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Transforming City Governments for Successful Smart Cities

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Transforming City Governments for Successful Smart Cities

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Foreword

In the past few decades, city governments have increasingly faced complex socio-technical problems and in response have developed strategies that rely on sophisticated information technologies (IT) in creative and innovative ways. Recently, this phenomenon of incorporating complex IT into solutions for equally complex problems has been labeled smart city and smart government. Smart cities could be conceptualized in different ways, from the intensive use of IT in urban contexts to the generation of innovative services, organizational capabilities, and physical infrastructure. In fact, there are many other labels applied to the same or similar phenomena such as digital city, innovative city, intelligent city, or creative city, to mention a few. Most of these terms highlight some aspects of being smart, although not always explicitly. In contrast, other concepts exist that clearly emphasize a single element of smartness in urban contexts such as sustainability, inclusiveness, or resilience. Scholars and practitioners are increasingly realizing that the smart city is a multidimensional concept with very diverse components and elements, many of which are not directly related to technology but are essential to the development of smart city initiatives.

One of these important elements is governance, which could be loosely defined as the structures and processes that enable collective decisions about issues that hold meaning for the actors involved. The term governance has also been used in the literature as a way to indicate that government is one actor, maybe the most important actor, but still just one actor embedded in a network of multiple actors making decisions and taking actions with regard to complex and pressing public problems. Cities are good examples of these networks in which local governments play an important role, but other organizations and individuals are also integral to the success of an initiative. To become smarter, a city needs to transform government in significant ways to engage with the full network of critical actors. ITs can enable these transformations, but only when other elements are considered, and important organizational and policy changes are made. IT needs to be implemented jointly with changes in government processes, structures, and regulations for a smart city initiative to be successful and have broad social impacts.

This book is a distinctive collection of chapters dealing with a theme that has shown increasing theoretical importance and empirical relevance in the past few

years: The role of city governments in implementing successful smart city initiatives. The authors present the experiences of a diverse set of cities from the USA, Asia, and Europe. As a whole, the book clearly shows not only the potential benefits from smart city initiatives but also some of the challenges city governments currently face. The book presents a well-balanced compilation of conceptual, empirical, and practical chapters. Within the smart city theme, it covers relevant topics such as implementation frameworks, platform development, the role of transparency and participation, performance evaluation, stakeholder engagement, leadership, mobile technologies, and a view from the academic literature. Despite their differences in content and methods, all chapters highlight the role of city governments in smart city initiatives and attempt to include diverse and relevant aspects. For example, Ojo and colleagues propose a smart city initiative design framework based on an extensive study of ten major smart city initiatives from a design science perspective. Using a very different approach, Anttiroiko studies how smart platforms can support innovative restructuring of postindustrial cities. As examples, these two chapters are quite different, but they both attempt to integrate and consider the complexity of smart cities and most chapters in the book are also sensible to this sociotechnical reality.

Therefore, as presented in this book, it is clear that the efforts to make cities smarter include both technological and social components. More specifically, cities are not only creatively investing in emergent technologies but at the same time also developing innovative strategies to achieve more agile and resilient government structures to improve information, services, and infrastructures. For instance, it could be argued that sensor networks, geographic information technologies, social media applications, and other emergent technologies could function like a nervous system that captures and distributes information about the resources and capabilities of government. Some city governments have begun to use newly available information to become smarter. The potential is great, but local governments are struggling to understand and create the new capabilities necessary to successfully leverage such technologies and data. In addition, new analytical tools and techniques can help city governments handle and process these new streams of sometimes disparate data and unstructured information. The right mixture of devices, people, and the necessary analysis for decision-making is not always clear.

Highly structured city problems may have clear necessary actions that require little analysis; other times cities face problems that are related to complex sociotechnical issues where multiple sources of data and complex analytics might be involved. When a problem is relatively simple and structured, automatic responses could be deployed. In contrast, when a problem is very complex, unstructured, and intertwined with multiple physical and social factors, the response normally needs a significant amount of time, intensive human intervention, huge amounts of data, and sophisticated analytics capability. These complex problems would also need a high degree of information integration across organizational boundaries within and outside city government. In my own research, I have suggested that the creation of smart governments is the next step in ensuring that information is integrated and available when and where necessary. Smart governments use sophisticated IT to

interconnect and integrate information, processes, institutions, and physical infrastructure. The resulting network could involve individuals monitoring services and programs as well as devices attached to systems, equipment, and physical infrastructure. As mentioned earlier, in the case of a highly structured problem, sensors and similar technologies could trigger immediate response, whereas in the case of complex and wicked problems the need for human intervention and sophisticated analysis is essential before making a decision or taking action.

To become smarter, city governments need to create new capability to use such technologies and emergent data streams to achieve the desired information integration in support of a broad spectrum of problems. The development of smart cities requires consideration of the people involved, the nature of the problem, the technology available, the organizational capability, and the tools and techniques available to understand and solve the problem. This book offers valuable insights and guidance for governments that are pursuing smart city initiatives. It is also useful to scholars interested in smart cities and the role of governments and other social actors in these initiatives. Covering a broad range of policy domains, some chapters emphasize the specific details of different urban settings, while others present comparisons of multiple cities and offer lessons from the most advanced or successful cases. In my opinion, the overall contribution of the book is a solid and well-balanced account of the role of city governments and other social actors in the design, implementation, and evaluation of smart city initiatives in different contexts from around the world. I am sure that the reader interested in smart cities will find provocative ideas and helpful guidance within this book. Enjoy it!

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Smart Cities: Big Cities, Complex Governance?

Manuel Pedro Rodríguez Bolívar

1 Introduction

In the early twenty-first century, the rapid transition to a highly urbanized population has made societies and their governments around the world to be meeting unprecedented challenges regarding key themes such as sustainable development, education, energy and the environment, safety and public services among others. It has lead cities and urban areas to be complex social ecosystems, where ensuring sustainable development and quality of life are important concerns. In addition, the current economic crisis has also forced many cities to cut budgets and set priorities.

In this milieu, the use of information and communication technologies (ICTs) and data has been considered as the means to solve the city's economic, social and environmental challenges (European Parliament 2014; Centre for Cities 2014). In fact, cities should recognize that ICTs are essential to a vibrant social, economic and cultural life of the city. Under this framework, the smart cities concept has gained a lot of attention lately and it will most likely continue to do so in the future. Although there is not a general consensus regarding the concept of "smart city", at its core, the idea of smart cities is rooted in the creation and connection of human capital, social capital and ICTs infrastructure to generate greater and more sustainable economic development and a better quality of life (European Parliament 2014).

In this regard, in the past years, cities are increasingly aware of the concept of "smart city" and actively developing strategies towards the goal of becoming "smart" and manage, more efficiently, city resources and addressing development and inclusion challenges. A recent review by the European Parliament of 240 EU28 cities implementing or proposing smart cities initiatives found that there are smart cities in all EU-28 countries, but these are not evenly distributed (European Parliament 2014). Nonetheless, many of the challenges to be faced by smart cities surpass the capacities, capabilities, and reaches of their traditional institutions and

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their classical processes of governing, and therefore new and innovative forms of governance are needed to meet these challenges.

Therefore, the growth of smart cities is helping the increase of government use of ITCs to improve political participation, implement public policies or provide public sector services. For Hollands (2008), the need for technologies to be smarter is not just in the way they make it possible for cities to be intelligent (as an institutional agent) in generating capital and creating wealth, but in the ways they operate their governments. It is making governments to think the need to advance in the implementation of ICTs to improve the participation of the citizenry in decision-making processes, to make more efficiency the public and social services rendered to stakeholders, to achieve transparent governance and to implement political strategies and perspectives, this is what has been called as "smart governance" (Giffinger et al. 2007).

Nonetheless, little research has been undertaken to know the role and incentives of governments to promoting smart cities. In this regard, this book seeks to contribute to the literature by filling the existing void and expanding knowledge in the field of smart cities. In any case, previous to read the chapters please let me a brief introduction to the debate of the role of governments in smart cities.

2 Governance in Smart Cities

In the past years, cities are becoming smart not only in terms of the way we can automate routine functions serving individual persons, buildings, traffic systems but in ways that enable us to monitor, understand, analyze and plan the city to improve the efficiency, equity and quality of life for its citizens in real time. Indeed, it aims at increasing citizens' quality of life, and improving the efficiency and quality of the services provided by governing entities and businesses.

Although there is no one route to becoming smart, and different cities have adopted different approaches that reflect their particular circumstances, three general principles to guide smart city agendas have included the integration with economic development and public service delivery plans, the pragmatic focus with the bulk of investment going on projects that are practical, achievable and financially viable and, finally, the participation of community representatives, local businesses and residents to ensure projects are relevant to the city's opportunities and challenges (Centre for Cities 2014). To achieve these aims, governments must use ICTs to improve political participation, implement public policies or providing public sector services. If government is to change, citizens will also have to change how they engage with government and what they expect from government (Doody 2013).

Despite previous comments, the current governance structures in most states require little involvement of citizens in decision-making. Further, responsibilities for different services are fragmented across multiple institutions, making the situation even more complex for any citizen. Therefore, the development of efficient and ef-

fective governments is a prerequisite for the development of smart cities and the role played by governments in these cities seems to be essential. In this regard, based on the market-making approach adopted by the government, it involves intervention in three main ways: by playing the role of coordinator and bringing different interests and stakeholders together to establish new platforms for collaboration; by playing the role of funder, which consists of funding infrastructure and demonstrator projects; and by playing the role of regulator, making sure that common standards and regulations are in place (Centre for Cities 2014).

In any case, nowadays, the city needs to be recognized as a network of multiple systems, all of which are closely connected in meeting human needs. This perspective requires an integrated vision of a city and of its infrastructures, in all its components. Indeed, innovation by local authorities requires vision and leadership. It means that the current practice of working in silos needs to be broken down with greater institutional integration, at least in planning and oversight. Indeed, governments should be sure that efforts in smart cities are coordinated rather than isolated. Smart government, hence, has to cope with (a) complexity and (b) uncertainty, and by so doing, has to (c) build competencies and (d) achieve resilience (Scholl and Scholl 2014). Therefore, it is not simply a question of the capability within local authorities to develop smart concepts.

According to European Parliament (2014), factors for successful smart cities include active participation of citizenry to create a sense of ownership and commitment, local level coordination to ensure the integration of solutions across the portfolio of initiatives and participation of local governments in networks to share knowledge and experiences. In brief, smart cities have really become in relational networks of actors— small and midium-sized enterprises (SMEs), schools, housing corporations, non-governmental organizations (NGOs), local governments, local transport, etc.—and the interaction among these urban actors constitute urban governance. Hence, governance is not about what governments do but about the outcomes of interactions between all actors in the public domain.

Nonetheless, local governments are called to be key actors to create an interactive-, participatory- and information-based urban environment with the ultimate aim at producing increasing wealth and public value, achieving higher quality of life for citizens. Therefore, in smart cities, governance should encapsulate collaboration, cooperation, partnership, citizen engagement and participation (Coe et al. 2001).

However, there appears to be a clear difference among cities that: pursue a mix of characteristics through many holistic initiatives; use a differentiated portfolio of specialized initiatives; support only a few holistic (multi-objective) initiatives; and implement a small number of initiatives tightly focused on the most salient characteristics (European Parliament 2014). It could lead to different patterns in governing smart cities. In fact, according to the European Parliament (2014), different patterns of actor roles and relations, policy instruments and implementation methods have been used by European smart cities. Which one is the best, if any? This is a question that is under a lively debate in research and empirical practice. In the next section, we try to contribute to this debate about the governance styles in smart cities.

3 Governance Style in Smart Cities

When considering the need for changing governance models in smart cities, a range of questions can arise: Are the objectives of smart initiatives relevant, appropriate and aligned with broader city development objectives? Does the initiative address problems of importance to the city in question? Is the mix of funding, participation, components and characteristics likely to produce the hoped for outcomes?

These questions make us to wonder other related ways of governing the smart city: Do all governance styles produce the same result in promoting smart initiatives? Do these governance styles allow the same increase of quality of life for all citizens? Is there a governance model better than the others or does it depend on the characteristics of the citizenry, place, …? Many questions remains unsolved up to now.

