The Role of ICT in Smart Cities Governance

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Abstract: *This position paper discusses the role of information and communication technologies in the governance of the transition process that urban areas will have to undergo in the coming years. The topic is analyzed from a value-oriented perspective and in the light of almost two decades of technology-driven innovation in both the private and the public sector. All this has been examined in an attempt to take stock of past mistakes and to embrace the opportunities deriving from some important paradigm shifts appearing on the horizon. A conceptual framework is proposed identifying three main contributions: the enablement of new production, distribution and governance processes; the transformation of organizational and institutional arrangements; and the information of individual choices and behaviors. Finally, the combined diffusion of Social Media and computer-based simulation in policy making is argued to lead to significant improvements in the management of smart cities by enabling value-driven, data-intensive and participative governance models, labeled as "extended governance".*

Keywords: Smart Cities, ICT, Governance, Policy, e-Participation, Innovation, Value, Simulation.

1. Introduction

An overwhelming body of scientific evidence now clearly indicates that climate change is a serious and urgent issue (Stern, 2007). In parallel, the unprecedented growth in the world population occurred over the last centuries coupled with the gradual increase in developing countries' spending power has contributed to exacerbate the unsustainability of existing consumption patterns. The drawing of world's natural resources at a faster pace that they can be restored has been proven over the decades to be one of the main pitfalls of modern socioeconomic systems (Meadows et al., 2004). The combined effect of the above phenomena is gradually but steadily leading the world towards a global environmental, economic and social collapse. As put in Stern (2007): "There exists a serious risk of major irreversible change with non-marginal effects on modern life as we know it today".

We are living momentous times, probably one of the few points in human history when mankind is called upon to act united and focused to face a number of major collective challenges. Contemporary governments, businesses and individuals are faced with an unprecedented responsibility towards future generations. The situation calls for a quick and significant

reconceptualization of current economic and societal models and the governance of the required change poses complex policy challenges with little or no room for errors.

In such a scenario, cities have been identified by many commentators as the battle-ground in the fight against climate change. As a matter of fact, cities are responsible for over 70% of the world's greenhouse emissions and, at the same time, they are places where the greatest efficiencies may be obtained (UN-HABITAT, 2011). As of 2010 half of the world population lived in urban areas and 150 metropolitan urban regions across the world generated almost 50% of the global GDP (World Health Organization & UN-HABITAT, 2010). In other words, cities are the *locus* where a process of deep societal and economic reform should start from, where global issues may be addressed locally. They have a sufficient critical mass in both demographic and economic terms to ignite a planetary revolution.

The European Commission recently launched the strategic energy technology plan (SET plan) which entails a smart city initiative to encourage and support urban areas which are willing to go beyond the well-known 20-20-20 objective. Such initiative poses a significant emphasis on the role of ICT as a strategic lever in the attainment of higher levels of sustainability and quality of life. A view shared by many international institutions and think tanks which promote the vision of a "wired", ICT-driven form of development.

To summarize, the situation depicted above highlights three main messages: firstly, the need to revisit the way society is organized and managed thus giving birth to a global process of reform; secondly, the identification of cities as fertile soil where to start the reorganization from; thirdly, significant expectations placed on information and communication technologies as a central ingredient of such change.

The focus of the article at hand cuts across the above messages and may be delimited by two simple yet fundamental questions:

- How is the transition that cities will have to undergo going to be governed?
- What role will ICT play in the governance of such process?

The discussion included in this paper offers some reflections on the above questions and proposes a conceptual model containing a unifying representation of the role that – in our view - ICT may play in the governance of smart cities.

The remainder of the article is structured as follows. Section two provides a review of the literature strands discussing important concepts on which the discussion will be based. Section three contains the conceptual framework proposed to portray the role of ICT in the governance of smart cities. Section four introduces an emerging paradigm of governance enabled by information and communication technologies. Finally, section five contains some conclusive remarks and indications of future possible research directions.

