Towards a systems thinking based view for the governance of a smart city's ecosystem

A bridge to link Smart Technologies and Big Data

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Abstract

Purpose – This paper aims to investigate the role of Smart Technologies and Big Data as relevant dimensions in affecting the emerging social and economic dynamics of society with the aim to trace possible guidelines and pathways for decision makers and researchers interested in the governance of the Smart City's ecosystem. The increasing attention to the domain of technologies and the amazing scenario that is emerging as a consequence of the influence of Smart Technology and Big Data in everyday life require reflection upon the ways in which the world is changing.

Design/methodology/approach – The paper adopts the interpretative lens provided by the systems thinking to investigate the challenging domain of the Smart City. A qualitative and interpretative approach is adopted to reflect upon the role of technologies in everyday life.

Findings – The Smart City ecosystem is defined as a multilevel construct useful for understanding how technical and technological dimensions of the Smart City can be managed not only as supportive instruments but also as key pillars to support, facilitate and ensure an effective cognitive alignment among all the involved actors.

Originality/value – This paper provides a tangible evidence of the systems thinking contribution in analysing, understanding and managing dimensions and paths of social dynamics. A contribution to previous studies is provided with reference to systems thinking, Big Data and Smart City.

Keywords Smart city, Big data, Systems thinking, Smart governance, Smart technologies

Paper type Conceptual paper

1. Introduction

According to several managerial contributions, the twenty-first century is the era of technology innovation, information sharing and hyper-connected societies (Castells, 1999; 2010; Shaw, 2002; Karakas, 2009; Webster, 2014; Barile *et al.*, 2015a, 2015b). All the traditional social and economic rules are progressively changing as a consequence of the fast evolutions in the challenging scenario in everyday life (Van Dijk, 2012; Del Giudice *et al.*, 2016). The emerging balances are showing an increasing relevance of technology and information as relevant drivers on which companies, organisations and institutions should "act" to improve their performances and opportunities for survival (Davenport, 2013; Evangelista *et al.*, 2016).

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The information is the new "key resource" for social and economic actors, and the information and communication technologies (ICTs) offer the instrument to better acquire, analyse and use it (Lopez-Nicolas and Meroño-Cerdán, 2009).

Building upon these reflections, several managerial contributions have analysed the domain of information with the aim to better explain its dimensions (Miller, 1996; Garson, 2000; Siponen, 2001) and processes (Alavi and Leidner, 2001; Applegate *et al.*, 2007; Davenport, 2013) and several researchers have highlighted the role of ICTs in supporting the information acquisition (Mansell, 1999; Roberts, 2000) and sharing (Hendriks, 1999; Steinmueller, 2000; Caputo *et al.*, 2016b). By following this approach, an increasing attention is emerging with reference to the topics of Smart Technology in terms of a "self-operative and corrective system that requires little or no human intervention" (Haque *et al.*, 2013, p. 22); and of Big Data as "high-volume, high-velocity, and/or high-variety information assets that require new forms of processing to enable enhanced decision making, insight discovery and process optimization" (Chen and Zhang, 2014, pp. 314-315).

Despite the relevance of these topics, they define a perspective strictly focused on the technological and instrumental dimensions of society and really little attention is paid in reference to the role of the actors involved in the information building and sharing process (Cook and Das, 2004; Caputo *et al.*, 2016a, 2016c; Perko and Ototsky, 2016). According to several contributions offered with reference to the domains of Smart Technologies and Big Data, society should be analysed and managed by building efficient digital platforms able to ensure better links among the many dimensions involved in social and economic processes (Uotila and Melkas, 2007). Unfortunately, the reality is more complicated than this (O'Connor, 1994; Espejo, 2015).

As underlined by Bijker and others (2012), technologies can explain only a small part of the "social complexity". In the same direction, Steinmueller (2000) underlines that information can only by partially decoded by using the technology because a large part of their meaning is embedded in human resources and they cannot be shared by simply using a technological platform. Johannessen and others (2001) outline that technologies are useful to improve the quality in management of more "tangible" dimensions of human life, but (for now) they are useless in understanding and managing cognitive and psychological variables.