In this regard, although there are different approaches to the concept of smart city governance in prior research, ranking from institutional conservation (traditional governance of a smart city) to institutional transformation (smart urban governance) (Meijer and Rodríguez Bolívar 2013), none is said to be the best way of governing smart cities. Indeed, the networking environments that characterized smart cities introduce new ways of governance different from traditional bureaucracy, with the use of nonhierarchical, nonmarket forms of organization in the public sector (Considine and Lewis 1999) and are becoming important for public management given that the management of smart cities relies on complex networks of interdependent organizations. These models of governance can range from that in which smart cities may be governed completely by the organizations that comprise the network (self-governance model), to that in which local government acts as a highly centralized network broker, or lead organization, and manages the development of the smart city (bureaucratic model).

For example, to many contemporary government officials, smart cities are essentially networks of sensors strewn across the city, connected to computers managing vast flows of data, optimizing urban flows like mobility, waste, crime and money (Kresin 2013). This technocratic rhetoric could take humans out of the loop and turn them into passive rather than active agents, which could promote the self-governance model of the smart city if politicians share this vision of smart city.

By contrast, on another site of the spectrum of governance models is the bureaucratic model of governance. Under the Bureaucratic model of governance, local governments retain the leading role in the implementation and management of smart initiatives in the city. In addition, the government designs the strategy for the implementation of smart initiatives and manages the interactions among the different actors directly. Finally, the Bureaucratic model is based on government monitoring, and so citizens have less control over smart initiatives and have a more passive role in the smart cities. They are only the receptors of the smart technologies introduced in the city. In summary, this model of governance is the successor to the Weberian bureaucracy model of production, which formerly prevailed as the desirable form of organization for the provision of public services (Tullock 1965;

Downs 1967; Niskanen 1971), especially under the Continental European style of public administration. Nonetheless, some authors indicate that this model is far to exist under smart cities because it is deemed to fail (Mulligan 2013) due to the risk aversion and the incentive structure under which government officials operate (Madriz 2013).

Other governance styles in the medium of the spectrum of interactions and control of local governments and the rest of actors are possible for managing smart cities. Indeed, in smart cities, the power balance seems to have changed and it seems clear that citizens need their governments and governments need the intelligence and the cooperation of their citizens to function well (Kresin 2013). This demands a change in how cities are governed. The strength of this change could not be the same under different environments as noted previously. Therefore, it could be interesting to analyze some empirical experiences in smart cities regarding the role that governments are taking in each one of them as well as the success of these smart initiatives. It could help us to understand factors or drivers for governance models in smart cities. This is the main aim of this book and the following chapters will tackle some issues regarding this subject.

4 Conclusions

Smart cities have introduced many questions unsolved at the moment. One key question is the role of governments in these cities. Must governments take a leading role in smart cities? Do they only have to coordinate smart initiatives facilitating technological infrastructure to make smart initiatives possible? Or do they have to be apart from the smart initiatives using a market approach?

Prior research does not have definitive conclusions about these questions. In fact, experiences in the European Union seem to indicate that each smart city has been developed according to their own characteristics and environment. In these cities, interestingly, there is no single definitive way in which all players behave and work together (Alcatel-Lucen 2012). Therefore, is there a pattern of development to becoming smart? Do we have to enforce local governments to follow some guidelines to achieve these aims?

In any case, prior research has indicated that transforming urban processes will only be achieved with better urban governance (Puppim de Oliveira et al. 2013). Cities are therefore increasingly seen as not only the engines of innovation and economic growth but also the level at which solutions to wicked problems need to be produced (Koppenjan and Klijn 2004). The idea of smart city governance fits well within the public management perspective that highlights solving societal problems is not merely a question of developing good policies but much more a managerial question of organizing strong collaborations between government and other stakeholders (Torfing et al. 2012). Indeed, city authorities play a key role in creating smart and sustainable city initiatives, and in attracting industry players to develop ideas for potential projects, and to act as partners (European Investment

Bank 2012). Also, forms of government are an important direct influence on the approach that communities take to sustainability (Bae and Feiock 2013). In this context, smart governance principles could guide the relatively complex administrative enactment of smart and open government more intelligently than traditional static and inflexible governance approaches could do (Scholl and Scholl 2014).

This debate is even more relevant if citizens are introduced. Governance has been and always will be based on citizens' participation. Therefore, focusing on smart citizens would appear to be a compelling alternative to the technocratic determinism of the smart city model. In this regard, what do citizens want? Have we forgotten to ask them? A smart city, therefore, starts with smart citizens who are asked their opinions and engaged in the process of deciding how they are used (Mulligan 2013).

In conclusion, ICT is not a sufficient condition. For a city to become a "smart city" it needs full engagement of its government and its citizens. As noted by Chourabi et al. (2012), eight critical factors of smart city initiatives to be analyzed in future research are: management and organization, technology, governance, policy context, people and communities, economy, built infrastructure and natural environment. These factors form the basis of an integrative framework that can be used to examine how local governments are envisioning smart city initiatives (Chourabi et al. 2012) and how they are dealing with these concerns. Future research should focus on the role of governments in developing smart cities not only as a producer of content in the smart cities' framework providing intelligent e-services or introducing ICTs to improving transparency in governments but also as a element for organizing and managing the smart initiatives in smart cities.

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Understanding the Smart City Domain: A Literature Review

Leonidas G. Anthopoulos

1 Introduction

Although the term smart city has appeared since 1998 (Van Bastelaer 1998), it is still confusing with regard to its meaning and context (Anthopoulos and Fitsilis 2013), since its definition ranges from mesh metropolitan information and communication technology (ICT) environments (Mahizhnan 1999); to various ICT attributes in a city (Chourabi et al. 2012; Allwinkle and Cruickshank 2011); to urban living labs (Komninos 2002); or to the "smartness footprint" of a city, which is measured with indexes such as, the education level of its inhabitants, the innovative spirit of its enterprises, etc. (Giffinger et al. 2007). The term smart city appeared early in the literature in 1998 (Van Bastelaer 1998; Mahizhnan 1999) from the urban simulations and knowledge bases and is still evolving to eco-cities (Anthopoulos and Fitsilis 2013).

All these different meanings address the scale and complexity of the smart city domain and describe alternative approaches, schools of thought and researchers who deal with this phenomenon. Furthermore, smart cities have attracted the international attention by international organizations (i.e., the European Union (EU; Anthopoulos and Fitsilis 2013)) and big vendors from the ICT industry (i.e., CISCO (2011), IBM (IBM Institute for Business Value 2009) and Alcatel (Alcatel-Lucent 2012)); the electronics (i.e., Hitachi (2013)); and the construction industries (i.e., GALE, POSCO, and HGC Group (Alcatel-Lucent 2012)) are stressed to develop respective products and to utilize this emerging market. To this end, this chapter aims to answer the following question: "What fundamental theories, models, and concepts in research (published between 1998 and 2014) reflect phenomena related to smart city?" This question is crucial to be answered since interdisciplinary studies investigate the smart city and view this topic from different perspectives.

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To answer the above question, this chapter was inspired by Niehaves (2011), methodology for performing a holistic literature review and analyzes different sources that investigates smart city and uses some of its context. This analysis attempts to identify authors, schools, approaches, case studies; classifies research projects and business products; and generates a taxonomy that can clarify this complex domain. To this end, the remaining of this chapter is organized as follows: Section 2 examines the relevant general literature on smart cities, while methods and data on this theme are set out. Section 3 summarizes the literature findings, whereas Sect. 4 contains some conclusions and future thoughts.

2 Background

Various scholars have stressed the smart city term since its initialappearance in 1998 (Van Bastelaer 1998) and attempted to analyze its context (Anthopoulos and Fitsilis 2013; Chourabi et al. 2012; Neirotti et al. 2014; Caragliou et al. 2011; Kuk and Janssen 2011). This chapter extends these approaches and findings with a methodological literature review, which is inspired by Niehaves (2011). In this section, the challenges with regard to the smart city domain are analyzed. Subsequently, the literature search strategy is defined and the corresponding review is performed in order for this chapter's research question to be answered. A rigorous literature study requires defining (a) the domain (the disciplinary field in which the literature search is conducted), (b) the sources (publication outlets from that domain to be included in the search), and (c) the search strategy (search terms applied to extract relevant articles).

a) Domain: This chapter's goal is to examine the smart city research. In this respect, a smart city has been defined with alternative approaches, which range from ICT attributes in the city (i.e., digital, broadband, wireless, etc.) that describe various ICT solutions in the urban space and prioritized differently across the globe (Anthopoulos and Fitsilis 2013); to the "smartness footprint" in an agglomeration area, which is measured with various indexes (Giffinger et al. 2007); to information flows across the urban space (Stock 2011); and to large scale to living labs (Komninos 2002). With this respect, the smart city can be viewed broadly and concerns theinterdisciplinary studies (Anthopoulos and Fitsilis 2013; Anthopoulos and Vakali 2012) such as ICT; urban planning and growth; living labs as large-scale testing beds; eco or green city and corresponding ecological aspects; and creative industry in a city. All the above scientific areas appear to "meet" in smart city and various outcomes are generated.

b) Sources: Therefore, as primary sources for this literature review (phase 1), the following bundles of publication outlets were selected: first, those from journals that publish corresponding works; second, those from major conferences that publish articles relative to smart city in their proceedings; reports from research projects, which have been or are being developed in this domain; corresponding PhD dissertations; research projects funded by the European Framework Programmes

(FPs); and business products. Volumes from 1998—when the first articles appear—till today were included. Journal selection was based on editorial policy conformity with smart city, as well as the criteria that they publish currently (resp. 2014) and have a high level of scholarly recognition (Saunders et al. 2009).

In this study, an initial search for source identification was conducted in SCOPUS, Science Direct and Google Scholar. The queries that were used contained "smart city" and relevant terms (i.e., "digital city," "ubiquitous city," etc.) that were identified by Anthopoulos and Fitsilis (2013) as smart city classification areas (Table 1).

The initial search was performed in late January 2014. A broad set of results was returned, where many journals—only in Elsevier an amount of 37 journals—appear to publish relative to smart city works. This initial finding is not surprising due to the broad smart city context. It is beyond the purposes of this chapter to illustrate how many articles per journal appeared. Moreover, for the purposes of this chapter, these results were limited to the ICT context, which resulted in a list of 32 journals from various publishers. This list contains the *Communications of the ACM; International Journal of Electronic Government Research; New Media & Technology; Public Administration Review; Cities; Pervasive and Mobile Computing; Journal of Urban Technology; Environment and Planning B; City; Environment and urbanization; Applied Geography; Information and Management; Electronic Commerce Research and Applications; Expert Systems with Applications; Sustainable Cities and Society; IEEE Internet Computing; Wireless Communications Journal; Behaviour and Information Technology; Journal of The Association For Information Science And Technology; Technological Forecasting & Social Change; Journal of Economic Literature; Future Generation Computer Systems; Automation in Construction; Environmental Modelling & Software; Applied Energy; Habitat International; Journal of e-Government; Government Information Quarterly; Electronic Government, An International Journal (EGAIJ); International Journal of Electronic Government Research; Information Polity; Electronic Journal of e-Government; Transforming Government: Process, People and Policy; and Journal of Information Technology and Politics*. All were located to have hosted several articles regarding smart city dated from 1998.

Table 1 Terms for phase 1 search and corresponding article results

Term	SCOPUS	Science Direct	Google scholar
Smart city	616	198	389
Digital city	448	188	405
Virtual city/information city	331/43	264/74	239/33
Knowledge based city	10	12	10
Broadband city/broadband metropolis	1/1	8/1	0/2
Wireless city/mobile city	27/33	20/30	47/57
Ubiquitous city	61	16	59
Eco-city	264	215	494

Fig. 1 Search method.

The above systematic search in journals was complemented by an analysis of secondary sources (phase 2), including articles referenced by papers identified in phase 1, as well as articles from non-systematic searching (especially in conference proceedings and books), research projects' reports, PhD theses and business products (Fig. 1). To this end, international conferences that have been organized by IEEE, that is, the Hawaii International Conference on System Sciences (HICSS), Info-tech and Info-day and PICMET; Digital Government Society (dg.o); DEXA; United Nations University (ICEGOV); Association for Information Systems (AMCIS); and IARIA also demonstrate relevant work. Various scientific books that have been published by publishers such as Springer and Routledge host as technological aspects, social issues, financial and managerial perspectives of the smart city, etc. Finally, postgraduate dissertations and PhD theses have been developed in the smart city domain and they return useful findings with regard to smart city and urban development (Lee and Oh 2008; Wang and Wu 2002).

c) Search strategy: As for the articles published in the aforementioned list of journals, their title, abstract, and keywords were scanned for smart city classification terms (Table 1). From the resulting set of articles, duplicates, and papers irrelevant to this study were excluded manually (screening). This applies to papers irrelevant to the ICT, for instance, on "urbanism" returning from the crawl of the search term "city"; "houses" that came up from "smart city"; and to "smart city regionalism" that was triggered by "smart city". Moreover, due to the size of the returned results, emphasis was given on a set of the most recent articles (dated between 2011 and 2014), as well as on corresponding review articles, which have already analyzed extensive literature parts. A comparison was performed on these review articles, with regard to the perspectives (or domains) they use to analyze smart city and a common framework is summarized.