2. Literature Review

The discussion that will be conducted in the following sections will address the role of ICT in the governance of smart cities oriented towards the creation of value for society. The review presented in this section will thus provide a glimpse of the three main concepts that are at the heart of our investigation, that are: the idea of smart city itself as well as the concepts of governance and value. The aim of the review is to create a clear and shared understanding to be used as a starting point for further discussion.

As many commentators highlight, the term smart cities is not new. It probably finds its roots in the late nineties with the smart growth movement (Bollier, 1998) calling for new policies in urban planning. Nevertheless, it was not until 2005 that some of the main ICT global players - CISCO (Abulhakim, 2005), SIEMENS (Siemens, 2004) and IBM (IBM, 2009) - started referring to smart cities as the integration of information systems with urban processes (Harrison & Donnely, 2011). Since then, the term has evolved to capture a more complex concept that many scholars have ventured in trying to craft a comprehensive definition for.

Recent reviews of such efforts have been published by Chourabi et al. (2012) and by Caragliu et al. (2009). The former asserts that the idea of a smart city itself is still emerging, and the work of defining and conceptualizing it is in progress. The latter - instead - underlines the importance of human capital by suggesting that the availability and quality of ICT infrastructures are not the sole ingredient of smart or intelligent cities; Berry & Glaeser (2005) - for instance - show that the most rapid urban growth rates have been achieved in cities where a high share of educated labor force is available.

In this article we do not intend to propose a definition of smart city to be added to those already present in the literature, as this is not felt to generate significant value. Therefore, for the purpose of the discussion to be conducted in the next sections, the definition proposed by Caragliu et al. (2009) will be employed. Such definition was chosen on the basis of its ability to reasonably capture all the relevant aspects previously highlighted: "a city is smart when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance".

As the chosen definition suggests, the concept of smart city includes the notion of governance. According to Forrester Research, smart governance is the core of smart cities initiatives (Belissent, 2011), therefore it has become paramount to better understand such concept to draw its boundaries and single out its components (Misuraca et al., 2011).

In the late nineties governance was viewed by international organizations such as UNDP, World Bank, UNESCO and OECD primarily as a form of political regime (Kauffman et al., 1999). More recently, the European Union, in an attempt to tackle some issues having to do with the effectiveness of its action and the recognition of the results achieved, published a white paper on European Governance (European Commission, 2001). The document proposed to revisit governance practices by introducing the concept of good governance based on five pillars: openness, participation, accountability, effectiveness and coherence. The OECD as well provided a definition of good governance which unfolds along a number of dimensions. According to such organization, good governance is participatory, consensus oriented, accountable, transparent, responsive, effective and efficient, equitable and inclusive and follows the rule of law. It assures that corruption is minimized, the views of minorities are taken into account and that the voices of the most vulnerable in society are heard in decision-making (OECD, 2001).

Little literature on smart cities addresses issues related to governance (Chourabi et al., 2012). According to Mooij (2003), the presence of leadership is important for good governance. In the same way, Lam (2005) emphasized on the presence of a "champion" that collaborate with all stakeholders as an essential factor for good governance characteristic of a smart city that is based on citizen participation (Giffinger et al., 2007) and private/public partnerships (Odendaal, 2003). According to Johnston & Hansen (2011), smart governance depends on the implementation of a

smart governance infrastructure that should be accountable, responsive and transparent (Mooij 2003). This infrastructure helps allow collaboration, data exchange, service integration and communication (Odendaal, 2003).

By looking at the evolution undergone by the concept of governance over the last fifteen years, it is possible to notice a gradual shift in focus from a mere application of administrative and political authority towards a bidirectional discourse with a diversified constituency who is more and more recognized as an authoritative interlocutor in the process of value creation for society. In this respect, good smart city governance should attempt to achieve two important operational objectives: produce effective decisions - i.e. make the best use of information to optimize decision making - and provide adequate incentives - i.e. given that all individuals act in their own self-interest, provide the incentives that produce the best/desired outcome. But, in order to achieve these results, it is paramount to have developed a clear and strategic vision detailing what value needs to be generated.

For this reason, in the final part of this review the focus will shift to the notion of value[1].

