainable (UN, 2018c; ISO, 2018). This vision was largely inspired by the challenges a city faces in coping with massive urbanization, while keeping essential services running (ISO, 2018). The related challenges involve the need for a city to connect institutional and industrial stakeholders (economic, technological) and citizens while also creating physical, social, economic and technological infrastructure for innovating and improving citizen services. There is also a need to ensure an understanding of smart cities as a data ecosystem where local government authorities coordinate data initiatives through three elements: openness, diffusion and a shared vision (Gupta *et al.*, 2020). Hence, a smart city can be defined as an ecosystem that enables innovative initiatives based on data and IT in an institutional context driven by the need to address urbanization problems faced by current and future cities.

Massive urbanization of cities is one of the oldest issues that regularly appear on the agendas of municipal and national governments. The most recent challenge brought about by the Covid-19 pandemic, tested the capacity of cities to manage the impact of the health crisis on its citizens. In this context, the role of innovation and information technologies played a crucial role in facing these challenges. Indeed, the COVID 19 pandemic was a drastic wake-up call that exposed the difficulties and failures of countries, provinces, cities, and so-called "smart cities" to handle unexpected challenges while keeping essential services running and protecting its citizens. The 2020 edition of the IESE Cities in Motion Index (Berrone and Ricard, 2020), published in the context of COVID-19 health crisis, highlighted new challenges uncovered by the crisis, and the state of preparedness of cities to *"face a crisis that shakes their stability across many dimensions"* (i.e., Social Cohesion, Economy, Governance, Environment, Mobility and Transportation, Urban Planning, Technology, International Projection and Human Capital). The UN's Urban Future report (UN-Habitat,

2021) explored the connections between the pandemic situation, cities considered vulnerable entry points for COVID-19, and the line of defense in responding to the crisis. This report highlighted the fragilities of our cities, questioned past practices and guidance to governments and reaffirmed that "sustainable urbanization" (UN-Habitat, 2020) should be prioritized in the development agendas for urban resilience and sustainable recovery.

Despite this uncertain context, there is no doubt about the multidimensional role of technology and innovation in urban areas and their influence on shaping the future of cities (UN-Habitat, 2021; Guo *et al.*, 2019). Although existing and emerging technologies provide great opportunities for cities to become "smarter," it is also clear that *"technology is most effective when coupled with institutional innovation and is not a substitute for improving governance, planning, operations and management"* (UN-Habitat, 2020, p.32). Therefore, it is clear that IT and information systems (IS) are at the heart of the challenges in smart cities, either as the supporting infrastructure or as the digital innovation platform.

In fact, the IT/IS dimension has been expressed as a key dimension in which a city must evolve to be considered as "smart" in multiple models (Giffinger *et al.*, 2007). This dimension has influenced several city rankings (Berrone and Ricard, 2020), benchmarking tools (e.g., BSI Smart city framework-SCF), smart city maturity models from independent institutes (TM Forum, 2019), consulting groups (e.g., Deloitte, KPMG) and advisory services firms (e.g., IDC Maturity Scape by IDC Government insights 2013). These co-evolving multi-dimensional models can therefore be used to assess a city's current and desired states against various criteria. From a technological perspective, they can be considered as enablers that help cities foresee the digital transformation required to allow the progressive transformation of the city. However, as we will also see in our bibliometric analysis through a co-citation analysis (Section 2), the vision of a smart city can't be limited to its technological capabilities.

2. A BIBLIOMETRIC ANALYSIS ON SMART CITIES

To better understand the role of IT in smart cities, we performed a co-citation analysis (CCA) to identify the main themes studied in the literature with the search key words "smart cities" and "information technologies". For this purpose, we used VOSviewer, a software tool for constructing and visualizing bibliometric networks.

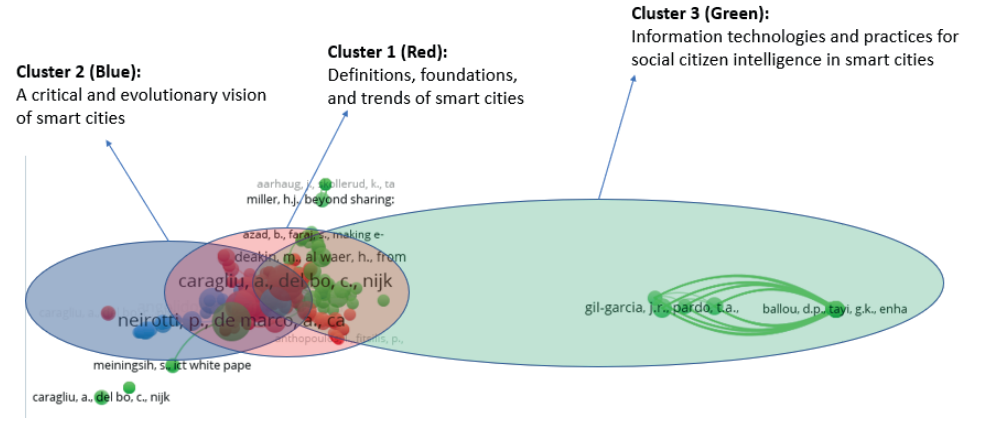
The CCA index that serves as a basis for the analysis is the frequency with which two units (authors, references, or journals) are cited together (Small, 1973; Zupic and Cater, 2015). This measure is assumed to indicate the relatedness of the units' content (Walsh and Renaud, 2017).