As a result, 41 publications related to the smart city domain were selected and analyzed in this chapter, 24 of which were extracted from corresponding journals (Table 2). Most of these papers, five in each, were identified in *Technological Forecasting & Social Change,* while *Cities* and *Journal of Urban Technology* follow with three articles. *Journal of Urban Technology* alone, has published several works

Table 2 Smart city in research journals (1998–2014)

Investigated journals	Results from crawling "smart city"	Dated after 2011	Number of articles after screening	Results (complete list)
Technological Forecasting & Social Change	134	50	5	Bulu (2014); Lee et al. (2014); Lee et al. (2013); Marletto (2014); Paroutis et al. (2014)
Cities	305	170	3	Neirotti et al. (2014); Debnath et al. (2014); Desouza and Flanery (2013)
Journal of Urban Technology	96	35	3	Allwinkle and Cruickshank (2011); Caragliou et al. (2011); Kuk and Janssen (2011)
The Journal of Systems and Software	50	23	1	Piro et al. (2014)
Journal of the Association for Information Science and Technology	43	18	1	Stock (2011)

in smart city domain (96 results come out from the keyword "smart city"), but only three have been included in this chapter's analysis according to their relevance and date.

The smart city was introduced in the Australian cases of Brisbane and Blacksbourg (Anthopoulos and Vakali 2012) where the ICT supported the social participation and the community's cohesion with the narrowness of the digital divide, together with the availability of public information and services. The smart city was later evolved to (a) an urban space for business opportunities, which was followed by the network of Malta, Dubai, and Kochi (www.smartcity.ae) and (b) ubiquitous technologies installed across the city, which are integrated into everyday objects and activities.

Moreover, smart city has been approached as part of the broader term of digital city by (Anthopoulos and Tsoukalas 2006), where a generic multi-tier common architecture for digital cities was introduced, and assigned smart city to the software and services layer of this architecture. For the purposes of this chapter, the term smart city will refer to all alternative approaches to metropolitan ICT cases. In the following paragraphs an analysis over various important smart cities is presented, outlining their mission, business case, and organizational structure.

Anthopoulos and Fitsilis (2013) performed an extensive review on smart city technological evolution and resulted in a corresponding classification with regard to the ICT that is installed in urban agglomerations. Churabi et al. (2012) investi-

gated smart city definition and concluded on an integrative framework for smart city analysis. Neirotti et al. (2014) provide a recent corresponding literature review and they define two classification domains for smart city theory with regard to the exploitation of tangible and intangible urban assets: Hard domain, which concern energy, lighting, environment, transportation, buildings, and health care and safety issues. Soft domain, which address education, society, government, and economy. From their domain analysis, they conclude on six application domains for smart city, which address corresponding challenges: natural resources and energy, transport and mobility, buildings, living, government, and economy and people. This six-domain model comes in contrast to the six main challenges to managing an urban community: providing an economic base, building efficient urban infrastructure, improving the quality of life and place, ensuring social integration, conserving natural environmental qualities, and guaranteeing good governance (Yigitcanlar and Lee 2014). Additionally, an analysis over a set of European research projects (Piro et al. 2014) addresses nine smart growth areas: transportation, government, safety, society, health care, education, buildings and urban planning, environment, energy, and water. Furthermore, Desouza and Flanery (2013) perform a smart city classification with regard to their resilience and they identified seven domains (components and interaction), which concern resources, physical, people, institutions, processes, activities, and social. Moreover, Lee et al. (2014) introduce their framework for smart city analysis, which is rather economic oriented and consists of seven dimensions: urban openness, service innovation, parnerships formation, urban proactiveness, infrastructure integration, and governance. New urbanism on the other hand (Wey and Hsu 2014), introduces a nine principles' model, most of which aligns to the aforementioned application domains, while it does not focus on government issues. This comparison seems to extend Giffinger et al.'s (2007) urban smartness "footprint" measurement model, with the incorporation of two more domains: urban infrastructure and social coherency (Table 3).

However, an in-depth analysis of the articles in this study extends the above review and provides an evidence of the following arguments and key areas of the study:

a. Smart city: A wide range of articles were identified to present various ICT approaches to urban challenges. These challenges vary from measuring and increasing urban capacity for smartness (smartness "footprint"; Giffinger et al. 2007; Akçura and Avci 2014; Lee et al. 2014), everyday life's improvement (Piro et al. 2014), energy consumption (Kramers et al. 2014; Lazaroiu and Roscia 2012; Kim et al. 2012; Yamagata and Seya 2013), urban planning and building architectural facts (Rassia and Pandalos 2014; Vollaro et al. 2014). Moreover, 19 research projects, which were funded by the EU (Piro et al. 2014), are focused on Internet-of-Things (IoT), the corresponding architectures and smart city services, while they are aligned to nine application domains.
b. Smart growth: With regard to sprawl management and resilience (Desouza and Flanery 2013; Wey and Hsu 2014); hard asset management such as transportation (Marletto 2014; Debnath et al. 2014), even with big data utilization

Table 3 Smart city conceptual framework

Domain	Neirotti et al. (2014)	Piro et al. (2014)	Desouza and Flanery (2013)	Wey and Hsu (2014)	Lee et al. (2014)	Yigitcanlar and Lee (2014)	Churabi et al. (2012)	Giffinger et al. (2007)
Resource	Natural resources and energy	Environment, energy, and water	Resources	Sustainability	Urban proactiveness	Environment	Natural environment	Smart environment
Transportation	Transport and mobility	Transportation	Activities	Walkability, green transportation				Smart mobility
Urban infrastructure	Buildings	Buildings and urban planning	Physical	Quality architecture and urban design, mixed housing, traditional neighborhood structure	Infrastructure integration	Urban infrastructure	Built infrastructure	
Living	Living	Health care, safety, education	People	Increased density	Quality of life	Quality of life and place	Technology	Smart living
Government	Government	Government	Processes		Governance	Good governance	Policy, governance	Smart government
Economy	Economy and people		Institutions	Mixed-use and diversity	Urban openness, partnerships formation, service innovation	Economic base	Economy	Smart economy
Coherency		Society	Social	Connectivity		Social integration	People and communities	

(Dobre and Xhafa 2014); to smart communities' and urban innovation networks' development, which account cities within regional and national urban systems (Malecki 2014; Lee et al. 2013); sustainable development and eco-living (Yigitcanlar and Lee 2014; Yamagata and Seya 2013); or even city's efficiency and effectiveness increases (Bulu 2014).

c. Living labs: They concern areas for large-scale testing beds (Cosgrave et al. 2013) as well as flourish landscapes for citizen-sourced innovation (Komninos 2002; Pallot et al. 2011); citizens as sensors is a novel approach that is applied for bottom-up information collection from the urban space (Arribas-Bel 2014; Sanchez et al. 2011).
d. Creative industry: It concerns ICT utilization for entrepreneurship in creative market (Anthopoulos and Fitsilis 2013); the niche smart city market, which varies from "smart city in a box" products (Paroutis et al. 2014; Alcatel-Lucent 2012) as well as cities from scratch (Lindsay 2010).

3 Discussion

The number of the located research journals (32 journals) and their context's differentiation—varying from construction, energy, social sciences, transportation, urbanship, ICT, etc.—that present corresponding to smart city works illustrate the attention, which the scientific community pays on this domain. The term is confirmed to be ambiquous, although the perspectives (application domains) that scholars use to approach smart city can be considered to be common.

The outcomes from the analysis of these articles illustrate that despite identifying 24 exceptional articles, which are clearly oriented to smart city, their corresponding scholars approach the term with four key areas (schools of thought): smart city, smart growth, living labs, and creative industry. Representatives from these schools approach the smart city from corresponding perspectives and utilize the intelligent urban space with means that address particular problems (i.e., creative industry considers city's capacity for innovative or media production).

Moreover, a conceptual framework for approaching a smart city appears to be structured and consists of the following application domains:

- *Resource (utilization and management)*: deals with natural resources, energy, water monitoring and management
- *Transportation*: concerns ICT utilization for transportation management, as well as intelligent transportation products and mobility in general
- *Urban infrastructure*: refers to building, agglomeration and sprawl management with the ICT
- *Living*: covers education, health, safety, and quality of life in urban space
- *Government*: mentions public e-service delivery, e-democracy and participation, accountability and transparency, and administration's efficiency within the city

- *Economy*: covers areas that reflect domestic product in city, innovative spirit, employment, and e-business
- *Coherency*: deals with social issues that address digital divide, social relations, and ICT connectivity

Beyond the above analyzed journal articles, a set of 17 publications was analyzed under phase 2 which contributes useful findings to this chapter. An important outcome concerns the involvement of three different industrial sectors (ICT, electronics and construction) in this niche international smart city market. Major representatives from these three industries appear (i.e., Gale and HGC; CISCO and Alcatel; and Hitachi accordingly) to play an important role in this market's formulation and they are mainly grounded in the USA and in the emerging Asian market.

Another useful finding concerns the identification of an indicative representative picture with regard to the most recently active countries, their involved stakeholders (universities, research centers, enterprises, etc.) and scholars (Table 4). From the investigated articles it appears that although smart cities are spread around the globe, this domain mainly interests South Korea, southern Europe Countries, and the USA.

Table 4 An indicative picture of the involved academia and industry around the world

Country	Institutes	Scholars
Greece	Two universities One research center	5
Italy	Five universities	13
Japan	One university One insitute	3
Mexico	One public organization	1
Netherlands	One enterprise	1
Romania	One university	2
Singapore	One university One institute	5
South Korea	Five universities One research consortium Two enterprises	5
Spain	One university	1
Sweden	Two universities One enterprise	4
Switzerland	One university	2
Taiwan	Two universities	3
Turkey	Two universities	3
United Arab Emirates	One enterprise	1
UK	Two universities	2
USA	sixteen universities Four enterprises Three public organizations	18

All the above findings can be used to answer this chapter's research question. More specifically, with regard to the fundamental theories, four key areas appear to attract smart city research: ICT in urban space (smart city), smart growth, living labs, and creative industry. Their corresponding concepts illustrate almost all urban challenges and how they can be addressed by the ICT. Furthermore, all recent ICT trends were found in the corresponding literature analysis: IoT, Big Data, Open Data and e-Government, and Smart Grids are only some of these trends. Moreover, eight different models have been introduced for smart city analysis, which can all align to a common conceptual framework consisting of eight perspectives (application domains).

4 Conclusions

Smart city is a "booming" phenomenon, which is still ambiguous in literature. Many different sciences look into the smart city domain and this can be met both in the academia (from the involved journals, schools and scholars) and the industry. Almost all sciences can be met in the smart city domain, which approach this phenomenon from different perspectives. Scholars and schools across the world are being or have been investigated this phenomenon and an indicative "picture" is provided. On the other hand, three alternative industries appear to meet in this domain and create an emerging corresponding market: the ICT, the construction, and the electronics.

To answer this chapter's question, a holistic literature review was performed, with a method that was inspired by Niehaves (2011). In this respect and with regard to the initially grounded research question, a smart city was viewed with four disciplinary perspectives, which were documented to form the corresponding smart city fundamental theories: ICT, urban planning and growth, living labs as large-scale testing beds, eco or green city and corresponding ecological aspects, and creative industry in a city. All the above scientific areas appear to "meet" in smart city and various outcomes are generated. Moreover, corresponding concepts illustrate almost all urban challenges and how they can be addressed by the ICT. Furthermore, all recent ICT trends were found in the corresponding literature analysis: IoT, Big Data, Open Data and e-Government, and Smart Grids are only some of these trends. Finally, eight different models have been introduced for smart city analysis, which can all align to a common conceptual framework consisting of eight perspectives (application domains). This conceptual framework is introduced in this chapter, which can be utilized in further smart city exploitation. Although this framework is based on existing literature findings, it would be useful to be tested and validated either by experts or under a real case study.