As Adam Smith reminds us, when talking from an economist's perspective "the word value has two different meanings, and sometimes expresses the utility of some particular object, and sometimes the power of purchasing other goods which the possession of that object conveys. The one may be called 'value in use'; the other, 'value in exchange'. The things which have the greatest value in use have frequently little or no value in exchange; on the contrary, those which have the greatest value in exchange have frequently little or no value in use" (Smith, 1776).

When taking a philosophical stance, traditional axiology shows how it is possible to distinguish between intrinsic value and instrumental value. In other words: if something is good only because it is related to something else, then its value is instrumental to the achievement of a given objective. To exemplify, money is supposed to be good, but not intrinsically good: it is supposed to be good because it leads to other good things such as the possibility to buy food and water (Schroeder, 2008).

In addition, the so called point of view theory (Schroeder, 2008) sheds some light on the difference between what is good *simpliciter* from what is good for a specific stakeholder: the former defines what has value from a more generic point regardless of the circumstances, while the latter is perspective-dependent.

Finally, the perception of value is strictly correlated with the needs of a society. In this respect, it is useful to mention that individual as well as collective needs may be hierarchically organized in order to provide a priority ranking. The work conducted at the beginning of the last century by the American psychology Abraham Maslow represents a cornerstone in this field (Maslow, 1943). His celebrated hierarchy of needs identifies five categories of needs having to do with physiology, security, belonging, esteem and self-actualization. In a resource constrained situation, such classification represents a useful tool in identifying and prioritizing the long term strategic priorities that should be targeted in order to create value for the society. A value that - as Savitz (2006) reminds us - unfolds along a number of dimensions touching upon financial, social, environmental aspects.

[1] A first definition may be drawn from (Wikipedia, 2013).

3. From Technological Infrastructures to Value Creation

To be properly understood, the use of ICT in governance processes needs to be framed within a longer process of technology-driven public sector reform. This process over the last decades has contributed to shape a novel vision of the public sector, where information sharing, transparency, openness and collaboration are key concepts with tremendous organizational and policy implications. This slow, yet steady, process has considerably contributed to render more complex the "business of government", in terms of competences required, institutional/organizational arrangements, policy actions' responsiveness and appropriateness (Ferro & Gil-Garcia, 2010).

In the governance of urban areas, city managers are faced with the challenge of balancing three overriding concerns: achieving a high quality of life for all citizens, maintaining economic competitiveness and protecting the natural environment (GlobeScan & MRC McLean Hazel, 2007). More and more, ICT is becoming a vital tool in the governance balancing act as buildings, transport networks and utilities systems (Economist Intelligence Unit, 2010).

There seems to be a general belief among the political, academic and professional world about the importance of role that ICT may play in the governance of city. In this section the discussion will try to shed some light on what type of contribution such technologies may offer as well as on how their potential may be turned into reality. In this respect a number of questions seem to be of particular relevance: are ICTs contributing to enable new and better decision making processes and/or incentive systems? May information and communication technologies help tackle the pressure on public budgets without cutting on service provision? How may the pervasive presence of connected devices in large metropolitan areas help reduce CO2 emissions and stimulate economic development? All these interrogatives may probably be considered a specification of an overarching and more fundamental question about how a technological infrastructure may be turned into value for society.

Answering these questions is of course not a straightforward task. Nevertheless a number of reflections may be put forward drawing from the experience gained over the last two decades in studying the role of ICT in promoting public as well as private sector innovation.

The first aspect worth considering is the acknowledgement of the fact that technology alone is not enough and that a number of complementary investments are required to fruitfully exploit its potential (e.g. training, organizational change, new policy frameworks). Secondly, it is key to understand that the diffusion and adoption of ICT as well as the "intelligence" that such technologies are supposed to generate do not possess an intrinsic value but an instrumental one. That is to say, they may be considered valuable only to the extent to which they allow the city to attain a set of objectives that are perceived as being of intrinsic value either for society (good *simpliciter*) or for a specific target group of stakeholders. In other words, ICT is a means to an end. For this reason, innovative solutions developed by public and private organizations should be assessed not on their technological intensity but rather on the value they generate for a given set of stakeholders. Therefore, it is important to question the often advocated assumption whereby the usage of the latest technology equates to more value for the final user. While this may sometimes be true, it nevertheless requires a thorough check since often the use of cutting edge technologies entails higher costs that may jeopardize the financial viability or long term sustainability of the associated solution (this is even more true in times of recession). In addition, the economics of innovations literature shows that incremental product innovation is characterized by a decreasing marginal utility (Adner, 2002). In this respect it is important to assess what functionalities generate

the most utility, as they are most likely subject to a Pareto distribution whereby 20% of the functionalities account for 80% of the utility.