In accordance with all these contributions and embracing the interpretative perspective of social sciences, a relevant research question is required to be investigated: *How do Smart Technologies and Big Data affect everyday life?*

With the aim to propose a possible answer to this question, the paper adopts the interpretative lens offered by the systems thinking and service logic to clarify the role of smart and digital environment in society life. An inductive approach is adopted to catch the relevant contributions that systems thinking can provided in understanding and managing some key concepts related to the domain of Smart Technologies, Big Data and Smart Cities. Accordingly, the research path has been structured by adopting a sequential approach in which the conceptual umbrella provided by systems thinking has been used to define a possible new interpretative path with reference to the role of Smart Technologies and Big Data and then, afterwards, discover ways to support the application of this new path with reference to the Smart Cities' logics and dynamics. Reflections herein are contextualised with reference to the domain of the Smart City as relevant examples of contribution among social and technological dimensions. Finally, implications, conclusions and future directions for research are presented.

2. Theoretical and conceptual background

2.1 The contributions of systems thinking in investigating Smart Technologies and Big Data

The society could be defined as a complex set of relationships based on the continuous sharing of resources and on the combination of several expectations culminating in the building of new value. All these elements make the society a domain that cannot be analysed by simply investigating its dimensions; they require an adoption of an interpretative lens that is able to outline how different elements interact by building conditions of "reciprocal influence" over time (Bandura, 1978; Di Nauta *et al.*, 2015; Turoff *et al.*, 2016). According to this view, society cannot be analysed in the light of a mechanistic approach; it requires the adoption of a holistic perspective able to link all the involved elements and pathways in a common "interpretative picture" (Odum and Barrett, 1971; Jackson, 2006; Hammond, 2010).

Building upon this assumption, systems thinking represents the better approach to understanding how all the elements and relationships in society are linked and evolve over the time (Cutcliffe, 2000; Caputo, 2016). The systems thinking approach supports the shift from a reductionist and mechanistic approach direct to explain how elements are composed and related to a holistic and dynamic view in which the attention is also on the elements that affect the emergence and the evolution of the whole phenomenon (Barile *et al.*, 2016; Perko and Mlinarič, 2016).

The systems thinking approach offers several relevant contributions to better understand how an entity is able to organise itself (Maturana, 1975; Varela, 1984) by sharing resources with the "external" environment (Espejo, 1990) to achieve conditions of survival (Beer, 1979; Barile, 2009). Among the contributions offered by the systems thinking approach, two research domains appear to propose relevant advancements in knowledge in understanding social dynamics: the viable system model (VSM) and the viable systems approach (*VSA*). While the first one clarifies how the elements involved in an organised entity are able to define conditions of reciprocal influence by building a shared balance (Beer, 1979, 1984, 1985; Espejo and Harnden, 1989; Espejo *et al.*, 1996, Espejo and Reyes, 2011), the latter proposes a general representation of systems based on its information variety useful to investigate any kind of organised entity designed to survive in a specific environment (Barile *et al.*, 2014, 2016; Saviano *et al.*, 2014).

Specifically, the systems thinking – thanks to the contributions offered by the VSM and the *VSA* – enriches previous knowledge in managerial domains by underlining the relevance of cognitive dimensions in affecting a system's decision and behaviours (Espejo, 1992; Barile *et al.*, 2013). At the same time, it highlights that it is not possible to define an objective view of reality because it is subjectively affected by the observers' perspectives and need (Saviano and Caputo, 2013), and it defines useful guidelines to better represent the link among the elements that formed the system (Barile, 2013).

As shown in Figure 1, adopting the interpretative lens offered by systems thinking emerges the relevant role of Smart Technologies in supporting the alignment among the different elements involved in a system by ensuring a fast reciprocal adaptation over the time (Streitz *et al.*, 2005; Di Fatta *et al.*, 2016), and also seen is the key role of Big Data as pathways to ensure the building of a strong feedback process able to increase the alignment between the linked systems (Wu *et al.*, 2014).