Finally, some limitations have to be considered, which address future research; although a quite effective sample of research journal articles were investigated, many were not included in this review either because they were citations in the investigated publications or they did not meet the criteria of this study. To this end, smart city studies older than 2011 are also important to this domain and they con-

cern a roadmap to today's smart city (Anthopoulos and Fitsilis 2013). Moreover, other industries are also involved in smart city domain but they were not accounted in this study, since they did not meet directly to the ICT context (i.e., biomedicine, economics, smart materials, etc.). However, it is estimated by the author that a unique literature review is extremely complex to be performed with regard to the smart city. On the contrary, detailed reviews will be more effective if they address the alternative perspectives of the introduced conceptual framework or the identified key areas.

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Smart Cities: Building Platforms for Innovative Local Economic Restructuring

Ari-Veikko Anttiroiko

1 Introduction

City is a constantly evolving high density concentration of people, which inhibits a particular area within national and global spatial structures and ensures its material existence by production, reproduction and circulation processes supported by socio-technical structures. Cities have been said to be among the greatest social innovations of humankind for being able to support effectively human desire for wealth, health, and security (Glaeser 2012). The creation of wealth is fundamentally based on the mix of cities' productive capability and efficiency of reproduction. In the current intensive global intercity competition cities face daunting challenges concerning the composition of their industries, occupational structures, and educational attainment (Kresl and Fry 2005; Savitch and Kantor 2003; Sellers 2002). Individuals, firms and communities, and their relations and positions, change over time, which implies that in the long run cities can maintain neither their vitality nor wealth only by maintaining their existing structures. They have to streamline and strengthen their economy continuously and renew it as a response to both local and contextual pressures.

One of the core aspects of the adjustment of urban communities to contextual changes boils down to the concept of local economic restructuring, that is, the design and implementation of local responses to structural challenges of the economy. The institution that has major responsibility for local development and serves as an intermediator in such local-global dialectic is local government, which has in developed countries responsibility to provide a range of infrastructure and welfare services to citizens and to secure long-term viability of local communities (John 2006, pp. 7–8). Even if local governments have become the primary instance of local democratic governance and the provision of public services, in the globalized world they face another kind of challenge that relates to their development function: A need to adjust to contextual changes.

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A smart city discourse brings a critical qualitative element into the picture of local economic restructuring, i.e. smartness. We may plausibly assume that there are huge differences in how smart local restructuring processes are in actual cases. The question is, how can individual urban community improve smartness in such processes and thus reap optimal benefits from the utilization of local assets and locality's connections to global markets and to global value flows? Smartness is a qualitative factor that has potential to make the difference, as it can be assumed to have long-lasting impact on restructuring and thus on the future direction of the entire urban community.

This chapter provides theoretically grounded view of the tools designed to smarten up policy and governance process. The research problem is: how can the smart city concept serve as the framework for local economic development policy and especially for building platforms for postindustrial cities to support innovative local restructuring? This chapter discusses the restructuring challenge, introduces smart city concept and the major dimensions of smartness, conceptualizes platforms that support smart local policy making and governance, and assesses how such development processes are able to help in restructuring local economies. Discussion is explorative and thus mainly theoretical, but utilizes exemplifications of local platform design to shed light on real-life developments in local platform creation. The case of New Factory from Tampere and one of its platforms for students-companies collaboration, Demola, are used to demonstrate the rationale and functioning of the new generation of local restructuring platforms.

2 Setting the Agenda: Local Restructuring

Restructuring is a generic concept that has different meanings depending on the context it is applied to. In this chapter perspective is limited to local economic restructuring. Discussion of this phenomenon has fairly long roots. It started actually some 200 years ago, when agricultural societies started to industrialize and led to the emergence of industrial cities, Manchester as the archetype of such an urban formation. Development accelerated globally in the latter half of the nineteenth century and reached its peek in the early post-World War II years, when industrialization still seemed to provide key to prosperity to the developed countries (Feinstein 1996, p. 172). A new discourse started to proliferate around the time when the advanced Western societies faced the decline of traditional industries, which caused high unemployment rates and tightened public budgets. Low labor and production costs, low labor and environmental standards, and the attraction of emerging markets especially in Asia marked a huge challenge to the Western countries, as they obviously could not maintain their dominance in industrial production. A tectonic change in global economy affecting dramatically the early-industrialized countries was about to begin (Bell 1973; Cohen and Zysman 1987).

Range of conditioning structural factors—the labor market structure, technological capability, and competitive setting of postindustrialism—increase structural

isomorphy in the perception of major structural challenge and, to a lesser extent, available policy options among postindustrial cities. The crystallization of the former is the very concept of "postindustrialism," whereas the latter has its expression in imitation in industrial policies, as evidenced by mushrooming of technology parks in the 1980s and 1990s, and the interest in creative industries and advanced business services or demand-led urban regeneration in the 2000s. From a historical point of view, this convergence was further increased by market-led regeneration and the role of private sector involvement in urban development (Moore and Pierre 1988). We may plausibly assume, though, that the restructuring challenge has divergent aspirations depending on each city's relative position in asymmetric urban hierarchy and on its transformative capacity.

In all, even if some of the restructuring challenges are case specific, such as industrial composition and networks and regional market structure, in the developed country context more or less common challenges behind the postindustrial cities' need for economic restructuring include such as losing competitive price advantage (if there ever was one), new demands to adjust to technological development and globalization, changes in local economy due to concentration of capital and offshore outsourcing, and pressure to increase innovativeness and high value adding services. In sum, when considering both the preconditions for local economic development in the globalized world and the real-life examples of local industrial restructuring, there is evidently a common denominator in the restructuring stories, which revolves around hard fact that cities must find ways to compensate the job losses in manufacturing.

In the rapidly changing world there is a need for ever-smartening support for economic restructuring. Such a need to maintain and improve local transformative capacity points to the idea of smart city, for it carries with it a promise of increase in local capacity to enhance knowledge processes and to facilitate interaction that is vital for local economic restructuring. What such smartness may mean in the given context will be discussed next.

3 Smart City Concept in Community Development

Smart city discourse has many strands. Since the late 1990s the key issue was primarily digitalization, which was discussed occasionally under the label "smart community" (Caves and Walshok 1997; Caves 2004), "digital city" (Aurigi 2005), or "intelligent city" (Komakech 2005; Komninos 2002; 2013). In this discussion smartness of cities is usually conceptualized by the way that brings it close to community informatics (Marshall et al. 2004). Perspectives on smartness in urban development widened and diversified in the 2000s, creating new discourses and concepts, associated with high tech and innovation-oriented "innovative cities" (Simmie 2001), knowledge process-oriented "knowledge cities" (Carillo 2006), and the idea of "creative city," especially the way it was presented by Florida (2005) with an emphasis of technology, tolerance, and talent as the recipe for urban growth.

In addition, emerging emphases in inclusive, open and user-driven innovations as critical elements of smart local development started to bring new dimensions of smartness into this picture (e.g., Carayannis and Campbell 2010; Antikainen et al. 2010). Another dimension to smart city discourse emerged in the wake of global environmental concern, as local and regional governments became active advocates of sustainable development (Edwards 2011; Hollands 2008; Komninos 2013). Hence connection with the idea of "sustainable city," which reflects another way of understanding smartness in urban development.

Technological solutions and especially new information and communication technologies (ICTs) form a necessary condition for the realization of the idea of smart city. Yet, in all sophisticated conceptualizations smartness goes beyond the kind of intelligence that can be reduced to the application of new ICTs, as one might assume on the basis of the various strands of smartness associated with urban communities (Anttiroiko et al. 2013). Concerning the main dimensions of smartness, it may refer to such things as smartness in community informatics (Marshall et al. 2004), production systems and networks (Komninos 2002), urban infrastructures and functional systems (The Royal Academy of Engineering 2012; Martinez-Torres et al. 2011; Tse et al. 2009), public governance and policy (Sanderson, 2009; Janssen and Estevez 2013), sociocultural aspects of community life (Goleman 2006), and sustainability of human settlements (Goleman 2009). Taken all these aspects together, we end up with tentative sixfold scheme of functional application areas of smartness, including semantic, economic (productive), logistic, political, sociocultural, and ecological dimensions of smartness in collective action and community life, as illustrated in Fig. 1. The list is not exhaustive, but illustrates well the multidimensionality of the concept in question.

All the forms of smartness or intelligence are emergent yet interdependent. The functional perspective serves for understanding the spectrum of smartness and reveals the kind of processes that we are supposed to facilitate if we wish to smarten up community processes. At a general level, smartness can be related to both our ways of doing things (form) and the things we create (content). Facilitating smart community processes forms in this sense two sides of the coin: smartness is inbuilt element of the platforms which we use to involve people or facilitate exchanges, but it is also in the richness of content we create through such processes. Smartness can thus be seen both in the design of policy and its implementation. In our case, the ultimate result of increased smartness would be the success of local economic policy in revitalizing local economy to meet the challenge of constantly evolving local-global dialectic.

4 Designing Platforms for Innovative Restructuring

Platforms can be used to facilitate restructuring processes. In general, *platform* is any physical, technological or social base on which sociotechnical processes are built. The concept of platform varies depending on the discourse or empirical

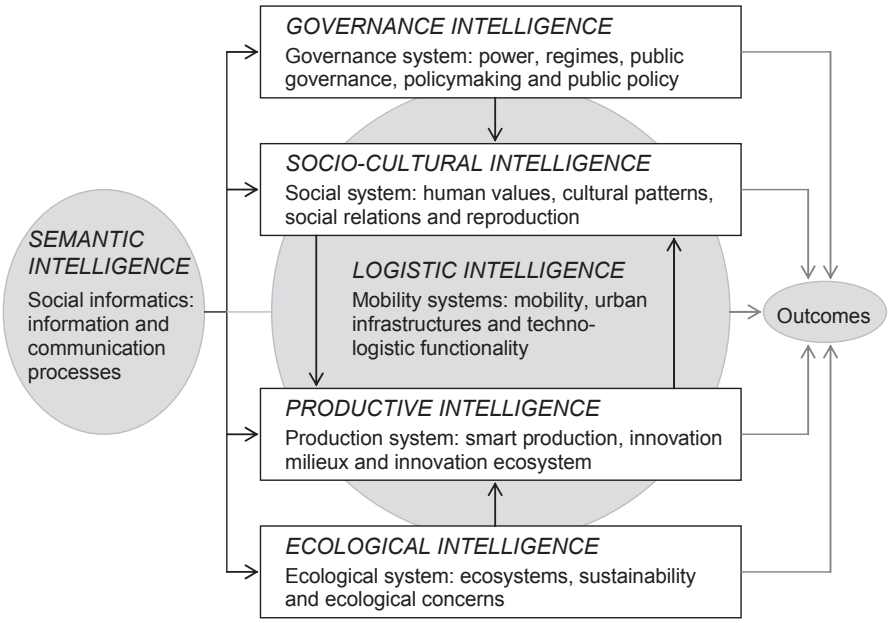

Fig. 1 Six aspects of smartness. (Modified from Anttiroiko et al. 2013)

context, of which good examples are such as product platforms, industry platforms, community platforms, regional development platforms, and the like (see, e.g., Gawer 2010; Cooke et al. 2010). On the basis of inductive reasoning we may identify following kinds of functions or dimensions typical to any platform: (a) *action*: it facilitates people's actions that aim at creating something that has value; (b) *tools*: it supports social action by providing some structures, methods, or tools relevant for the actions of actors involved; (c) *connectedness*: it facilitates connectedness of people and/or their actions; and (d) *critical mass*: it promotes the achievement of some social outcomes or results through critical mass of users and/or their inputs. Through such mechanisms platform provides a structured and enabling environment for technologies, applications, or social processes of basically any kind with a potential of smartening up their development (Anttiroiko 2012; cf. Janssen and Estevez 2012). Platform thinking found its way long-time ago to such fields as software development and business, but it is becoming essential element of policy making and governance, too, mostly because of the deep impact of intensifying informatization or technological mediation in the public domain.

The first widely discussed platform issue in the field of e-enabled public governance revolved around *government websites*, followed by a discourse that focused on integrated public sector *portals*, which became an important topic in e-government field in the late 1990s. Thereafter, more sophisticated platform thinking began to suffuse in governance discourse through such ideas as one-stop government, joined-up government, and collaborative government as expressions of platform thinking and, possibly, as an indication of the looming paradigm shift in public

governance. More radical perspectives appeared in two waves: first in the form of virtual communities in the 1990s and some 10 years later due to the emergence of Web 2.0 or social media, which set a completely new agenda for platform thinking. When this picture is added with ubiquity and artificial intelligence, we have identified the core elements of the platform development relevant to local policy making and governance (Eggers 2005; Deakin and Al Waer 2011; Anttiroiko 2012; Anttiroiko et al. 2013; Ferro et al. 2013).