Other two additional aspects to consider are causality and time. As the literature on information systems tells us, the understanding of the interaction between technology and ecosystems of actors (as cities may be considered) has gone through three main phases over the last two decades (Helbig et al., 2009). The first was characterized by the presence of a technological deterministic view according to which impacts mainly came from the inherent features of technology which was thought to be able to solve social, political, economic, and organizational problems. According to this vision, the simple infusion of technology into an ecosystem was enough to introduce significant performance improvements. The second phase, instead, taking stock of the numerous failures occurred during the previous phase, was characterized by a contingent approach in which human choices within social structures determined the impacts of technology. In this view, technology could be compared to a tailor-made suit that needed to be customized on the specificities of the ecosystem considered. This view slightly improved success rates, but did not fully take into account the time dimension. The third and more recent phase promotes an evolutionary view according to which there exists a mutual and iterative influence between technological solutions and the social ecosystem in which they are implemented. In other words, technological solutions should be designed to meet the needs and wants of the targeted group of stakeholders, while accounting for the fact that the adoption of the solution itself is changing them.

Moving now onto discussing the role of ICT in the governance of the transition process that smart cities will have to undergo, a synoptic framework has been devised providing a unifying view of such role as well as of the ingredients necessary to turn technological infrastructures into value for society.

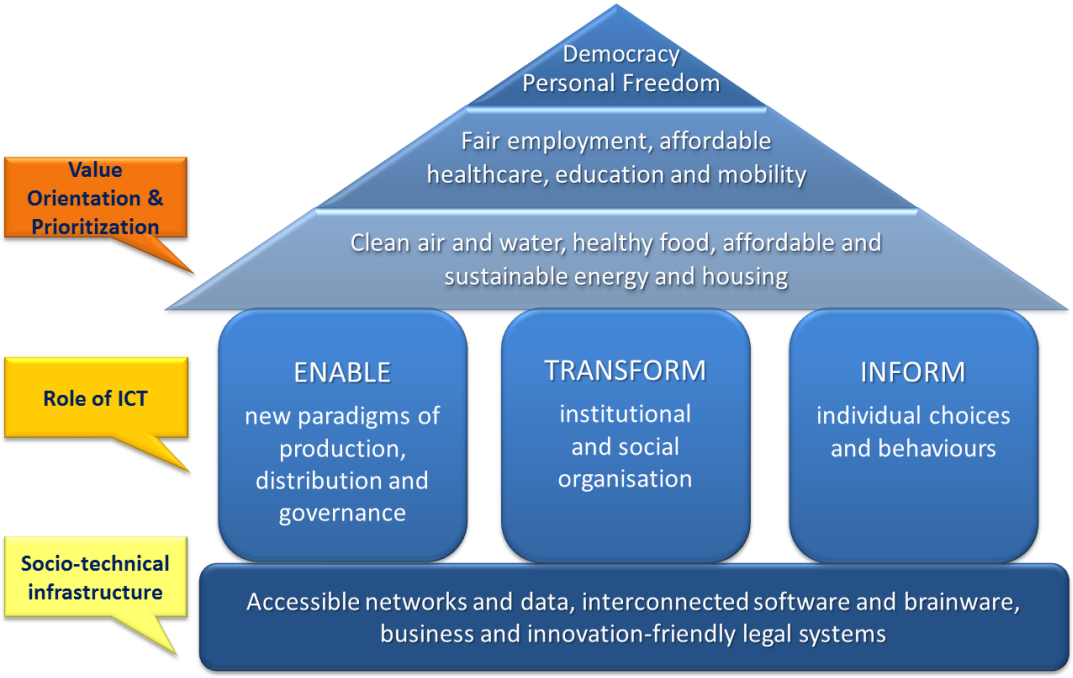

Figure 1: The Smart City House: ICT in Smart Cities Governance

The framework was baptized "the smart city house" model with the intent to run a parallel between the process of building a house and that of value creation. The model should be read from the bottom upwards. In the foundations of the house, it is possible to find a socio-technical infrastructure (Lock & Sommerville, 2010) containing the contextual factors that need to be present in an ecosystem in order for it to be able to fully exploit the potential of ICT. The key ingredients are networks, data, software, "brainware" (i.e. people) and laws that should be respectively accessible, interconnected and innovation-friendly. It is, in fact, important to underline that value does not only reside in the individual resources (e.g. data or software) but also in the links and connections that it is possible to establish between the different resources. This of course in the belief that – as asserted by complexity theory (Laughlin, 2006) – the whole is greater than the sum of its individual parts. In this respect, interoperability in all its possible declinations (technological, semantic, organizational, etc.) represents a key value driver for society.

Moving up one level, we find the pillars of the house representing the key strategic contributions that ICT may offer to the creation of value and to the transformation of cities in smarter and more sustainable environments. In particular, three main contributions have been identified. The first has to do with the possibility of enabling new paradigms of production, distribution and governance. To exemplify, let's think of the energy sector, where the emergence of distributed generation paradigms is bringing along significant changes such as the need to build networks with smarter peripheral nodes. In such a framework, ICT may