In such a perspective, the systems thinking offers the opportunities for defining a shared conceptual framework in which technological and social dimensions are effectively linked (Polese *et al.*, 2016; Saviano *et al.*, 2016a). It underlines the need for enlarging the perspective both in technological and social studies to build better bridges among human resources and technical instruments (Barile *et al.*, 2015a, 2015b; Saviano *et al.*, 2016b). By adopting the systems perspective, it is possible to state that the advanced technologies are not smart themselves, but they become smart only if they are aligned with users' ability when using them to solve their needs (Caputo, 2018). Moreover, the automatised processes are suitable only in the case in which there is a shared expectation, but they are useless in every case in which involved actors have different needs and/or perspectives. Finally, when the environment is subjectively built by the system then technologies can produce effective, efficient and suitable solutions – but only in the case in which they are based on an in-depth study of variables and elements that address the systems' perceptions.

According to the contribution of systems thinking, it emerges the "relational nature" of Big Data and Smart Technologies as key levers able to produce effects only as a consequence of actors' participation and collaboration. In such a vein, the way in which actors involved in the same system interact using Big Data and Smart Technologies requires investigation. A possible interpretative contribution, in this way, is provided by the service logic as detailed in the next section.

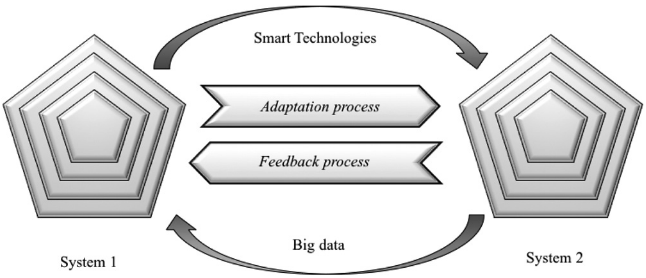
2.2 The service perspective for Big Data and Smart Technologies

Big Data is being generated by everything around us at all times. Every digital process and social media activity produces it. Systems, sensors and mobile devices transmit it. Big Data are arriving from multiple sources in an alarming velocity, volume and variety. To extract meaningful value from Big Data, you need optimal processing power, analytics capabilities and skills (www.ibm.com/big-data/us/en/).

Over time, several definitions have been provided with reference to the domains of Big Data and Smart Technologies in the light of several interpretative lenses. Some of these definitions are reported in the following Tables I and II with the aim to highlight the multiple perspectives interested to these domains.

Evidently, we can find in every single system a lot of different approaches and processes that produce and analyse data all the time. This is a common feature of all implementation of information technology (Jørgensen *et al.*, 2009). It is necessary to underline that only this fact does not mean anything very significant or remarkable. However, adding this capability to interconnect the devices, we can use, along with following, the analytic processes results in a huge number of combinations which enables the creation of a unique system that proves data and information to run other subsequent systems (Fricker, 1997).

There is no difference in the Smart City environment. Sources of the basic simple data (sensors and basic devices) can also be identified, along with the processes and applications that are analysing them and the companies that are using that data to provide the service for the citizens (Bowerman *et al.*, 2000; Paskaleva, 2009; Cocchia, 2014).



Source: Authors' elaboration

Figure 1. The role of Smart Technologies and Big Data in systems' linking

Table I.
Some definitions of Big Data

Definition	Source
"Big Data is at once simpler and more powerful"	McAfee *et al.* (2012, p. 5)
"Big Data is a new term used to identify datasets that we cannot manage with current methodologies or data mining software tools because of their large size and complexity"	Fan and Bifet (2013, p. 1)
"Big data is a term for massive data sets having large, more varied and complex structure with the difficulties of storing, analysing and visualising for further processes or results"	Sagiroglu and Sinanc (2013, p. 42)
"Big Data is about being able for the first time to collect and interrogate complete datasets rather than the traditional method of sampling and extrapolating. As such, it can give the impression that it generates a form of objective truth as opposed to the guesswork, inspiration or hunches that have been the currency of creative practitioners"	John Walker (2014, p. 183)

Table II.
Some definitions of Smart Technologies

Definition	Source
"Smart Technologies are . . . architectural designs and software components which using meta information on system and its usage conditions are able to solve efficiently the problems of maintenance and usage: data quality and performance monitoring, software flexibility and testability, context dependant user interface"	Bičevska and Bičevskis (2007, p. 262)
"Smart technologies are the methods employed to achieve certain purpose by using a priori knowledge"	Yun and Yuxin (2010, p. 71)
"Smart technologies are helpful to improve sustainability and safety"	Haque *et al.* (2013, p. 30)
"Smart Technologies are designed for a smart consumer or user—one who is interested, immersed, and engaged in managing their energy demand, and willing and able to embrace new Smart Technologies and strategies to achieve energy-management goals"	Strengers (2014, p. 5)

This situation apparently leads to the creation of a new kind of environment for following stakeholders:

- Customers – city citizens, who are the final receivers of the service;
- Industry – that can be also represented by the municipality services, who are trying to improve their service level using the application of Big Data; and
- Developers – companies or/and individuals who are developing applications (mobile or web) according the order of the industry for the sake of the customers.