Platform approach offers a framework for supporting governance and policy informatics, which is supposed to bring changes notably on two fronts: first, technology can replace or supplement bureaucratic structures as a means of control by employing technological rather than bureaucratic gatekeepers in policy and governance processes, and second, the platform approach has the capacity to increase flexibility and responsiveness of actors involved in such processes (Wachhaus 2011, pp. 3, 7; Anttiroiko et al. 2013).

To make sense the role of platforms, we need to specify the nature of processes in which they are utilized. In principle, *policy making* involves agenda setting, policy formulation, implementation, and evaluation. Yet, in the case of *local economic restructuring*, the process cannot be identified as a linear policy process with distinct phases. This is because "restructuring" refers to fundamental changes brought about loosely related processes that are continuously renewing the structure of the local economy (cf. Neil and Tykkyläinen 1998, pp. 6–7). It may include overlapping industrial programs, special incentives, contributions from education policy, setting up an area-specific revitalization program, participation in national development programs or global networks, and so forth, making it complex set of stakeholder-involving processes.

Another special feature of local economic restructuring is that even if its core is in industrial policy, it must be cross-sectoral or integrative to be effective. Thus, economic dimension is usually supported by selected aspects of education policy, cultural policy, health care, social policy, and technical services. This adds another requirement for the smartness of local restructuring policy, which can be met by platforms as mechanisms to integrate different policies. To support such aspects of restructuring special attention should be paid to broader stakeholder involvement in idea generation, creative policy making, and innovative use of local assets in economic restructuring. We may identify four major functions for such policy platforms: (i) providing open access and encouraging broad-based stakeholder involvement; (ii) enhancing individual, group, and community creativity; (iii) facilitating open dialogue and sharing; and (iv) making policy integration possible, as illustrated in Fig. 2. (See Wachhaus 2011; Koliba et al. 2011; Anttiroiko et al. 2013. See also Dais et al. 2008; Wang and Wang 2011; Sefertzi 2000).

In increasing smartness within any policy making and governance platform the need to utilize ICTs is indispensable. There is a plethora of newly created online co-creation and innovation platforms, which give a hint of how platforms may serve as engaging forums, which enhance the involvement of citizens, service users, entrepreneurs, and other stakeholders for the benefit of whole community and society (Ramaswamy and Gouillart 2010; cf. Antikainen et al. 2010; Brabham 2009). Such platforms are concrete expressions of the idea of smart city.

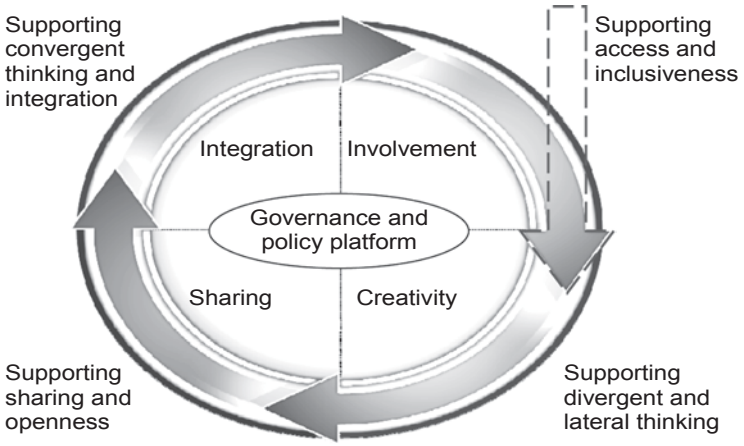

Fig. 2 Main functions of local policy platforms. (Applied from Anttiroiko 2012)

Platforms have traditionally underpinned a strong *local* tone, as getting together has been based on organization of small or mass gatherings on some single physical site. In addition, both attracting resources from the global value flows as well as developing products for global markets, have in both cases locality as their basing point, at least in the cases of players with strong local roots. Yet, such trends as globalization of the economy, improved mobility, radically reduced transportation costs and close-to-zero transmission costs of digitized deliveries, have radically changed the scene for human interaction and transactions. The impact on social organization is visible in increased use of networks both in private and public sectors, which has created new social morphology for the information age, as described by Castells (2000). Such tendencies have affected the forms and use of platforms, giving rise to a new generation of platforms which is not restricted by narrow-minded localness.

5 Examples of Restructuring Platforms

Restructuring and related knowledge-intensive policy design and governance processes involve large number of actors who have a stake in and are affected by such processes. We may conceptualize their communicational instances as "knowledge moments," which are spontaneous or planned situations in which knowledge is discovered, created, nourished, exchanged, and transformed into a new form. In a simplified sense, knowledge moment "is a conversation between people in a particular place, using structured or unstructured processes aimed at explicit or implicit purpose" (Dvir 2006, pp. 245–246). Platform in such a social activity serves as a physical or virtual setting, which usually includes some rules that guide people's behavior and tools they can use to support their communication and goal-oriented interaction.

Local restructuring processes are determined by various internal, relational, and external factors, which form a unique constellation in each case. The general requirements of restructuring provide a basis for considering what aspects must be addressed in such a process. We may identify three core material processes: (1) *community asset* mapping and utilization to best enhance local history, nature, built environment, culture, and human and creative potential; (2) identification and utilization of local *attraction factors* to attract resources from the global flows of values, and (3) supporting local R&D, commercialization and selling of *local products* in global markets. Beside these, we may add to the list a cross-cutting category with high relevance to restructuring process, (4) globally-oriented *knowledge processes and networking*. This field of local-global dialectic is illustrated in Fig. 3.

Even if most of the platforms are hybrid formations in the sense that they serve simultaneously various functions, we next present examples of them grouped into four categories according to their primary functions.

5.1 Platforms for Local Asset Utilization

Local asset utilization schemes are primarily directed to community or local business development. It is a kind of underlying set of activities that are inbuilt elements of both local and relational development processes. Community oriented developments include such widely discussed processes as neighborhood regeneration projects and community capacity building schemes, in which the facilitation

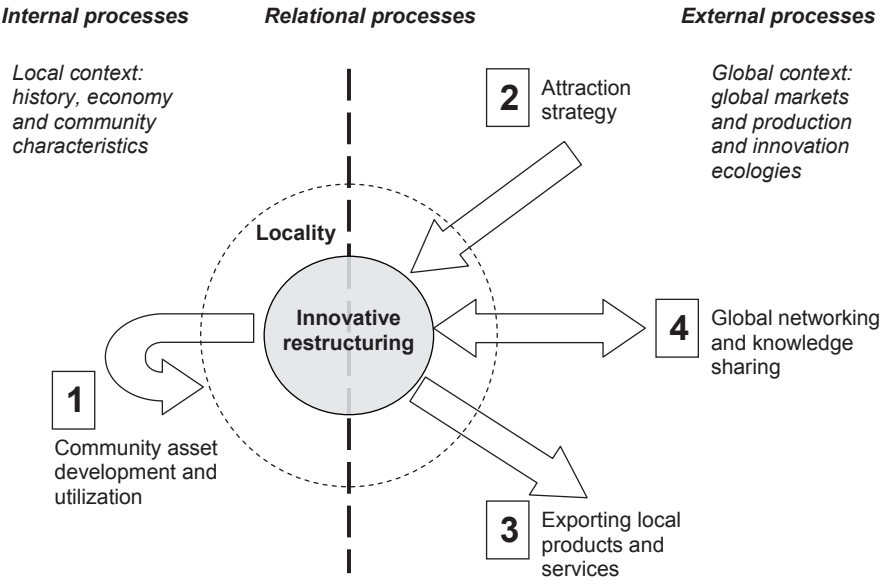

Fig. 3 Functions of local restructuring in local-global dialectic

of knowledge moments and processes takes place in various real-life settings, occasionally facilitated, or supplemented, by online forums. There are literally thousands of such platforms all over the world. Also the creation of virtual communities and new community networks has for decades paved way for the new style of facilitation of community development (e.g., Schuler 1996). Some of them have served local regeneration with important economic dimension, but generally, their rationale have been rather on the side of social inclusion, learning, collaboration, and governance than that of local economic restructuring. Another set of examples to be mentioned here is programs and platforms that support some special activities, which may be relevant also from the economic restructuring point of view, as in the cases of community service platforms set up by non-profit incubators (NPI) in some major Chinese cities, or Shanghai Community Venture Philanthropy Match (SCVPM), which through local government-sponsored platform for social entrepreneurship facilitates knowledge sharing, collaboration, and everyday working of social entrepreneurs (see Cai 2011).

There are also various Web 2.0-style forums and creative ad hoc communities that combine the harnessing of local development potentials with social innovations and innovative product development. For example, Social Innovation Camps (SIC), which originated in the UK, have such a nature as the forums for the development of social innovations. Also local innovation incubators and accelerators of different kind may serve similar functions, such as the New Factory in Tampere, Finland. Also Forum Virium Helsinki and other living labs organized in many European cities have such a dual nature as local innovation platforms with an idea of supporting innovation-driven internationalization of local business.

As a counterpart to community-oriented processes we may present business-oriented processes, which have natural connection to local restructuring. A good example of such scheme is the Business Improvement District (BID), an area within which business pays an additional levy to fund area development project (PUMA 2010; Grossman 2010). Such projects are primarily about partnership-based community asset utilization, but relate also to the idea of increasing the attractiveness of the district through place shaping and destination branding.

5.2 Platforms for Attracting External Resources

Attracting external resources sets special requirements to platforms. Investment portals have been designed for that particular purpose. There are, however, also more recent developments which combine network logic with globalization. One such example is InnovationXchange (IXC). It was set up in Australia as an international knowledge exchange platform to identify and create collaborative business, research, and policy opportunities. It is not-for-profit business model developed to support open innovation and enable fast transfer of knowledge across corporate and geographical boundaries through the IXC Intermediary Service. There are currently some 20 IXC Intermediaries worldwide (Christopherson et al. 2008).

A special case of the local asset and attraction mix is a magnet institution, such as world-class university or high-performing hospital, which attract talent and have at the same time huge impact locally. They may also serve as platform-makers in various locally oriented development processes (e.g., Lester 2007). To this category we may also add international fairs and exhibitions, which serve as meeting or rather "mingling" points for businesses, professionals, developers, public managers, and customers.

5.3 Platforms for Export Promotion

Export promotion is executed in different forms by export promotion agencies and occasionally by high-level trade missions to promote export and on a more regular basis but more selectively by diplomatic missions (e.g., Lederman et al. 2009). National think tanks, innovation funding agencies, and some foundations may serve such functions as well. Incubators and accelerators and generic or specialized export or growth programs have more hands-on involvement in direct export promotion (e.g., Stockholm Innovation and Growth business incubator and Go Global program, see http://www.stockholminnovation.com/EN/11/incubator-business-development).

A category of its own is export-related enclaves or, as they are usually called, special economic zones (SEZ), including such forms as export processing zones, free ports and export promotion industrial parks (Wang 2013). Most of these organized forms of support can be understood as export promotion platforms, even if all of them are not platforms in the narrow sense of the word.

5.4 Platforms for Knowledge Sharing and Networking

Think tanks, research institutes, and universities are knowledge creation and sharing forums par excellence. They are often actively involved in local economic restructuring processes, which gives them vital role in the big picture of restructuring as knowledge creators, disseminators, and intermediators. As regional and local governments are the key players in the process, they have equally important role in knowledge sharing, which is manifest in various platforms created on a bottom-up basis for international collaboration. For instance, local governments and their associations have set up several platforms and networks to support development, such as, PLATFORMA—European Platform of Local and Regional Authorities for Development setup on the basis of the initiative of the Council of European Municipalities and Regions (CEMR); The African Caribbean Pacific Local Government Platform for capacity building and poverty reduction (ACP-LGP, see http://www.acplgp.net/); or L.E.D as an experience sharing platform for development related issues initiated by the Weitz Center for Development Studies (http://my-led.org/).

Platforms that have a more accurate connection with restructuring of postindustrial cities are usually based on global or regional intercity networks and alliances. An example of such a formation is European Network of Living Labs (ENoLL), which provides chances for cities to learn and share experiences of organizing living labs, which are user-centric open innovation platforms.