cover a complementary role by offering an important contribution in terms of management, planning and control of production to both energy "prosumers" and energy network operators. The second contribution pertains to the possibility to transform the way in which many daily activities are conducted. In this respect, we may think of telework and telemedicine which are leading to a decoupling between activities and the physical location in which they are conducted. Another example could be the opportunities offered to local communities to self-organize (Cottica, 2010) to manage different aspects of their lives (e.g. fair-trade collective purchasing promotes the consumption of local products and the disintermediation of the distribution chain with deep social and environmental impacts). The third and final contribution has to do with the role of ICT in informing individual choices and behaviors. As a matter of fact, the reduction of the carbon footprint of an urban area inevitably requires the modification of everyday choices of millions of individuals. Inducing such change is not an easy task and surely may not be achieved by a mere top-down approach. In this respect, the wise use of ICTs and, in particular, Social Media may help in diffusing a greater environmental awareness and sensitivity leading to the emergence of social norms incentivizing more virtuous behaviors.

Moving now to the final part of the house, the roof represents the value orientation that any smart initiative should never lose sight of in order to generate positive externalities for society. The triangular shape has been divided into three different layers in order to generate a stack configuration with diverse and interrelated levels. Each level, in fact, depends from the level below in terms of existence similarly to what happens in other hierarchical models present in the literature (e.g. Maslow pyramid, OSI/ISO stack). The introduction of society's needs in a layered structure intends not only to stress the importance of a value orientation but also to stimulate the reflection of what value should be produced. To exemplify, the mere push towards economic growth to the expenses of the environment and public health that has dominated the world's economy over the last century, when put in relation with this hierarchical schema clearly shows its shortcomings linked with the attempt to build the second layer without having assured the

existence of the level below. We are of course aware of the fact that the model proposed represents a simplification and that in the real world it may be necessary and possible to privilege economic aspects to the expense of more fundamental needs. At the same time, it is important to stress that this misalignment of priorities may only be considered a temporary solution as it is clearly unsustainable. Long term strategies should therefore attempt to wisely balance the actions aimed at producing resources with high value in exchange and actions aimed at better employing environmental resources with a high value in use.

Concluding, the framework proposed provides a simple and synthetic representation of how ICT infrastructures may be turned into value within urban areas and, more in general, in any type of social ecosystems. In our view, it contains an organic depiction of the relationship between the necessary inputs (the foundation), the expected outputs (the pillars), and the desired outcomes (the roof) of a smart and sustainable urban ecosystem. This representation on top of offering a useful tool in the definition of smart city strategies may also provide precious inputs in the design of impact assessment frameworks for the evaluation of a city performance against a number of long term policy objectives to be operationalized in terms of value creation.