There are two main questions to answered:

Q1 How the data are used and by whom?

Q2 How the revenue for the data usage is generated and by whom?

The data, provided by the sensors and other devices should be easily accessible by anyone who wants to use them. The city itself should guarantee the free access to data – only via this city's management ensure political independence, market persistence and standardisation (Vilajosana *et al.*, 2013).

Then, the revenue is not generated by the data themselves but are born by their utilisation. The industry is about to invest in the sensors to get the initial data to be used and, simultaneously, is pushing the developers to create new and more useful application for their customers. The same principle as on Android or Apple market for revenue generation is used – it is revenue sharing (Vilajosana *et al.*, 2013).

We can easily see that this model of the Smart City is based on the services that are dependent on open data. But the approach, presented above, is focusing just on comparing two variables: data flows and revenues coming from the work with those data flows.

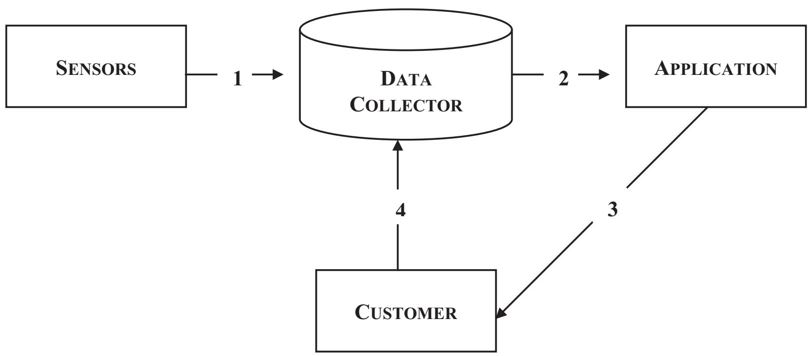
From the service perspective, reflecting the role of ICT, one more important aspect cannot be missed: a value, co-created by the participating parties. The value is not equal to revenue. Revenue is represented by money transfer, but to explain the role of the Big Data in the process of sustainability, there needs to be a focus on the process of the value creation as well.

In the beginning, the basic data are created; data are taken from sensors and similar devices. Those data are collected, processed and offered to customers via several applications, provided by different companies. Customers, or, in general, all users of the application, are also sources of the data (feedbacks, data about their geographical position, searching data, data about their preferences, etc.. . .). Those data are again added to the collection of the Big Data and together with actualised data from sensors are used to provide a new level of the service (Lusch, 2011). As shown in Figure 2, this cycle is potentially never-ending; it ends only in the moment when it would not be able to provide a new value for the customer.

The most important connection is Number 4. It represents the will of customers to participate in service creation. They are not only passive users of the data; they need to provide (and be the source of) new data, actualised and improved by their contribution. This critical factor determines whether or not the service and whole environment will run and be continuously developed.

This also means that the citizens must be motivated not only to use the services but also to participate in their development. They need to understand their position and its importance; and they need to be willing to collaborate. The question is, "How can citizens be motivated to do so?"

With the aim to provide a possible answer to this question, a multi- and trans-disciplinary framework occurs to support a paradigmatic change in the approach to Big Data and Smart Technology. A strong focus on the relational dimension is required, and a better understanding of the role of users in a defined environment should be maintained. In



Source: Author's elaboration

Figure 2.
The data process

such a vein, the topics of Big Data and Smart Technology are analysed. Specific reference is made to the Smart City environment to clarify which interrelated elements in a shared structure can generate different systems as a consequence of their ability to build conditions for collaboration and participation.