As a co-citation analysis is based on past references that are co-cited, it helps to identify the main themes within a field of research. The Scopus database was used as the core database for this bibliometric search. Scopus currently covers nearly 36,377 titles from approximately 11,678 publishers, of which 34,346 are peer-reviewed journals in top-level subject fields: life sciences, social sciences, physical sciences, and health sciences.

The initial search using the keywords "smart cities" and "information technologies" for the period (2001-2021) resulted in 891 publications and was the basis for stage

1 of the co-citation analysis. We then, removed the references that were incomplete. The final sample used in this analysis was 855 documents. With a minimum number of citations of cited references set to 2, then 294 publications were analyzed. With a minimum cluster size of 38 publications, we obtained the three clusters in Figure 1.

Figure 1. Cartography of clusters obtained with a co-citation analysis performed on an initial list of 855 references obtained from a research using the keywords (Smart city + Information Technologies) during the period (2001-2021).



Cluster 1 – Definitions, foundations, and trends of smart cities

Cluster 1 (155 references) gathers works aiming to define the concept of smart cities, its theoretical foundations and trends. Analyzing the number of co-citations, we observe that a first group of scholars built their work based on a limited and mostly operational definition of smart cities suggested by Caragliu *et al. (*2011). Caragliu *et al. (*2011) adopted a multi-disciplinary framework (including theories of regional competitiveness, transport and information and communication technologies (ICT), economics, natural resources, human and social capital, quality of life and participation of societies in cities) to define smart cities through 6 dimensions revealing the main targets a city should satisfy. To be smart, a city needs to invest in human and social capital and modern digital technologies to fuel economic growth, optimize natural resources of the environment, improve citizens' quality of life and living standards, and enable a more participatory governance. In fact, since the early work of Giffinger *et al. (*2007), it became usual to describe smart cities through 6 operational dimensions: smart economy, a smart mobility, a smart environment, smart people, smart living and smart governance. However, this approach has two main limitations. First, it offers the foundations of a marketing vision of what is a smart city. Second, it locks the perception of what smart cities are into a purely operational approach. Indeed, the 6 dimensions are mostly mobilized as analytical frameworks to build indicators establishing rankings of smart cities. For instance, Neirotti *et al*. (2014) investigated

the ratio of domains covered by a city's best practices to the total of potential domains of smart initiatives. More generally, most of these studies offer a debate on whether smart cities exist or not, or on the degree to which cities are successful or not at being smart. But, in terms of performance, most pioneering studies define indicators that measure the efficiency of deployment of smart solutions. The contribution of smart solutions towards the ultimate smart cities' goals, such as environmental, economic, or social sustainability are largely neglected (Ahvenniemi *et al.*, 2017), which might be explained by the predominant strategic and technological vision of smart cities in this group of works.

Interestingly, two main frameworks and visions of smart cities separate academic researchers. The first gathers works defining smart cities mainly through a technological approach and brings the concept closer to that of digital cities. Here, much attention is paid to modern and digital technologies, and the smartness of cities is measured through the ability to implement and use those technologies in all the six dimensions that define a smart city. More generally, smart cities are mainly shaped by a technology-push force, which aims to satisfy a strategic urban future vision, rather than a reality (Angelidou, 2015). The technology-push implies that smart solution or services implemented in cities are supply driven, where the digital and technological innovations are introduced into the market as a result of advancing science and technology. This leads to the development of a research stream gathering works from computer sciences and engineering mostly focused on how to adapt or use Internet of Things (IoT) technologies in smart cities projects. This is the case, for example, in Jin *et al.* (2014) who suggest a framework and new methods for creating smart cities through IoT technologies. In the same vein, Zanella *et al.* (2014) provide a comprehensive survey of the enabling technologies, protocols, and architecture for an urban IoT. The authors discuss the technical solutions and best-practice guidelines that should be adopted when developing a proof-of-concept deployment of an IoT solution for a smart city project and they stress the close collaboration between the city municipality and developers. In this research stream, security and privacy concerns appear as an important other topic. Zhang *et al.* (2017) offer an overview of several security and privacy challenges in smart city applications to emphasize the need for research efforts to address these issues, particularly in the field of healthcare, transport systems and smart grid solutions.

The second framework of smart cities puts more emphasis on the initial targets of sustainability of cities. It depicts a more recent vision of smart cities much closer to people's well-being enabled by digital technologies (Albino *et al.*, 2015). The smart cities' projects are influenced by a demand-pull force where innovative solutions and services result from an answer to the demands of society. Smart solutions are developed to satisfy the initial target – sustainability – of smart cities. Observing that there is a much stronger focus on the first vision of smart cities, Ahvenniemi *et al.* (2017) conclude that there is a need to adopt an accurate term – *smart sustainable cities* – to re-focus on sustainability in smart city development. Furthermore they suggest not to limit the assessment of smart city performance to indicators that measure the efficiency of deployment of smart solutions; but to consider indicators that measure the contribution towards the ultimate goals such as environmental, economic, or social sustainability. Thus, ongoing research needs to consider the

environmental impacts of using IT, to better understand whether IT-based services or equipment have a higher environmental impact than those IT-based solutions that can mitigate during its lifetime.

Thus, whichever framework is used to define smart cities, Albino *et al.* (2015) conclude that there is no universal fixed system of smart cities because of the variety of cities worldwide that have different visions and priorities. For instance, some smart city projects are more technology-centered, others are more sustainability-oriented, while others are a mix between the two. Thus, a successful smart city project is one that succeeds in realizing and implementing its initial vision whether it is more digital or more sustainable.