4. Towards an Extended Governance

Even though many factors may influence the success or failure of public policy, here we would like to underline one aspect that has been identified by Cottica (2010) as fundamental. According to him, in fact, "most public policies fail due to a deficit of attention". The wide portion of the attention that the public sector may offer is usually allocated to monitoring, supervising and influencing the process of program design. Little or no attention is instead devoted to the process of projects implementation, thus leaving a critical aspect of public policy success almost unattended. As Tapscott et al. (2007) puts it, Governments no longer have in-house sufficient scope, resources, information or competencies to respond effectively to the policy needs of an interconnected, fast-evolving and unpredictable global environment: policy makers must seek out new partners and participants to help identify problems and create innovative solutions.

In this respect, ICT may allow to create decision processes relying on distributed attention, thus enabling a new form of governance, an "extended governance" whereby the intelligence and the attention of actors residing outside governmental boundaries are harnessed in the management of public resources. According to Shirky (2008), in the governmental opening up, social and technological drivers generated by Web 2.0 applications and Social Media platforms have brought with them new organizational forms, through the capacity of the Internet and its users to "organize without organizations". The lowering of communication and coordination costs brought by ICT coupled with the emergence of behaviors driven by non-financial motivations, values and reputational incentives has ignited a process that through sharing and collaboration leads to collective action. A proof of this lies in the fact that citizen-developed applications are an emerging trend around the world (Economist Intelligence Unit, 2010).

Thanks to ICT the eyes and the brains of people may be turned into useful governmental "antennas" that can help to oversee the intricacy of city processes and functions that would otherwise be impossible for local administrations to constantly monitor. In addition, creativity and knowledge residing in citizens' brains - if harnessed - may significantly contribute to improve the outputs of the policy making cycle by allowing it to be more demand-driven, to tap into additional

skills and competences and to analyze the problems at stake from a multitude of perspective and cultural backgrounds thus reducing the risk of biased or oversimplified problem setting.

Another aspect worth considering for the improvement of public policies success is the possibility to conduct *ex-ante* impact assessments of policy options in order to produce relevant evidence to inform the decision making process. In this respect, the use of computer-based simulations could provide a useful contribution in the promotion of a scientific management of policy issues (Ferro & Gil-Garcia, 2010). Simulation, in fact, represents a valuable support tool for the accurate definition of complex and articulated problems, allowing to better understand the dynamics present between the main determinants. Computer-based simulation, if combined with classical statistical analyses, may also be employed as an input to carry out a number of useful and cost-effective analyses (e.g. *ex-ante* comparative evaluations of alternative policy solutions, sensitivity analyses). Finally, if adopted in a more open and collaborative environment, computer simulation could be useful in eliciting the trade-offs in the allocation of scarce resources as well as in making more evident the aggregated impact of individual behaviors (on environmental issues, for example). The net result of such usage of computer simulation may thus be summarized in the generation of more informed, qualified and realistic contributions by the involved stakeholders.

In the future, these activities could also be conducted taking advantage of the integration of public information (PSI) such as data on census, mobility, environment, etc. In addition, a wider availability of real-time and machine-readable data could allow improving "forecasting" as well as "nowcasting" abilities. The development of three-dimensional representation tools coupled with the diffusion of GPS-enabled devices and the affirmation of an Internet of Things (IoT) paradigm represent three concurrent propelling factors that could significantly expand and increase the applications and value of such tools. As a matter of fact, the inclusion of a wider range of data inputs (coming from objects as well as from people) in combination with the possibility to add spatial information to the contributions received, constitutes an incredible opportunity to provide perspective-dependent representations of issues, as well as to conduct context-dependent analyses.

In order to move the discussion to a more concrete level, we inserted some examples of how ICT could practically contribute to improve the governance of the different domains in the life of city.