2.3 The domain of Smart City among users, services and technologies

The Smart City is a term for a city that focuses basically on two main goals. One is a high living standard of its citizens, and the second one is a sustainable development of the city. These main goals can be fulfilled by incorporating and evolving many services that support citizens' living standards, on the one hand, and help to develop the city and prevent exhausting of sources, on the other. There are many different papers contemplating about Smart City service domains. In addition, there is still no shared agreement on them.

For instance, here follows one of the latest definitions of the Smart City using a distribution of service domains (Mattoni *et al.*, 2015):

- Community - Participation and Communication.
- Environment - Enhancement.
- Energy - Sustainability and Optimisation.
- Mobility - Movement.
- Economy - Dynamism and Innovation.

In other words, a Smart City should support innovations, the use of a new technology, communication (people, services, private and public organisations from different city sectors), citizens' engagement and knowledge development – all to create a supportive synergistic environment. In such a line, the domain of the Smart City includes a clear representation of several research streams and perspectives interested in investigating multiple aspects of the same concept. These multiple aspects can be represented through three key perspectives related to technology, service and user as summarised in Table III.

Considering the multiple perspectives involved in the domain of the Smart City and the reflections reported in the previous sections, this paper proposes an approach for developing Smart Cities in a complex manner using a framework based on the Management by Competencies (MbC).

MbC is a managerial approach that describes a way of managing a vital company. Vitality in this context means that it is not just successful, but it is constantly successful. Exactly, the definition of the vitality is as follows: *Attaining of current goals does not diminish the chance to achieve goals in the future* (Plamínek and Fišer, 2005). To sum it up, a company following MbC does not drain its possibilities (resources) for a one-time achievement; it is successful in a long-term, and the mean of success is its employees.

Here is an analogy with Smart Cities that aims to achieve sustainable development and focus on lowering energy consumption and renewable sources, on the one hand, and aims to create a city with entertainment and work possibilities for its citizens, on the other.

The main idea, MbC builds on, is an existence of two worlds in companies. There is a world of possibilities and world of requirements. If a link between these two worlds is weak, company balances on the edge of its existence (requirements should reflect possibilities and vice versa).

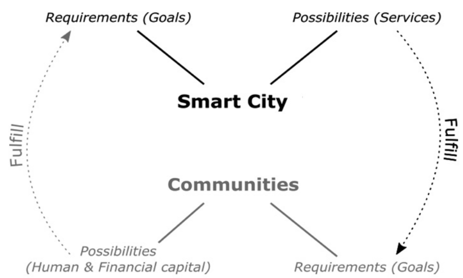
Using this idea, we developed a Smart City duality model. Each city – regardless of whether it is smart or not – has some requirements (goals) and possibilities (services). What should make Smart Cities different is a way of assessing and reaching goals. Smart Cities' goals are more oriented to their inhabitants (sustainable city development and high living standard) and can be fulfilled just by the active participation of their communities. Thus,

Perspective	Key concepts	Source
Technology perspective	At the beginning of future cities research, there was the main focus on technology perspective. More specifically, with the development of information technologies and its common use in daily lives, there was an idea to use an advancement of this technology broadly in cities as well. This is how a concept of Digital City was born. Then, this technology attitude was innovated and more oriented on services (e.g. Intelligent city, Ubiquitous city)	Dooley, (1996), Schaffers *et al.* (2011), Komninos *et al.* (2013), Perera *et al.* (2014), Zanella *et al.* (2014)
Service perspective	The shift to service orientation means using the technology not just for controlling and sharing information, but to provide better and usually more complicated or complex services. The current services don't have a broader context in many cases. They are executed separately, which doesn't utilise a full potential of other services and cities in general. The next step, some pioneering cities are already working on, is to interconnect the services to gain an advantage of more data and an infrastructure	Nam and Pardo (2011), Mulligan and Olsson (2013), Anttiroiko *et al.* (2014), Piro *et al.* (2014)
User perspective	Having a high number of interconnected services can be a good parameter of the city development. Nevertheless, we still miss a proposal of an attitude to create new services, meaning which are of the highest priority and which can be created later. There is no doubt about the services they have to be useful to someone. One of the first questions is, to whom (city government, citizens or even other subjects). We propose to use a framework based on the Management by Competencies® (Plamínek and Fišer, 2005) to deal with this problem. The framework is not yet completed, but the main idea follows	Cardone *et al.* (2013), Walravens and Ballon (2013), Carvalho (2014)

Table III. The perspectives involved in the study of smart city

there are two main units with their possibilities and requirements. The first one is a Smart City itself whose requirements are its goals, and possibilities are city services. The second one is the communities in the city with their requirements (high living standard, and possibilities) human and financial capital.