Cluster 2. A critical and evolutionary vision of smart cities

Cluster 2 (38 references) gathers papers that criticize the technology-push vision of smart cities research stream described in Cluster 1. All these papers agree to adopt a more evolutionary framework and vision of what is a SC, what it should be, and how efficiently it could be developed.

According to Perera *et al.* (2014), the challenges of smart cities and IoT are inseparable since IoT technologies are adapted to the characteristics of smart cities. In fact, smart cities and IoT technologies are increasingly moving towards each other to achieve a common goal. They propose a "sensing-as-a-service" (SaaS) model to enable smart services. The model is composed of four conceptual layers (sensors and sensor owners, sensor publishers, extended service providers, and sensor data consumers) and is applied to three smart cities scenarios (waste management, smart agriculture, and environmental management). The authors identify the challenges of their SaaS model and categorize them as (i) technological, (ii) economic, and (iii) social (Perera *et al.*, 2014).

(i) The technological challenges include the development of middleware solutions that are able to handle billions of sensors and parallel sensor data streams, the different aspects related to sensor configuration (sensor embedded software, intermediate devices, and cloud middleware-software), and others challenges related to data fusing, filtering, processing storage (security and privacy), infrastructure and energy consumption.

(ii) The economic challenges include several innovation, entrepreneurship and entry barriers that need to be addressed by future research. As there is much competition among actors of smart innovations or solutions, a clear business and ecosystem model needs to be defined. Zygiaris (2012) for example introduced a smart city reference model that could be mobilized by city planners to address sustainability challenges at a local innovation ecosystem context (that is the city). In this case, he argues that a smart city project could be successful if certain elements of an urban innovation ecosystem anchor a city's smart investments into a sustainable future. In the same vein, Kummitha and Crutzen (2017) suggest adopting a framework that is more focused on the involvement of various actors in the smart city ecosystem. But as these actors have different interests and expectations, they can be classified into three categories: firms from varied industries (which are centered on their

market and value creation and capture), city governments (to reach efficiency in their governance) and citizens (to improve their living standards and quality of life). In this context, smart cities projects are perceived as a market creation strategy where an alternative storytelling is necessary (Söderström and Klauser, 2014) to consider the input and contribution of those various actors (Hollands, 2008).

(iii) The social challenges mainly include issues related to trust and social acceptance which incorporate security and privacy, safety, accessibility, usability and the legal terms of the SaaS model and the solutions or services it enables. Considering the case of smart homes in a smart city, Bhati and Hansen (2017) illustrated why it is important to consider social challenges in future research. Examining the perception of Singapore households on smart technology and its usage to save energy, there was a gap between the technology design and people's behaviors and perception, which were not included as part of the smart home design functionality.

Cluster 3. Information technologies and practices for social citizen intelligence in smart cities

Cluster 3 (101 references) focuses on citizens as resources involved in a process to help cities become more intelligent and consider citizens as their final objective. It gathers three main topics. First, it provides a critical view of the level of achievement of smart cities to serve their citizens in a sustainable way. Deakin (2011) asserts that smart cities have not yet reached their goals but are more focused on marketing campaigns rather than social intelligence and sustainable approaches. To move from intelligent to smart cities, they need to develop creative partnerships, knowledge transfer, learning and capacity-building. Similarly, Komninos (2009) defends the idea that cities will become smarter if they manage to develop innovation networks (communities, clusters, districts, multicultural territories). ITs are a facilitator that contributes to serving and developing human creative skills, innovative institutions, broadband networks and virtual collaborative spaces. Ismagilova *et al.* (2019) provide a valuable summary of 104 articles specialized in ISs with several definitions. Moreover, this article clearly repositions the final goals of smart cities to address challenges aimed at improving the quality of life of citizens through sustainable means. Based on the UN's (2018c) 17 sustainability development goals, the authors question the level of achievement and propose challenges that are not sufficiently covered by the IS literature. For instance, the challenges of including marginalized people (migrants, elderly people, women, differently abled people), and simultaneously planning the process of building cities while making them smarter by effectively connecting technological and social infrastructures.

Second, Cluster 3 reminds us that the central core theoretical model in IS used to study smart cities is currently the UTAUT (Unified Theory of Acceptance and Use of Technology) (Venkatesh, 2003) to explain the intention to use and the final use of IT dedicated to smart cities. This core model focuses attention on the determinants of UTAUT (expected performance, expected efforts to use IT, social influences and facilitating conditions) according to the profiles of users. This stream of research leads to quantitative models applied mainly

to smart homes, smart energy and smart transportation.

Finally, cluster 3 provides several frameworks, based at the extreme right side of the CCA, to enhance smarter cities to generate social intelligence with two main orientations. First, empowering citizens to become smarter by facilitating citizen-sourcing initiatives (innovative ideas with appropriate IT use) (Nam, 2012) and by developing new models such as open data (Stone and Aravopoulou, 2018). Second, by adapting the governance of cities through open governance, participation mechanisms and technical infrastructure (Gil-Garcia *et al.*, 2014) and improving transparency (Nam, 2012). All these initiatives need to be assessed (Nam, 2012). Cities will have to overcome the substantial challenge of security (Goodchild, 2007) and clearly position themselves on privacy (protection of personal data, surveillance purpose) (Komninos, 2009; Van Zoonen,2016). In doing so, most papers generally propose methodologies such as case studies and design-science research (Simonofski *et al.*, 2021).