- Budgeting: a combination of Social Media, visualization and simulation tools could be useful in participatory budgeting activities. In particular, it could help the citizenry in understanding the trade-offs in the process of scarce resources allocation as well as the effectiveness of alternative courses of action. This would represent necessary and solid stepping stone to make educated choices in a process of priorities definition that keeps into account not only the perceived need but also the marginal value generated by any specific policy action.
- Emergency management: to enhance buildings' security, simulation could be run to support the allocation emergency exits and fire extinguishers or to test the level of safety of existing buildings in events of fires. The implementation of such applications could also result in a further refinement and improvement of the exiting legal requirements and standards.
- Urban planning and management: the use of real-life data collected from the citizenry (on most common mobility needs weighted by frequency) coupled with traffic data could be used - instead of rough estimates - to plan public transportation routes and time tables in order to minimize the commuting time for citizens and the aggregated costs of mobility (environmental, health-related).

- Environment and energy: the aggregation of energy consumption data (e.g. per condos or per post code) could be used to stimulate more environment-friendly behaviors thanks to the possibility to adopt context-dependent policies and to ignite virtuous circles of competition. In addition, an easier visualization of the aggregate impact of individual behaviors may help to increase the environmental sensitivity of the citizenry thanks to intuitive and reliable results.
- Healthcare: possible alternative policies aimed at reducing the impact of aging populations on the healthcare systems could be cost-effectively tested. In addition, anonymized aggregated data could be used to manage the diffusion of contagious illnesses on robust estimations and real-time data rather than on more emotional approaches.

To conclude, we are convinced that the wise and diffused use of ICT tools in policy making may lead to significant improvements in the management of urban areas by enabling value-driven, data-intensive and participative governance models.

5. Conclusive Remarks

Starting from the acknowledgement of some of the grand challenges that mankind has to face in terms of environmental and economic sustainability, this paper attempted to promote a discussion about the role of ICT in the governance of the transition process that cities will have to undergo in the coming decades. The theme was looked at from an interdisciplinary and value-oriented perspective, taking stock of the lessons learnt in in the promotion and implementation of ICT-driven innovation in the public and the private sector over the last two decades.

A number of inspiring elements emerged from the discussion: the need for complementary investments; the instrumental nature of the value possessed by technology and the consequent need to assess the development of potential solutions on the basis of the intrinsic value generated rather than on mere technological intensity; the desirability of adopting an evolutionary approach accounting for the mutual influence present between technological solutions developed and the context in which they operate; and, finally, the relevance of a bottom-up *modus operandi* in the elicitation of stakeholders' needs and wants aimed at the identification of key value drivers.

The conceptual framework proposed describes the role that ICT may play in the governance of smart cities. Three main contributions were identified: the enablement of new production, distribution and governance processes, the transformation of organizational and institutional arrangements and, finally, the information of individual choices and behaviors. In addition, an overview of the required inputs, possible outputs and desired outcomes was provided. The value offered by such framework is twofold. It provides a simple and concise representation of the process of turning a technological infrastructure into value for society and it constitutes a useful tool for the design of assessment frameworks aimed at evaluating cities' smartness both in terms of readiness and outcome generation.

Finally, the notion of "extended governance" was introduced. In particular, the combined use of Social Media and computer-based simulations in policy making was identified as an important ingredient in exploiting the availability of an increasing amount of data as well as of "connected intelligence" present in urban areas. The new paradigm appearing on the horizons seems to introduce new models of governance that are value-driven, data-intensive and participatory.

As far as future research is concerned, a number of important steps are required in order to turn the new governance paradigm into a mainstream practice. Advances will have to be made along a

number of dimensions among which: effective management of large and heterogeneous communities, real time elaboration and visualization of unstructured content, lead time and cognitive barriers linked with the production and effective usage of simulation models, assessment of the impact in term of marginal value creation of the new governance model.

Concluding, there seems to be a great potential for the application of ICT in the governance of the change that urban areas will have to undergo in the decades to come. In order to deliver on their promises, such technologies will have to be employed not only to increase the intelligence of socioeconomic systems but also to establish incentive structures promoting the creation of sustainable public value. The real smart city - in fact - will have to learn how to reconcile individual and collective needs, in other words to channel individual aspirations towards the creation of value for society at large through the attainment of economic, social and environmental objectives.

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