The whole system works like a cycle. As shown in Figure 2, Smart City goals are fulfilled by communities' possibilities and their requirements are conversely fulfilled by Smart City services (Figure 3).



Source: Author's elaboration

Figure 3. Smart City management cycle

3. Method and research path

The paper builds upon a qualitative approach method to investigate previous managerial and organisational contributions with the aim to provide useful guidelines for better understanding and managing the domain of Big Data. According to Liamputtong (2013), the qualitative and descriptive approaches offer the opportunity for organisation of previous knowledge in new schemes with the aim to understand structure and functions of a new phenomenon.

The choice to adopt a qualitative approach is motivated by the nature of the investigated domain (Denzin and Lincoln, 1994). Smart City is a relatively new topic, and a clear picture about its structure and functioning is still missing (Batty *et al.*, 2012).

With the aim to fill this gap, the paper adopts the interpretative lens provided by systems thinking and service logic to identify a set of key concepts potentially useful for better understanding the domain of the Smart City. After this, the identified concepts are integrated with the aim to build a possible conceptual picture of the Smart City. Finally, this conceptual picture is detailed in the next section, focusing the attention on some dynamics that could represent interesting starting points to investigate the Smart City domain through quantitative approaches as well.

4. Towards an ecosystem view of Smart City as complex adaptive systems

According to Lusch (2011, p. 15), an ecosystem is:

> A spontaneously sensing and responding spatial and temporal structure of largely loosely coupled value proposing social and economic actors interacting through institutions and technology, to: coproduce service offerings, exchange service offerings and cocreate value.

As presented, this definition seems to offer a clear representation of the Smart City, as proposed in the previous sections. Specifically, the Smart City can be considered a complex of users, services and technologies linked to ensure a shared satisfaction (Nam and Pardo, 2011).

In such a perspective, a relevant role is played by Smart Technologies and Big Data in ensuring a shared satisfaction of all the involved actors by supporting the fast adaptation of the relationship on which the Smart City is based. Specifically, Smart Technologies represent the instruments to improve the efficiency in the relationships between citizens and city infrastructures and services, while Big Data ensures an effectively adaptation of city services to citizens' expectations. According to this, Smart Technologies and Big Data can be considered the levers on which to act to build a more efficient approach in the management of the Smart City as a complex adaptive system (CAS).

As underlined by Holland (2006, p. 1), CAS is a system that has "a large numbers of components, often called agents, that interact and adapt or learn". As shown in Figure 4, by adopting systems thinking, the Smart Technologies and Big Data could support the emergence of Smart Cities aligned with the logic of CAS (Figure 4).

In line with the reflections proposed in the previous sections, Figure 4 shows that by acting on the Smart Technologies and Big Data, it is possible to better understand the relational and transactional network in which the elements involved in Smart City are engaged. Decision-makers can then gain a clear picture about the relationships among the elements involved in Smart Cities. Consequentially, decision-makers have the opportunity for understating that individual behaviours and decisions are the result of multiple influences. According to Sterman (2000, p. 8), here emerges the need to:

> Improve our understanding of the ways in which an organization's performance is related to its internal structure and operating policies, including those of customers, competitors, and suppliers and then to use that understanding to design high leverage policies for success.