Summarizing the co-citation analysis

The findings of the co-citation analysis conducted here, is largely in line with recent literature reviews that divide smart cities literature in two groups. For example, evaluating the global research trends in smart city publications from 1986 to 2019, Guo *et al.* (2019) identified two mainstream approaches: *one* based on technology-enabling services; *and a second* based on a people-oriented approach including softer factors such as participation, education, culture, and policy innovations. However, the authors do not identify the evolutionary vision of smart cities, as revealed by our Cluster 2.

Similarly, Mora and colleagues (2017) identified two dominant interpretative models from their literature review: *one* group of publications, which is clearly oriented towards a techno-centric interpretation of smart cities; and *a second* group proposing a more "holistic" view of smart cities resulting from the combination of technological aspects with human, social, cultural, economic, environmental aspects. However, what is lacking from this review is the social citizen approach highlighted by our Cluster 3.

Our co-citation analysis offers a more unified classification of the literature on the topic of smart cities, which includes the technology-push vision (Cluster 1) commonly identified in the works of both Guo *et al.* (2019) and Mora *et al.* (2017). However, it also includes both of the two other groups that differentiate the classifications of the respective authors (ibid). That is, our Cluster 2 incorporates Mora *et al.* (2017) holistic view of smart cities and our Cluster 3 incorporates the people-oriented approach of Guo *et al.* (2019).

3. PERSPECTIVES OF RESEARCH ON SMART CITIES

Although a great number of smart city definitions and visions co-exists, the idea that "technology" is an integral aspect of smart cities is common to most perspectives (Warnecke *et al.*, 2018; Guo *et al.*, 2019; Gupta *et al.,* 2020). It clearly appears that data openness, IT and IS are at the heart of the challenges in smart cities, either as the supporting infrastructure or as the digital innovation platform. It is also clear that "intelligent" design,

implementation, deployment and use of these technologies contribute to the level of city "smartness", enabling the delivery of valuable services based on data and IT. With this in mind, we identify three ongoing and future streams of research. The first focuses on the most recent technological challenges and issues that foster the development of smart cities (Camero and Alba, 2019; Ismagilova *et al.*, 2019). The second stream relates to knowledge management challenges in smart cities' innovation projects. And the third stream addresses challenges of the ethics of management issues.

Stream 1: Design, technological challenges and issues to foster the development of smart cities

We should note that, since the emergence of the smart city concept, ITs and IoT technologies have evolved. IoT cloud software platforms have matured, and many of the early IoT technical challenges have been addressed. Nevertheless, there remain many more emergent and difficult challenges related to the 'soft' non-technical parts of projects, such as "true" smart cities that are people-oriented and people-driven *vs* technologically driven by multiple private sector firms focusing on "cities as markets for smart city technologies" (UN-Habitat, 2020).

From the IoT (sensors, networks, application platforms, etc.) to artificial intelligence, via open data and disruptive technologies such as blockchain, future research should study how smart city players might take advantage of these innovations to carry forward their projects. Indeed, while information and technological innovations foster the development of smart cities (Camero and Alba, 2019; Ismagilova *et al.*, 2019), several topics need to be addressed to understand the following questions:

Firstly, how does the combination of resources and data organization occur within complex ecosystems that make up smart cities? This question leads to further develop the recent concept of smart cities data ecosystems introduced by Gupta *et al.* (2020), as an integrated view of data applications by various city entities that operate within an institutional environment. The study of data initiatives within the smart cities ecosystems needs not be limited to the authorities playing the role of coordinator in such ecosystems. A focus needs to be made on other entities that make up smart city ecosystems, for example incumbent *vs* younger (start-up) firms. How IT and IS could support or enable the organization of these entities within the smart city's ecosystem is one area, we encourage future research to investigate.

Secondly, coopetition and orchestration between actors are key characteristics of ecosystems. Future research should develop empirical works to examine how local public authorities, as key players and coordinators in smart cities data ecosystems, can manage coopetition. There is also a need to better understand what coopetition means within this type of ecosystems. To answer such question, future work can emphasize the role of IS as a means of support and/or generators of disagreements in smart cities (Eveno, 2018). For that purpose, they need to consider the critical question of property and power games to gain smart city control (Abbasi *et al.*, 2016; Bernardin and Jeannot, 2019; Martin, 2015, 2019). Intellectual property rights (IPRs) and coopetition between ecosystem members can derail the innovation process of smart city services. The neutral role that public organizations

(like public research organizations or local public authorities) play is also important (Attour and Rallet, 2014; Attour and Della Peruta, 2016). Future research needs then to fully investigate how public actors can play a neutral role in smart cities projects and how ITs can help them to assume this role.

Another research theme is the hidden side of technological innovations, which can be studied from the perspective of the impact of digital innovation in terms of cyber security and data privacy. Future work can consider several contexts, such as the context of connected objects proliferation and communication networks in smart cities (Braun, 2018; Vitunskaite *et al.,* 2019), ecological performance of smart cities (Tingting *et al.*, 2020), risk management and anticipation (accidents, terrorist acts, contamination) and the safety of citizens (Laufs *et al.*, 2020).

Stream 2: Digital innovations and knowledge for the development of smart cities

The second stream of future research suggested by this special issue aims to address the way in which knowledge management processes facilitate collaboration between public and private actors involved in a digital innovation project carried out in the context of smart cities (Attour and Rallet, 2014). The challenges linked to the creation, coordination, sharing, reuse and/or development of knowledge within the complex ecosystems of smart cities (Israilidis *et al.*, 2019) need to be addressed to develop and facilitate service innovation (Dominguez-Péry *et al.*, 2013).