A good example of macro-regional platform is European Union's smart specialization platform, which is special type of macro-regional support and knowledge-sharing platform with explicit connection with local economic restructuring. Smart specialization platform, known as Strategies for Smart Specialisation or S3 Platform, was established 2011 by the European Commission to provide professional advice to EU countries and regions for the design of their research and innovation strategies for smart specialization (see http://s3platform.jrc.ec.europa.eu/home). It provides guidance material and good practice examples, organizes information sessions and training for policy makers, facilitates peer reviews, supports access to relevant data, and participates in high quality research projects to inform strategy formation and policy making (see European Commission 2012).

6 The Case of Innovation Factories of Tampere

In this section, two cases of new generation of platforms for local restructuring are presented, the New Factory and one of its special platforms, Demola, from Tampere, Finland. They illustrate well the new style of platform governance that contributes to the broadly understood local economic restructuring. This "new style" implies that instead of building a city government-controlled platform to support the work of local business development agency, platforms are built in a collaborative manner to meet the needs of local restructuring through the energy and innovativeness of local actors. There is a link between city's economic development strategy and the mission of such platform, but content-wise the latter is not deduced from city strategy by politicians and top management, but rather, local actors are given high degree of freedom to decide on project ideas, innovation activities, and business creation.

6.1 Background

Tampere started to industrialize in the first half of the nineteenth century. The drivers of the development were Finlayson and other large factories, which utilized Tammerkoski rapids in producing power needed for manufacturing. The city's industrial heritage is enunciated in its nickname, Manse, which is abbreviated from Manchester of Finland.

It is just a curiosity, but most telling one, how Scottish engineer James Finlayson's cotton factory built in 1820 by the Tammerkoski rapids, which grew to be among the largest industrial complexes in the Nordic region, changed over time. In

the nineteenth century it became a corporate town within the city of Tampere with its own school, hospital, police, convenient store, and church. Almost 200 years later it had turned into a refurbished cultural center, hosting media and new media companies, IT firms, architecture companies, consultancies, museums and galleries, movie theatre, restaurants and cafeterias, beauty shops, and among them, the innovation platform called New Factory. This illustrates well how industrial production made way for entertainment, creativity, and knowledge-intensive services (on Finlayson area see http://www.finlaysoninalue.fi/).

6.2 Innovation Factories as Engagement and Matching Platforms

Tampere has based its restructuring on a range of partnership-based economic development programs, which started from eTampere (2000–2005) and continued with BioneXt (2003–2009) and Creative Tampere (2006–2011). They reflect, as such, changes in local understanding of the basic needs and directions of economic restructuring. The current framework program, Open Tampere (2012–2018), is more cross-sectoral. It has been described as project generator, which contributes to the birth of new growth-oriented companies, creates global business, and promotes the restructuring of existing industries.

Among the new concepts applied in Tampere, supported by city government's economic development programs, are *innovation factories*. They are community-based innovation platforms, which provide combinations of space and action model to promote innovation activities; support product development and R&D of innovators in different industries; and strive for new innovations and their efficient dissemination. Three newly created innovation factories are New Factory, Konela, and BioMediTech. (Tredea 2014). New Factory, which will be discussed later, is a good example of recent trends in the creation of new generation of innovation platforms. Concerning the other two, BioMediTech or Institute of Biosciences and Medical Technology, is a research unit and an innovation platform specialized on biotechnology set up by the University of Tampere and Tampere University of Technology (TUT), whereas Konela ("Kone" is machine in Finnish) is open innovation center for mechanical engineering and energy technology, matching leading firms and small and midium-sized enterprises (SMEs) with top research made at TUT and VTT Technical Research Centre of Finland.

6.3 New Factory as a Hybrid Platform

New Factory Ltd was set up in 2010. It was backed up by numerous local and national organizations, including the city of Tampere and surrounding municipalities, a regional authority known as the Centre for Economic Development, Transport, and the Environment of Tampere Region, the Council of Tampere Region, three

local universities, Tampere Chamber of Commerce and development corporations Tredea and Hermia. Organizationally, it became part of local development concern Hermia Group. (City of Tampere 2010). Development manager of the city of Tampere, Kari Kankaala, describes the role of New Factory as follows: "New Factory is a community that is open to all actors and industries, which is the proactive answer of Tampere Region to structural change. Aim is to give birth to large number of new businesses, new jobs, and international growth business know-how during the coming years." (City of Tampere 2010).

New Factory is not only a conventional business incubator but, literally, a multifaceted innovation platform, as it connects business and people within several subprograms or mini-platforms by providing space, tools, facilitation and expertise for collaboration with an ultimate aim of creating new business. New Factory offers matchmaking (First Customer), accelerator and coaching services for start-ups, two special innovation platforms (Demola to involve university students in creating demos and Protomo for prototype-driven startupping), and mentoring. (New Factory 2013).

Some results of the inception phase of New Factory are collected in Table 1.

Due to its open and inviting working culture and great local visibility, New Factory has created a lot of optimism and innovation-related buzz in the city.

6.4 Demola as a Student Engagement Platform

The platform with special significance for understanding new generation of platforms is Demola. Demola was set up in 2008 as one of the projects supported by Creative Tampere program (2006–2011) and managed by Hermia Science Park. It

Table 1 New Factory's results for the first years, 2010–2012. (Source: Matikainen 2012)

Performance indicators	Results in 2012	Cumulative results (from the mid-2010 until the end of 2012)
New members of the New Factory communities	900	2500
New projects	190	445 (accomplished projects)
Active people involved in projects	1195	3010
New firms	41	66
New jobs through projects	245	425
Finance for innovators and start-ups	About 13 million €	15+ million €
New partner companies participating in projects	80	160

provides students and companies with a collaborative and multidisciplinary innovation environment where students from three local universities create demonstrations of novel service and product concepts that originate in local companies (Davey et al. 2011, p. 30). Thus, project ideas come from local companies or other organizations, and university students form teams to create innovative solutions for such real-life needs. Students can apply to available projects for several periods during the academic year according to their own interests, and through participation they earn credits for their degrees and occasionally also monetary rewards.

As Creative Tampere program ended in 2011, Demola needed a new host organization. The New Factory served such purpose perfectly. Actually New Factory concept helped to ensure that results and products created in Demola have a stimulating path for continuation and development into business creation. Furthermore, in such a networked environment Demola's connections grew dramatically, for national and international networks have been created to both generate talent flows between regions and to create maximum value for the partner companies and other parties involved (Davey et al. 2011, p. 32). Demola has actually grown into a network of eight locally operated Demola centers in northern and eastern parts of Europe.

Since its establishment Demola has served as a platform that has involved more than 150 partner companies with their needs for new concepts and solutions, and at the other side of the equation, has gathered some 2000 students (of which some 35 % were international students) working in teams for product and service concept development projects, of which some 350 have been completed so far. Students' work has contributed to the generation of licenses, new jobs and start-ups. As the open innovation model of Demola wants to reward those who contribute to the projects, the teams of students own the results of their work, which gives them a chance to develop the ideas further and create their own business. In addition, project partner can also license the results from the teams. One indication of the success of the work is the high share of projects with licensed results (some 90 %) which has generated over 1 million € to students as licensing fees. Another indication of the success of the model is that many students are headhunted after the projects (some 15 %) and that the willingness to become an entrepreneur rises among participating students considerably, on an average from some 30 to 75 % (Davey et al. 2011; Bessonova 2011; Salomaa (n.a); on Demola, see http://tampere.demola.fi/).

In all, Demola is one of the projects that express well the open innovation-driven developmentalism at the heart of Tampere's restructuration in the 2000s. It has been able to involve active and innovative students in the innovation processes. Such an additional input in innovation-driven business is vital for successful restructuring (Davey et al. 2011, p. 31).

7 Discussion

Smart city was originally a concept that focused on community informatics and, in the context of local economic development, most apparently on the creation of intelligent environments to restructure existing industries, support start-up creation, and attract international high tech firms (e.g., Komninos 2002). The suitability of the concept of smart city for the framework for local economic development depends primarily on the relevance and operational aspects of "smartness" in such a context, an issue that has not been elaborated sufficiently in current literature. In this chapter we have connected these two discourse areas by introducing the idea of platform, which connects smartness with local economic development. In that sense, platforms can be understood as special aspect of community informatics and more importantly as mechanisms that help in increasing broadly defined productive smartness.

The next question is, how well-platform governance is able to facilitate smartening-up of local restructuring. Examples of platforms and the case of New Factory and Demola in particular provide preliminary evidence to claim that in the increasingly complex economic environment well-designed open platforms have proven to serve efficiently local restructuring. Platforms make the utilization of local assets effective and help to gather the main aspects of attraction factors into one hub, which has a potential to match local strengths with the interests of external actors. Platforms involve active and talented people, encourage and enhance creativity, create knowledge-sharing culture, and integrate activities especially within the loosely connected programs and platforms of local innovation environment. In the case of Tampere, at the policy level especially the latter function—policy integration—is taken care by the city government and two development corporations, Tredea and Hermia.

Yet, "smartness" does not necessarily grow at the same pace as the number of people involved in the process, as the value of information does not come only from quantity of information nor case-specific local knowledge but also from novelty resulted from creativity and innovativeness. In well-designed online or hybrid platforms transaction costs grow only marginally when platform activities proliferate, but in any case both complexity of challenges and information overflow may become a problem. Also assorting promising ideas from less-promising may become laborious, at least until there is enough semantic intelligence in the system that supports platform's functionality. In this sense, the challenge is to utilize the "long tail" of development-oriented knowledge but at the same time be able to effectively create, process, and utilize the most critical knowledge that is needed in strategic local restructuring. In New Factory such a screening is conducted within different service packages and programs, whereas in Demola the relevance is an inbuilt element of company-driven initiatives. That is the way how platforms can effectively turn quantity into quality and thus enhance business creation.

An important concern worth discussing here is the tension between openness and managerialism in development processes. It seems evident that both dimensions

are needed, and the cases of New Factory and Demola show well how it can be achieved. There is an "open sphere" which invites all interested parties to involve in development processes. Yet, at the core of the platform there is a clear view of how processes and services are supposed to be organized and a managerial team that guarantees that sufficient managerial and case-specific competence is provided to fulfill platform's mission.

8 Conclusion

Restructuring is one of the most important aspects of local economic development, as it relates to the durability of economic vitality in changing times. In the developed countries, local economic restructuring boils down to the transformation from industrial to postindustrial economy, the latter associated with such sectors as high technology, high-value adding services, and knowledge-intensive activities. Smart city is not originally designed as the framework for local economic development policy, but it has a potential to serve such a function. It can serve both in defining means and ends of local economic development, which refer respectively to such major aspects as smart facilitation mechanisms and smart policy choices in local economic restructuring. We have concretized this view by focusing on platforms that are used to facilitate such processes.

The two empirical cases, New Factory and Demola supported by the city of Tampere, show convincingly that platform development is not only a smart "means" to an end but also helps in determining rich content to local restructuring, as it utilizes local talent and entrepreneurial potential as well as global knowledge networks in critical knowledge processes. At the same time it seems evident that smart city framework works best in the cases in which the forms and degree of smartness can be defined as operationally as possible, to provide rationale for the very idea of smartness in the given activity area. In local economic restructuring such a rationale can be certainly found, as smartness has potential to make a difference in complex knowledge-intensive and stakeholder-involving processes that affects the fate of urban communities.

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Designing Next Generation Smart City Initiatives: The SCID Framework

Adegboyega Ojo, Edward Curry, Tomasz Janowski and Zamira Dzhusupova

1 Introduction

Cities worldwide are facing the challenges of rapid urbanization and need for social and economic regeneration for survival and greater competitiveness. In addressing these challenges, governments at city and other levels are initiating smart city programs. These initiatives are directed at how the respective cities can transform themselves in different policy areas such as the use of alternative or renewable energy, use and management of natural resources, waste reduction and management, carbon emission, and green areas to achieve the desired sustainable socioeconomic outcomes.

However, experiences from earlier and ongoing smart city initiatives have revealed several technical, management, and governance challenges arising from the inherent nature of a smart city as a complex "socio-technical system of systems". While these early lessons are informing modest objectives for planned smart city programs, no concrete framework based on careful analysis of existing initiatives is available to guide policy makers and other smart city stakeholders. Existing frameworks are either conceptual, developed based only on review of smart city literature,

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for instance, Nam and Pardo (2011a) or they narrowly focus on the technological aspects or architecture of smart cities, for instance, Zygiaris (2012). Rather than providing prescriptive smart city frameworks or reference models that are detached from the realities of users, we argue that frameworks that offer users a design space consisting of a set of options for different aspects of smart city initiatives are potentially more effective. Such frameworks will allow users to make choices based on the realities of the environment or externalities of the smart city program under consideration.