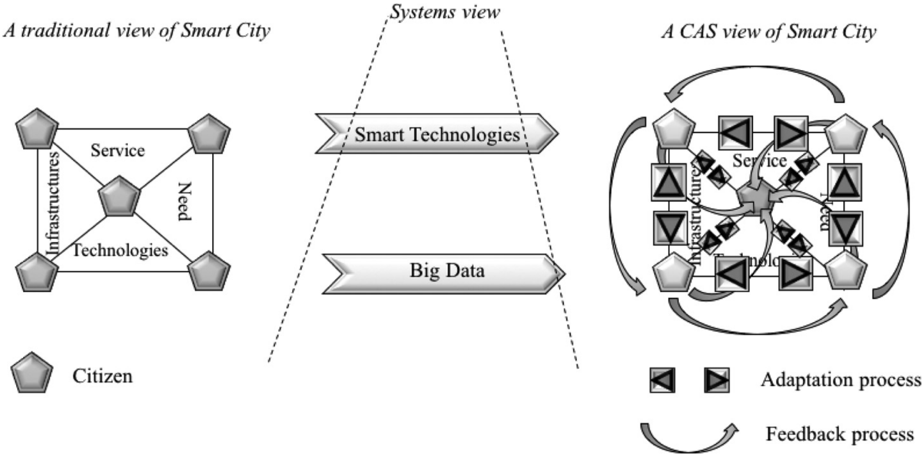


Figure 4.
From a traditional to a CAS view of Smart City

More specifically, in the light of CAS, the Smart City could shift to be considered an ex-ante planned technological city managed by some kind of "supra entity" to become a multi-dimensional, interconnected domain that can adapt itself through reliance on the support offered by the technologies (Smart Technologies) to respond to citizens' behaviours and expectations (Big Data). From such a perspective, the elements involved in the Smart City can be considered agent in terms of "semi-autonomous units that seek to maximise their fitness by evolving over time [and able to] scan their environment and develop schema" (Dooley, 1996, p. 3). By adopting this interpretative perspective, it is possible to highlight the high subjectivity that affects the Smart City, and it is also possible to highlight that it is not possible to define an objective representation of the Smart City because for each involved agent, it acquires different meanings.

In the light of the CAS perspective, the Smart City is a relevant example of social phenomenon and its analysis, study and representation requires combining multiple perspectives in a shared interpretative framework to show, by adopting a holistic approach, how agents' relationships affect its dynamics and evolutions over the time (Bowerman *et al.*, 2000; Paskaleva, 2009; Cocchia, 2014).

5. Conclusions, implications and future directions for research

As it was shown, Smart City development depends on two main factors: continuously updated Big Data and Smart Technologies that are using them as one factor and customer willingness to cooperate on their development.

Data and applications, used to produce more data that are used for the better utilisation of the service and whole service environment. The process seems to be never-ending, depending only on the fact and will of all the stakeholders to cooperate on its sustainable development.

Accordingly, the paper shows that an effective management of the Smart City requires to clarify role and contributions of Smart Technologies and Big Data. In the same direction, the paper underlines the existence of multiple perspectives involved in the management of the Smart City, and it highlights the need for adopting multi- and trans-disciplinary approaches with the aim to effectively provide a clear picture and framework to the actors involved in the management of Smart City.

Following these reflections, it is possible to state that, from the theoretical point of view, the paper focuses the attention on the opportunities related to the application of systems thinking and service logic as general interpretative frameworks through which several research streams and perspectives can be combined. At the same time, from the managerial point of view, the paper shows the inefficiency of traditional tools and instruments for managing a phenomenon such as the Smart City based on new logic not still fully schematised in the existing "managerial kit".

Recognising the validity of the proposed concept, some possible future lines of research can be tracked with the aim to clarify the reasons that motivate users in sharing personal data through the use of Big Data and Smart Technologies that are also in the domain of the Smart City.

Reflecting upon these research streams, some implications can be derived both from theoretical and practical points of view. Specifically, from the theoretical point of view, it emerges the need for defining innovative approaches and instruments to better investigate the role and dimensions of Big Data and Smart Technologies that rely upon the users' perspective with the aim to explain social and economic changes produced by their use. From a practical point of view, managerial and organisational knowledge is enriched with new instruments able to face the emerging challenges imposed by the complex domains of Big Data and Smart Technologies in the light of their cognitive influence on users' decisions and behaviours.

Accordingly, the reflections herein are only directed towards outlining a possible conceptual path in which borders and boundaries require to better definition because of the multiple connections and influences that can be traced among the identified concepts. Specifically, more studies should be developed to effectively understand how Big Data and Smart Technologies can affect the sustainability of business and social processes with the aim:

> To move from generalizations about accelerating learning and systems thinking to tools and processes that help us understand complexity, design better operating policies, and guide change in systems from the smallest business to the planet as a whole (Sterman, 2000, p. 4).

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