These challenges could be addressed by considering the role of living labs in smart cities development projects. In this special issue, Florence Orillad, Valérie Fautrero and Gilles Puel qualify urban living labs (ULLs) as innovation intermediaries within smart cities. Traditionally, when a living lab is implemented in a city, the latter becomes the field of experimentation for collaboration and innovation (for example ENoLL: European Network of Living Labs). Orillard *et al.* (2021) demonstrate another role assumed by ULLs. This encourages future research on ULLs' role within smart cities. We encourage future research to study the use of alternative approaches of participation in urban life taking up the idea of fablabs to make "fab cities" (Rumpala, 2018) that stimulate the emergence of collective and participative knowledge. Smart cities projects involve several knowledge management issues (Ardito *et al.*, 2019) that need to be further investigated. One main problem concerns the role of ITs and information systems as enablers of knowledge exchange and security in smart cities (Ismagilova *et al.*, 2019). A related issue concerns how IS standards and supporting architectures can facilitate the sharing of knowledge between several cities and the emergence of learning cities (Israilidis *et al.*, 2019).

Access to data in smart cities is perceived as a source of information and knowledge (Krishna and Kummitha, 2019). We encourage the development of research to study how open data in smart cities enables the exploitation of new opportunities for entrepreneurs. Here, future works could adopt an entrepreneurial perspective on smart city development (Krishna and Kummitha, 2019). New models measuring the intelligence of cities could then be developed. These models need to break away from technology-push and demand-pull visions of smart cities and adopt an ecosystemic approach. For example, Camboin *et al.* (2019) define smart cities as an urban

innovation ecosystem, that relies on defining how to integrate its four constituent dimensions (governance, environ-urban, techno-economic, socio-institutional), where the governance dimension leads the process of urban transformation. We suggest that future research on smart cities add at least two other dimensions to Camboin *et al.*'s (2019) model: knowledge creation and sharing, and business model innovation. Through these two additional dimensions, we encourage the adoption of an entrepreneurial approach to smart cities.

Stream 3: Ethics of data management in smart cities

Developing smart cities in the 21st century now more than ever raises the questions – smart for what and for whom? In this context, ethics from *ethos* can be defined as the capacity to achieve a consensus on what would be "good" cities in which to live. Indeed, digital innovation favored by smart cities are highly dependent on the collection, storage and reuse of personal data in a way that is anonymous and non-identifiable, which lead to the ethical challenges of data management (Abbasi *et al.*, 2016; Bernardin and Jeannot, 2019; Martin, 2015, 2019). Based on a common vision, some cities will then be able to adapt the management of information, data and knowledge and make choices to develop an IS that would drive stakeholders' behaviors (the public administration, citizens, public and private organizations).

We encourage the development of research in three main areas. Firstly, to foster the level of participation of citizens, who are central to the use of public data, in the construction of smart cities. A few publications have started to tackle this challenge by imagining citizen-centered data spaces (Aguilera *et al.*, 2017) and participatory governance (Janowski *et al.*, 2018; Ju *et al.*, 2019). This will lead to establish the specific contextual factors that influence citizen participation in the design and development of smart cities (Simonofski *et al.*, 2019), among them their educational level which is globally low.

Secondly, future research should develop frameworks on smart cities governance. Major questions are still underdeveloped such as the role of the public administration within the whole ecosystem: orchestrators or followers? Might local government managers, adopt the role of an 'institutional entrepreneur' to mobilize and legitimize the digital transformations (Tassabehji *et al.*, 2016) fundamental to smart cities. Or should public administrations limit themselves to the openness and diffusion of data that would be then processed by other stakeholders? Open data does not mean free data. Several stakeholders can develop value added services based on public open data but we believe that cities should have a certain level of control on the public data diffused and acquire knowledge to propose innovative IS. Smart cities should also position themselves in terms of business models to be able to finance efficient IS infrastructures able to support a data-driven strategy.

Thirdly, the use of complex artificial intelligence algorithms within the information systems of smart cities brings new burning issues such as algorithmic governance (Rouvroy and Berns, 2013), the preservation of privacy, algorithmic intelligence and datafication (Markus, 2017), transparency and algorithmic accounting (Koene *et al.*, 2019) to preserve social inclusion (Maestre-Gongora and Bernal, 2019). Margulis *et al.* (2016) show that industries provide useful services to citizens by analyzing big data

about their consumption habits generated from pervasive and connective proximity with RFiD tags without informing them beforehand. This leads to potential issues such as threats to privacy, increased surveillance and tracking, loss of control of personal data, lack of transparency, ease of use, limiting citizen choices and power, issues similarly relevant to the implementation of smart cities. Last but not least, smart cities will also have to respond to grand societal challenges such as climate change. To do so, they will have to integrate the data management of transient "citizens of the world" who might not necessarily stay for long periods of time in their cities. The movement of sharing cities (Cohen and Muñoz, 2016) is one way of addressing this issue, but beyond sharing information via technological devices, cities will have to learn together and develop common knowledge management practices.

CONCLUSION AND PRESENTATION OF PAPERS PUBLISHED IN THIS SPECIAL ISSUE

Challenges faced by smart cities open several avenues for research in management science. Currently most of the research developed in the field of management of information systems is based on the theory and model of technology adoption. This stream of research needs to be developed to ensure all the actors within the smart cities ecosystem know how, when and for whom IT can improve life in cities. However, we believe that other and more diverse theoretical frameworks are needed not only in our field (Walsh *et al.*, 2018) but also more largely in the field of management science. There is a need for an interdisciplinary approach for future research to encourage a creative lens to tackle the current and emerging challenges of the 21st century. The papers selected and organized for this special issue are based on the three main streams of research that arose from our co-citation analysis.