This chapter offers researchers, policy makers, and practitioners a framework (Smart City Initiative Design (SCID) framework) to support the planning and design of smart city initiatives. The framework enables users to link smart city objectives with concrete impacts or changes in different city aspects and consequently city and stakeholder transformation goals. As a resource base, the framework presented in this chapter provides readers with concrete objectives, strategies, and critical success factors that could be adapted by policy makers or further investigated by researchers.

The SCID framework is grounded in the analysis of ten flagship Smart City programs around the world, including Smart Amsterdam, Netherlands (Šťáhlavský 2011); Climate-Smart Malmö, Sweden (Malmo City Environment Department 2009); Smart City Malta, Malta (SmartCity 2014); Masdar Smart City, United Arab Emirate (Masdar City 2011); PlanIT Valley, Portugal (Living PlanIT 2011); Smart City Singapore, Singapore (Mahizhnan 1999); Smart Curitiba, Brazil (International Council for Local Environmental Initiatives 2002); Smart Songdo, South Korea (http://www.songdo.com); Tianjin Eco-City, China (http://www.tianjinecocity.gov.sg/); and Yokohama Smart City, Japan (http://jscp.nepc.or.jp/en/yokohama/). The study is comprehensively documented in a report (Ojo et al. 2012a). The framework is constructed following the design science research approach, considered appropriate when inventing or building new innovative artifacts for solving problems or achieving improvements of high relevance in an application domain (Iivari and Venable 2009) (Hevner et al. 2004).

The rest of the chapter is organized as follows: Section 2 reviews the different conceptualizations of the term "smart city" and provides a working definition. Section 3 describes our methodology for developing the SCID framework while the details of the framework are presented in Sect. 4. Section 5 discusses the issues related to the use and validation based on the Design Science Research (DSR) checklist (Hevner and Chatterjee 2010), before presenting the conclusions in Sect. 6.

2 Conceptualizing Smart Cities

This section provides the conceptual underpinning for the study and definitions of core concepts of a smart city. The term smart city (or smart cities) has been adopted by different governments, consulting organizations (IBM 2013) and research groups. Despite the wide use of this term, its meaning remains fuzzy (Caragliu et al. 2009;

Nam and Pardo 2011b). Smart city according to Giffinger et al. (2007) is "A City performing in a forward-looking way in economy, people, governance, mobility, environment, and living, built on the smart combination of endowments and activities of self-decisive independent and aware citizens." This definition is based on the traditional regional and neoclassical theories of urban growth and development. In particular, the axes are based—respectively—on theories of regional competitiveness, transport and information communication technologies (ICT) economics, natural resources, human and social capital, quality of life, and participation of societies in cities. Based on Giffinger's definition, Caragliu et al. (2009) offer a similar definition of the concept as follows: "We believe a city to be 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."

Smart cities are expected to dramatically improve their citizens' quality of life, encourage business to invest, and create a sustainable urban environment (Vasseur and Dunkels 2010). Interestingly, while the term *smart city* literarily implies an outcome or result, most usages of the term consider it as an "activator" of change through exploring relevant open innovation processes (Paskaleva 2011). Other conceptualizations such as from Nam and Pardo (2011b) consider smart city as an urban innovation involving technological, organizational, and policy innovation. Finally, smart city could be understood as a certain intellectual ability that addresses several innovative socio-technical and socioeconomic aspects of growth (Zygiaris 2012).

Three elements characterizing the smart city concept identified in Hollands (2008) include (1) utilization of networked infrastructures to improve economic and political efficiency and enable social, cultural, and urban development (infrastructures including ICT), (2) business-led urban development, and (3) social and environmental sustainability. Social sustainability implies social cohesion and sense of belonging, while environmental sustainability refers to the ecological and "green" implications of urban growth and development.

Komninos (2011) presents the concept of spatial intelligence of cities as a composite capability, enabling communities within the city to harness the intellectual capital, institutions, and material infrastructure in dealing with problems and challenges. Spatial intelligence is composed of three types of intelligence: (1) the inventiveness, creativity, and intellectual capital of the city; (2) the collective intelligence of the city's institutions and social capital; and (3) the artificial intelligence of the public and citywide smart infrastructure, virtual environments, and intelligent agents. These three types of intelligence involve all dimensions of the city and maps to three types of spaces—physical, institutional, and digital spaces. The "physical space" corresponds to the inventiveness and creativity of the city, the "institutional space" includes the social capital and collective intelligence of a city population, and the "digital space" contains the artificial intelligence embedded into the physical environment, including public broadband communication infrastructure and digital technologies. Focusing on the digital space, Vasseur and Dunkels (2010) identified the following infrastructure networks for smart cities. Some of these networks are

related to transport, public safety and security, public services and utilities, and social networking. In the physical space, skills and human capital are considered as arguably the most important elements. For instance, it is argued that the greatest competitive advantages of cities are qualities that attract the best and brightest from the world to a city (Bloomberg 2011). This is supported by the fact that educated cities grow more quickly than less-educated ones, since skilled cities are economically more productive and better at adapting to economic shocks (Glaeser and Saiz 2003).

As a concept, there have been a number of attempts to measure smart cities. For instance, Lombardi et al. (2012) characterized smart cities as an innovation system consisting of five clusters—smart governance, smart economy, smart human capital indicators, smart living, and smart environment involving major actors including university, government, civil society, and industry. The study provided example indicators for each cluster and actor.

Finally, works such as Harrison and Donnelly (2011) situate the understanding of smart cities in the tradition of studies which fundamentally view a city as a complex system characterized by interconnections, feedbacks, adaptation, and self-organization. Smart cities here provide new instrumentations that enable observations of urban systems at a microlevel.

We summarize the different elements of the definitions of the smart city concept in Table 1. Further discussions on the conceptualizations and definitions of the smart city are provided in Hollands (2008), Caragliu et al. (2009), and Nam and Pardo (2011b).

Table 1 Elements of "smart city" definitions

No	Description	Reference
Nature	Is a (1) forward-looking city in the areas of economy, people, governance, mobility, environment, and lifestyle; (2) form of urban innovation; and (3) intellectual capital profile of a city	Giffinger et al. 2007, Nam and Pardo 2011b, Zygiaris 2012
Essence	Means (1) information access, bridging digital divide, lifelong learning, social inclusion, economic development; sustainable economic growth and urban development, higher quality of life; and wise management of natural resources and (2) innovative socio-technical and socioeconomic growth of a city	Hollands 2008, Vasseur and Dunkels 2010, Zygiaris 2012
Approach	Involves (1) investments in human and social capital; (2) investment in traditional (transport) and modern (ICT) communication infrastructure; (3) promoting participatory governance and engagement of citizens; and (4) technological, organizational and policy innovation	Caragliu et al. 2009, Nam and Pardo 2011b

3 Approach

The approach employed in developing the SCID framework follows the design science research guidelines and process elaborated in Hevner and Chatterjee (2010), Hevner et al. (2004), and Peffers et al. (2007). Design science in general creates and evaluates artifacts that define ideas, practices, technical capabilities, and products through which the analysis, design, implementation, and use of information systems can be effectively accomplished. Our objective was to create an artifact in the form of a design tool to assist smart city policy makers and practitioner in making decisions about different aspects of smart city initiatives to achieve a set of objectives or desired outcomes. The practical relevance of the tool is related to its direct purpose of supporting the knowledge and decision needs of smart city policy makers in Macao Special Administrative Region (SAR) and of planning for smart city initiatives. We summarize the DSR profile for the SCID framework design process in Table 2.

3.1 Research Framework

The research framework employed is an instantiation of the DSR framework, comprising three core cycles—relevance, design, and rigor (Hevner and Chatterjee 2010). As shown in Fig. 1, the contextual environment for our work is the smart city policy environment in Macao SAR, China, as well as the knowledge needs for the policy makers charged with the design and implementation of smart city initiatives in the city. Macao SAR is one of the SARs of the People's Republic of China lying on the western side of the Pearl River Delta on South China Sea. Macao, a former Portuguese colony and one of the world's largest gaming and tourism destination, has a population of about 600,000 people. It is one of the fastest growing economies of the world (about 10%) and a purchasing power parity (PPP) or gross domestic product (GDP) per capital of about US$82,400.00.[1] To address some of its major challenges including the need for diversification and modernization of the city's economy, building very efficient transport infrastructure, and creating greener environment, the city government has since 2010 continued to build the necessary foundations for developing smart cities initiatives.

Our knowledgebase consists of the sources of information on all ten selected smart city case studies and the literature related to conceptualization of smart cities and smart city initiatives. The design cycle iteratively builds elements of the SCID framework from the analysis of the cases.

[1] https://www.cia.gov/library/publications/the-world-factbook/geos/mc.html

Table 2 Design science research profile for the study

Guideline	Description	SCID framework instance
G1: design as an artifact	DSR must produce a viable artifact in the form of a construct, a model, method, or an instantiation	We develop first a conceptual model for smart city initiatives and a concrete framework as a design support tool. The framework could also serve as a knowledge map as it maintains references to the origin of options in the cases
G2: problem relevance	The objective of a DSR is to develop technology-based solutions to important and relevant business problems	The SCID framework directly addresses the need of policy makers with the need to know decision options for different aspects of the smart city initiative design
G3: design evaluation	The utility, quality, and efficacy of a design artifact must be rigorously demonstrated via a well-executed evaluation method	The framework has been reviewed by the targeted users—smart city policy makers with positive feedbacks on its usefulness. Additional field studies are planned for evaluating the tool with practitioners in different cities
G4: research contributions	Effective DSR must provide clear and verifiable contributions in the areas of design artifact, design foundations, and/or design methodologies	The major constructs and relationships in the SCID framework constitute a research contribution in the smart city domain. The SCID framework contents contribute to the smart city literature
G5: research rigor	DSR relies upon the application of a rigorous method in both the construction and evaluation of the design artifact	The SCID framework is grounded in findings from the analysis of concrete cases of ten mature smart city initiatives. The analysis of the cases is based on the clearly defined conceptual model. Policy domains discovered in smart city literature are used to map or streamline initiatives identified in the cases
G6: design as a research process	The search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment	Each major element of the framework was iteratively developed based on the analysis of each of the ten case studies. Subsequent steps of the iteration sought to refine current contents of the framework
G7: communication of the research	DSR must be presented effectively both to technology-oriented as well as management-oriented audiences	The SCID framework has been communicated to the target policy makers uses in a form of a toolkit. This chapter is one of the attempts to communicate the same to the technology and research audience

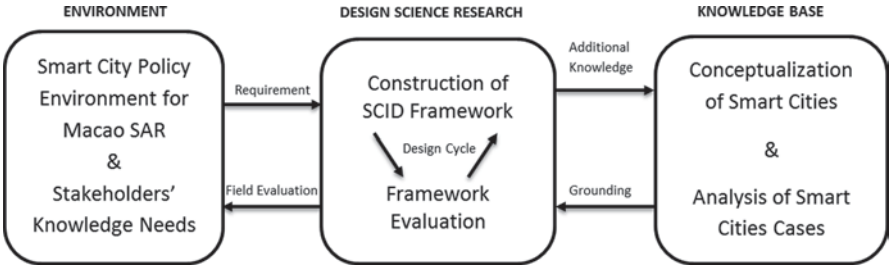

Fig. 1 The research framework. *SAR* special administrative region, *SCID* Smart City Initiative Design

3.2 Design Process

Guided by the framework in Fig. 1, an elaboration of the DSR methodology process model (Peffers et al. 2007), the design process proceeded in the following major steps:

1. Identification and motivation of problems
2. Definition of objectives for the framework
3. Design and development of the SCID framework
4. Demonstration of use of the framework
5. Evaluation of the framework
6. Communication of the framework

As highlighted in Table 2, at least one iteration has been carried out in each step of the process. Further evaluation with larger numbers of users is underway. We have already published the artifact as a toolkit report for policy makers and aim with the current effort to disseminate the outcome of the research as a scholarly publication as part of the activity of the process.