Two of the selected papers (Zumbo-Lebrument *et al.*; Meyer-Waarden *et al.*) reflect the themes identified in Cluster 3, as they both adopt a citizen-centric approach to smart cities using the adoption theory model as their frameworks. Indeed, both papers rely on the Unified Theory of Acceptance and Use of Technology (UTAUT) model to respectively study the acceptance of Mobility-as-a-Service applications and the acceptance of innovative applications in connected homes. In their article entitled *"Acceptance of MaaS mobile applications: an application of UTAUT2 to the context of French smart cities,"* Cédrine Zumbo-Lebrument, Norbert Lebrument and Corinne Rochette explore the "smart mobility" and the implementation of Mobility as a Service (MaaS). They highlight the predictive value of their model for understanding and anticipating the acceptance of MaaS solutions.

Lars Meyer-Waarden, Julien Cloarec, Carolin Adams, Dorothea Nislusha Aliman and Virginie Wirth's paper entitled *"Home, smart home: How well-being shapes the adoption of AI-powered homes in smart cities"* examine another smart city key area: the "smart living" and the development of smart homes. Several decades after the inauguration of home automation, in the age of connected objects and artificial intelligence, the authors explore the factors of acceptance (and resistance) of innovative applications in connected homes. They also rely on UTAUT model and other relevant models to conduct their research.

The third paper of this special issue presents a pedagogical case illustrating how

knowledge management and innovation occur in the context of smart cities. In this paper, the authors Florence Orillard, Valérie Fautrero and Gilles Puel consider another side in the adoption of innovations, i.e. the social acceptability and appropriation of services in smart cities. In their article untitled *"Urban Living Labs (ULLs), a platform for smart cities as levers for experimenting with open innovations,"* the authors analyze the intermediation role of Living Labs in the open innovation processes carried out at the city level. By well representing the third stream of the future research we identified, they highlight the roles of the ULLs in mobilizing knowledge, supervising experiments, supporting project stakeholders and, above all, in contributing to the sustainability of the initiative.

REFERENCES

Abbasi, A., Sarker, S. & Chiang, R.H.L. 2016. Big data research in information systems: toward an inclusive research agenda. *Journal of the Association for Information Systems,* 17(2), I -XXXII.

Aguilera, U., Peña, O., Belmonte, O., & López-de-Ipiña, D. (2017). Citizen-centric data services for smarter cities. *Future Generation Computer Systems*, 76, 234-247.

Ahvenniemi, H., Huovila, A., Pinto-Seppä, I., & Airaksinen, M. (2017). What are the differences between sustainable and smart cities? *Cities*, 60, 234-245.

Albino, V., Berardi, U., & Dangelico, R. M. (2015). Smart cities: Definitions, dimensions, performance, and initiatives. *Journal of urban technology*, 22(1), 3-21.

Angelidou, M. (2015). Smart cities: A conjuncture of four forces. *Cities*, 47, 95-106.

Ardito, L. Ferraris, A., Messeni Petruzzeli, A., Bresciani, S. et Del Giudice, M. (2019). The role of universities in the knowledge management of smart city projects. *Technological Forecasting and Social Change*, 142, 312-321.

Attour, A., Rallet, A. (2014). Le rôle des territoires dans le développement des systèmes trans-sectoriels d'innovation locaux: le cas des smart cities. *Innovations*, (1), 253-279.

Attour, A., & Peruta, M. D. (2016). Architectural knowledge: key flows and processes in designing an inter-organisational technological platform. *Knowledge Management Research & Practice*, *14*(1), 27–34. https://doi.org/10.1057/kmrp.2014.21

Bhati, A., Hansen, M., & Chan, C. M. (2017). Energy conservation through smart homes in a smart city: A lesson for Singapore households. *Energy Policy*, 104, 230-239.

Ben Letaifa, S. (2015). How to strategize smart cities: revealing the smart model. *Journal of Business Research*, 68(7), p. 1414-1419.

Bernardin, S., Jeannot, G. (2019). La ville intelligente sans les villes? *Réseaux*, (6), 9-37.

British Standards Institute (BSI). PAS 181:2014-Smart city framework (SCF), PAS 181 Smart city framework. Guide to establishing strategies for smart cities and communities. https://www.bsigroup.com/en-GB/smart-cities/Smart-Cities-Standards-and-Publication/PAS-181-smart-cities-framework/

Camero, A., & Alba, E. (2019). Smart City and information technology: A review. *Cities,* 93, 84-94.

Camboim, G. F., Zawislak, P.A., Pufal, N.A (2019). Driving elements to make cities smarter: Evidences from European projects. *Technological Forecasting and Social Change*, 142(C), p.154-167. 8

Caragliu, A., Del Bo, C., & Nijkamp, P. (2011). Smart cities in Europe. *Journal of urban technology,* 18(2), 65-82.

Berrone, P. and Ricard, J.E. (2020). IESE Cities in Motion Index – CIMI 2020. IESE Business School. Available online www.iese.edu/cim

Cohen, B., & Muñoz, P. (2016). Sharing cities and sustainable consumption and production: towards an integrated framework. *Journal of cleaner production*, *134*, 87-97.

Deakin, M., & Al Waer, H. (2011). From intelligent to smart cities. *Intelligent Buildings International,* 3(3), 140-152.

Dominguez-Péry C., Ageron B, Neubert G. (2013), A service science framework to enhance value creation in service innovation projects. An RFID case study. *International Journal of Production Economics*, 141:2, February, 440-451.

Eveno, E. (2018). La Ville intelligente : objet au cœur de nombreuses controverses. *Quaderni,* 96, spring 2018. Available online http://journals.openedition.org/quaderni/1174

Giffinger, R., Fertner, C., Kramar, H., Kalasek, R., Pichler-Milanovic, N. and Meijers, E. (2007). Smart cities ranking of European medium-sized cities. Centre of Regional Science, Vienna University of Technology, Vienna. Available from: http://www.smart-cities.eu/download/smart_cities_final_report.pdf

Gil-Garcia, J. R., Helbig, N., & Ojo, A. (2014). Being smart: Emerging technologies and innovation in the public sector. *Government information quarterly*, 31, I1-I8.

Gil-García, J. R., Pardo, T. A. (2005). E-government success factors: Mapping practical tools to theoretical foundations. *Government information quarterly*, 22(2), 187-216.

Goodchild, M. F. (2007). Citizens as sensors: the world of volunteered geography. *GeoJournal,* 69(4), 211-221.

Gubbi, J., Buyya, R., Marusic, S., & Palaniswami, M. (2013). Internet of Things (IoT): A vision, architectural elements, and future directions. *Future generation computer systems*, 29(7), 1645-1660.

Guo Y.M, Z.L. Huang, J. Guo, H. Li, X.R. Guo and M. J. Nkeli (2019). Bibliometric Analysis on Smart Cities Research, *Sustainability* 2019, 11, 3606.

Gupta A., P. Panagiotopoulos, F. Bowen (2020). An orchestration approach to smart city data ecosystems. *Technological Forecasting and Social Change*, 153, p.119-929.

Harrison, C., Eckman, B., Hamilton, R., Hartswick, P., Kalagnanam, J., Paraszczak, J., & Williams, P. (2010). "Foundations for Smarter Cities". *IBM Journal of Research and Development*, 54(4).

Hollands, R. G. (2008). Will the real smart city please stand up? Intelligent, progressive or entrepreneurial? *City,* 12(3), 303-320.

IDC Government insights (2013). Smart Cities and the Internet of Everything: The Foundation for Delivering Next-Generation Citizen Services https://www.cisco.com/c/dam/en_us/solutions/industries/docs/scc/ioe_citizen_svcs_white_paper_idc_2013.pdf

Ismagilova, E., Hughes, L., Dwivedi, Y.K. et Raman, K.R. (2019). Smart Cities: advances in research – an information systems perspective. *International Journal of Information Management*, 47(2019), p. 88 -100.

Israilidis, J., Odusanaya, K. et Mazhar, M.U. (2019). Exploring knowledge management perspectives in smart city research: a review and future research agenda. *International Journal of Information Management*, in Press.

ISO (2018). ISO 37120:2018 Sustainable cities and communities — Indicators for city services and quality of life. Available online: https://www.iso.org/standard/68498.html.

Janowski, T., Estevez, E. & Baguma, R. 2019. Platform governance for sustainable development: reshaping citizen-administration relationships in the digital age. *Government Information Quaterly*, 35 (2018), S1 -S16.

Janowski, T., Estevez, E. & Baguma, R. 2019. Platform governance for sustainable development: reshaping citizen-administration relationships in the digital age. *Government Information Quaterly*, 35 (2018), S1 -S16.

Jin, J., Gubbi, J., Marusic, S., & Palaniswami, M. (2014). An information framework for creating a smart city through internet of things. *IEEE Internet of Things journal*, 1(2), 112-121.

Ju, J., Liu, L. & Feng, Y. 2019. Public and private value in citizen participation in E-governance: evidence from a government-sponsored green commuting platform. *Government Information Quaterly*, 36, 101400.

Jun, C.N., Chung, C.J. 2016. Big data analysis of local government 3.0: focusing on Gyeongsangbuk-do in Korea. *Technological Forecasting & Social Change*, 110, p. 3-12.

Krishna R. et R. Kummitha (2019). Smart cities and entrepreneurship: An agenda for future research. *Technological Forecasting and Social Change*, 149, 119763

Koene A., Clifton C., Hatada Y., Webb H., Patel M., Machado C., LaViolette J., Richardson R., Reisman D. (2019), A governance framework for algorithmic accountability and transparency, *European Parliamentary Research Service (EPRS)*, 124 p.

Komninos, N. (2009). Intelligent cities: towards interactive and global innovation environments. *International Journal of Innovation and regional development*, 1(4), 337-355.

Kummitha, R. K. R., & Crutzen, N. (2017). How do we understand smart cities? An evolutionary perspective. *Cities*, 67, 43-52.

Laufs, J. H. Borrion, B. Bradford (2020). Security and the smart city: A systematic review. *Sustainable Cities and Society*, 55 102023

Maestre-Gongora, G. P., & Bernal, W. N. (2019). Conceptual Model of Information Technology Management for Smart Cities: SmarTICity. *Journal of Global Information Management*, 27(2), 159-175.

Margulis, A., Boeck, H., Bendavid, Y. et Durif, F. (2016). Building Theory from Consumer Reactions to RFID: Discovering Connective Proximity. *Ethics and Information Technology*, 18(2), 81–101.

Markus, M. L. (2017). Datification, Organizational Strategy, and IS Research: What's the Score? *Journal of Strategic Information Systems*, 26, 233-241.

Martin, K. 2015. Ethical issues in the big data industry. *MIS Quarterly Executive*, June (14:2), p.67 -85.

Martin, K. 2019. Ethical implications and accountability of algorithms. *Journal of Business Ethics*, 160, p. 835-850.

Mora, L., Bolici, R., & Deakin, M. (2017). The first two decades of smart-city research: A bibliometric analysis. *Journal of Urban Technology*, 24(1), 3-27.

Nam, T. (2012). Suggesting frameworks of citizen-sourcing via Government 2.0. *Government Information Quarterly,* 29(1), 12-20.

Neirotti, P., De Marco, A., Cagliano, A. C., Mangano, G., & Scorrano, F. (2014). Current trends in Smart City initiatives: Some stylised facts. *Cities,* 38, 25-36.

Perera, C., Zaslavsky, A., Christen, P., and Georgakopoulos, D. (2014). Sensing as a service model for smart cities supported by internet of things. *European Transactions on emerging telecommunications technologies,* 25(1), 81-93.

Rouvroy, A., & Berns, T. (2013). Gouvernementalité algorithmique et perspectives d'émancipation. *Réseaux*, (1), 163-196.

Rumpala Y. (2018). Intelligente autrement : de la « Smart city » à la « Fab city ». Émergence d'un modèle alternatif de ville « intelligente » et logiques de reconfiguration du collectif urbain. *Métropole,* 22. Available online https://doi.org/10.4000/metropoles.5949

Simonofski, A., Asensio, E. S., De Smedt, J., & Snoeck, M. (2019). Hearing the voice of citizens in smart city design: the citivoice framework. *Business & Information Systems Engineering,* 61(6), 665-678.

Simonofski. A., T. Vallé, E. Serral, Y. Wautelet (2021). Investigating context factors in citizen participation strategies: A comparative analysis of Swedish and Belgian smart cities *International Journal of Information Management*, 56.

Small, H. (1973). Co-citation in the scientific literature:A new measure of the relationship between two documents. *Journal of the American Society for information Science*, 24(4), 265–269.

Söderström, O., Paasche, T., & Klauser, F. (2014). Smart cities as corporate storytelling. *City*, 18(3), 307-320.

Stone, M., & Aravopoulou, E. (2018). Improving journeys by opening data: the case of Transport for London (TfL). The Bottom Line.

Tassabehji, R., Hackney, R., Popovič, A. (2016) Emergent digital era governance: Enacting

the role of the 'institutional entrepreneur' in transformational change. *Government Information Quarterly* 33(2), 223-236.

TingtingY., Z.Huang,W. Zhao (2020). Are smart cities more ecologically efficient? Evidence from China, Sustainable Cities and Society, 60, September 2020, 102008.

TM Forum (2019). TR259 Smart City Maturity and Benchmark Model R19.0.1. Technical report, V.2.0.1Available online: https://www.tmforum.org/resources/technical-report/tr259-smart-city-maturity-benchmark-model-r19-0-0/

UN-United Nations (2018a). World Urbanization Prospects -The 2018 Revision. United Nations, Population Division of the Department of Economic and Social Affairs. Online Edition. Available from https://population.un.org/wup/Publications/Files/WUP2018-Report.pdf

UN-United Nations (2018b). The speed of urbanization around the world, Population facts, No.2018/1 dec. UN Population Division, Department of Economic and Social Affairs. Online Edition. Online Edition. Available from https://www.un.org/development/desa/pd/content/publications

UN-United Nations (2018c). Sustainable development goals. (Accessed on 2nd December 2018) https://www.un.org/sustainabledevelopment/sustainable-development-goals

UN-Habitat (2020). World Cities Report, 2020, The Value of Sustainable Urbanization. United Nations Human Settlements Programme (UN-Habitat). Online Edition. Available from https://unhabitat.org/sites/default/files/2020/10/wcr_2020_report.pdf

UN-Habitat (2021). UN-Habitat for a better Urban Future (2021). Cities and Pandemics: Towards a more just, green and healthy future. United Nations Human Settlements Programme. Online Edition. Available from https://unhabitat.org/cities-and-pandemics-towards-a-more-just-green-and-healthy-future-0

Van Zoonen, L. (2016). Privacy concerns in smart cities. *Government Information Quarterly*, 33(3), 472-480.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS quarterly*, 425-478.

Walsh I., Kalika M., Dominguez-Péry C. (2018), « Les grands auteurs en systèmes d'information », Editions EMS Management et Société, Book coordination.

Walsh, I., & Renaud, A. (2017). Reviewing the literature in the IS field: Two bibliometric techniques to guide readings and help the interpretation of the literature. *Systèmes d'Information Management*, 22(3), 75-115.

Warnecke D., R. Wittstock and F. Teuteber (2019). Benchmarking of European smart cities – a maturity model and web-based self-assessment tool. *Sustainability Accounting, Management and Policy Journal,* 10 (4), 654-684

Zanella, A., Bui, N., Castellani, A., Vangelista, L., & Zorzi, M. (2014). Internet of things for smart cities. *IEEE Internet of Things journal*, 1(1), 22-32.

Zhang, K., Ni, J., Yang, K., Liang, X., Ren, J., & Shen, X. S. (2017). Security and privacy in smart city applications: Challenges and solutions. *IEEE Communications Magazine*, 55(1), 122-129.

Zupic, I., Cater, T. (2015) "Bibliometric methods in management and organization." *Organizational Research Methods* 18.3 (2015): 429–472.

Zygiaris, S. (2013). Smart city reference model: Assisting planners to conceptualize the building of smart city innovation ecosystems. *Journal of the knowledge economy*, 4(2), 217-231.

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