3.3 Selected Cases: The Ten Smart City Initiatives

Given the centrality of the ten cases underpinning the design of the framework (i.e., knowledgebase element of our research framework), we highlight in Table 3 the profiles of the associated cities. The cases were selected based on their maturity, availability of detailed information on the respective initiatives, and to some extent the interest of the target users, i.e., policy makers in Macao.

Table 3 Selected smart city programs

Program name	City	Population
Smart Amsterdam	Amsterdam, Netherlands	783,364 within city urban population of 1,209,419 metropolitan population of 2,158,592
Climate-Smart Malmö	Malmö, Öresund region, Sweden	Third largest city in Sweden with 270,000 inhabitants
Smart City Malta	Malta, Malta	5600 knowledge workers (out of 412,000)
Masdar Smart City	Abu Dhabi, United Arab Emirate	895,000 in 2009
PlanIT Valley	Paredes, Portugal	150,000
Smart City Singapore	Singapore, Singapore	5 million
Smart Curitiba	Curitiba, Brazil	2.3 million, 1.6 million of which live in Curitiba. It is expected to reach 3.1 million in 2015
Smart Songdo	Songdo, Incheon, South Korea	
Tianjin eco city	Tianjin Binhai New Area, China	300,000
Yokohama Smart City	Yokohama, Japan	3.68 million

4 The Smart City Initiative Design Framework

This section presents the details of the SCID framework resulting from the process described in Sect. 3.2. The framework is a solution designed to address the lack of a concrete design framework for smart city initiatives. It specifies major aspects of smart city initiatives and how the initiatives can impact specific policy domains of a city government. The conceptual model in Fig. 2 describes the core aspects of "smart city initiatives" that are of interest and how these aspects relate.

The model was developed based on our analysis of the cases highlighted in Sect. 3.3. In summary, the smart city initiatives have clear objectives that are to be realized through concrete strategies. The initiatives are designed to impact on specific city aspects or policy domains and at the same time realize some larger city transformation outcomes and other outcomes desired by the wider stakeholders group. However, initiatives would have to address environmental factors that may pose concrete challenges and at the same time consider lessons from similar initiatives in the form of catalogued success factors. Managers of smart city initiatives need to identify specific governance and institutional mechanisms to address the challenges and critical factors. An important aspect of the model is the explicit link between the initiatives and the outcomes. This provides a value-oriented perspective to the solutions associated with the framework. The rest of the section describes elements of the framework and related design choices.

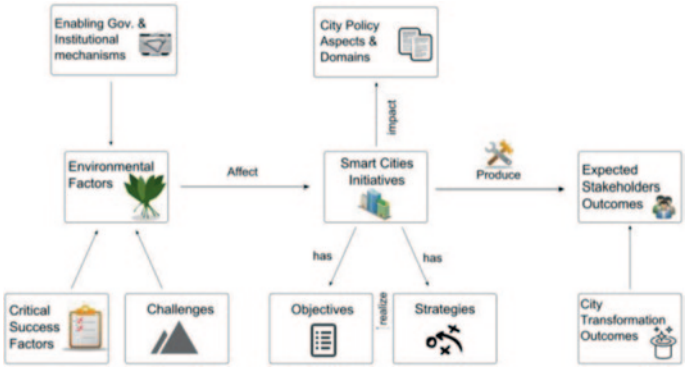

Fig. 2 Conceptual model for smart city initiatives

4.1 Overview

In line with the conceptual model in Fig. 2, there are six major elements of the SCID framework (Fig. 3):

1. *Smart city initiatives*—specific smart-city-related projects or programs to be implemented.
2. *City policy domains*—related set of city aspects to be impacted by the initiatives.
3. *Stakeholders' and sity transformation outcome*—expected impacts on the city as a whole and desired results by wider smart city stakeholder groups.
4. *Enablers*—partnerships and institutional and governance mechanisms required to address critical factors and challenges.
5. *Challenges*—difficulties that policy makers may face in implementing smart city initiatives.
6. *Critical success factors*—set of conditions that significantly contribute to the success of smart city initiatives. Both enablers and challenges contribute to understanding the critical factors.

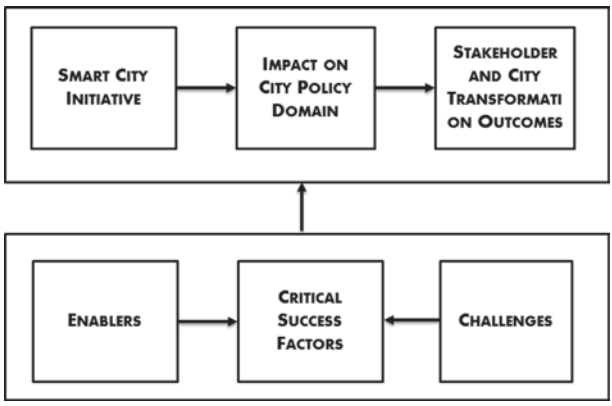

Fig. 3 The Smart City Initative Design (SCID) framework

At a practical level, each element of the framework provides choices for the following policy makers' questions about smart city initiatives:

(Q1) What kinds of outcomes could city residents and other stakeholders desire with regard to transformation of the city?

(Q2) What aspects of the city life should be transformed to achieve the desired outcomes?

(Q3) What types of initiatives can be pursued towards achieving these outcomes?

(Q4) What types of concrete objectives can be set for these initiatives?

(Q5) What factors contribute to successful smart city initiatives

(Q6) What are the common difficulties faced by managers of smart city initiatives?

(Q7) What are the typical mechanisms deployed to address success factors and challenges in smart city initiatives?

4.2 Elements

4.2.1 City Policy Domains

This section provides answers to the question related to aspects of the city life that should be improved to achieve the desired outcomes (Q2). These city aspects correspond to major policy areas for city governments that are usually targeted for transformation within the smart city context. Our findings revealed the following eight primary domains:

- Economy
- Environment
- Energy
- People (intellectual endowment and skills)
- Lifestyle (building)
- Mobility (transportation)
- Technology
- Governance

While smart city initiatives may target a single domain, in general, initiatives would be expected to target two or more related domains. As shown in Table 4, most of the cases provide examples where two or more policy domains are targeted. The table also shows that energy, environment, and mobility are the domains most commonly targeted.

4.2.2 Smart City Initiatives

This section provides answer to Q3, what types of smart city initiatives can be pursued to achieve desired outcomes. The answers are presented in two parts—the objectives of the initiatives and the strategies or mechanisms to realize those objectives.

Objectives of Smart Cities Initiatives Across all cases, we observe that smart city initiatives in general aim at:

Program	Economy	Economy and Environment	Energy	Energy and Environment	Environment	Environment and People	Envi ronment, Energy	Governance	Lifestyle	Lifestyle, Environment	Mobility	Mobility and Environment	Mobility, Governance, Environment	Technology	People
AMSTERDAM			■								■				
MALMO		■	■		■			■	■		■				■
MALTA	■														
MASDA CITY			■		■			■			■				
PLAN IT							■	■			■				
SINGAPORE			■		■			■	■		■				
CURITIBA		■			■	■					■		■		
SONGDO				■	■						■			■	
TIANJIN					■				■	■		■			
YOKOHAMA			■		■										

Table 4 Dimensions covered in selected smart city programs

1. Carbon or O2 reduction and neutrality
2. Achieving energy efficiency
3. Leveraging ICT to develop niche industries such as those relating to multimedia contents or knowledge-based industry
4. Attaining highest-quality living environment for residents
5. Developing green areas within the city
6. Developing accessible state-of-the-art information infrastructure
7. Achieving economic growth and quality of life simultaneously
8. Developing sustainable communities
9. Ensuring social harmony among different groups of residents
10. Evolving the city as living laboratory to foster continued improvements

We show in Table 5 concrete examples of these objectives.

Exemplar Strategies for Major Dimensions Here, we provide examples of strategies to realize the objectives presented above. Complete listings of strategies are provided in the practitioner's SCID framework toolkit document. Below we describe the strategies for the most common policy domains: environment, energy, and transport.

Environment—This dimension is associated with seven categories of strategies including:

1. Water management
2. Open and green space development
3. Material flow and recycling
4. Sustainable city operations
5. Land use planning
6. Sustainable agriculture and natural resource management
7. Waste management

Table 5 Summary of objectives of smart city programs

Program	Purpose
Smart Amsterdam	Focuses on CO_2 reduction, energy efficiency, and behavioral change. Becomes Europe's first "intelligent" city, with an initiative to incorporate a smart grid, smart meters, electric vehicles, and "smart" building design. Reduces energy consumption in commercial properties, public buildings and areas, housing, and transportation. Develops and implements sustainable and cost-effective programs that will help Amsterdam reduce its carbon footprint while exceeding the carbon reduction targets put forward by the European Union's (EU) 2020 emissions and energy reduction targets
Climate-Smart Malmö	Becomes a world-leading climate city and Sweden's first climate-neutral city by 2020 with respect to municipal sector activities. Exceeds EU's energy target of reducing CO_2 emissions by 20% by 2020
Smart City Malta	Transforms the Ricasoli Industrial Estate in Malta into a state-of-the-art ICT and media business community. Facilitates ICT and media employees to develop competencies in niche sectors
Masdar Smart City	To be "smart, green city in the desert" and a model for sustainable urban development regionally and globally, seeking to be a commercially viable development that delivers the highest-quality living and working environment
PlanIT Valley	Aims to build the world's greenest city from scratch and to establish a genuine European alternative to Silicon Valley and a working template for new generation low CO_2 cities. Seeks to integrate companies, education, and government into the urban environment which is a major difference from the technology parks and Silicon Valley campuses. Provides stimulus for the application of advanced technologies in transforming environment and supporting innovation, skills, and education. Aims at savings in both its construction and subsequent operation. It is expected to save 30–40% on traditional building costs and construct buildings 30–50% faster and to a much higher quality. This will also lead to significant savings in operation costs for the buildings based on the use of new materials and designs
Smart City Singapore	Addresses the extreme demand on urban infrastructure. To be an "intelligent island and one of the first countries with an advanced nation-wide information infrastructure" with "interconnected computers in virtually every home, office, school, and factory." Enhances the quality of life and economic growth
Smart Curitiba	Aims at sustainable development and integration of Curitiba's metropolitan region. Addresses a rapidly increasing demand for improving urban services caused by population and economic growth
Smart Songdo	Aims to be an urban living space that is intelligent, green, and self-sufficient, where eco-friendliness and energy savings are key characteristics of the zone
Tianjin Eco City	Aims to serve as a model for future developing Chinese cities that is socially harmonious, environmentally friendly, and resource-conserving. It is designed to be practical, replicable, and scalable, so as to serve as a reference for other cities. The vision is to be "A thriving city which is socially harmonious, environmentally-friendly and resource-efficient—a model for sustainable development." This vision is underpinned by the concepts of "Three Harmonies" and "Three Abilities"
Yokohama Smart City	Addresses urban problems including pollution, traffic congestion, inundation, and solid waste management. Consolidates on post-earthquake and World War 1 reconstruction

Table 6 provides strategies for the environment dimension and the information on the sources of the strategy.

Table 6 Strategies for environment dimension

Initiative	Strategies
Waste management	Waste separation into dry recyclables, wet recyclables, residuals, and solid waste (Masdar, Curitiba)
	Designed to encourage recycling in low-income areas where it was more difficult to reach by the conventional waste management system (Curitiba)
	Involve children in the program by exchanging recyclable garbage for school supplies, chocolates, food parcel (Curitiba)
	Hires retired and unemployed residents temporarily to clean up specific areas of the city where litter has accumulated (Masdar)
	Minimizes the amount of waste, makes reuse and recycling possible, and enables the use of waste and sewage as an energy source (Malmö)
	Construction of waste separation systems in buildings (Malmö)
	Food waste is primarily collected to produce biogas for vehicle fuel (Malmö)
Open and green space	Building a central park as a large 100-acre green space, the city's centerpiece, which was modeled after New York City's Central Park (Songdo)
	Ensures all blocks to connect pedestrians to open space, walking/biking corridors, and public gathering areas (Songdo)
	Design open spaces and public gathering areas are arranged to optimize access to sunlight, views, and open sky (Songdo)
	Provides 40% open space to maximize the connection to nature within the city for residents, workers, and visitors (Songdo)
Material flow and recycling	75% of construction waste is targeted to be recycled (Songdo)
	Recycled materials and locally produced/manufactured materials will be utilized to the maximum extent possible (Songdo)
	Portland cement reduction of 20% or more through the utilization of flash-content concrete (Songdo)
	Low-volatile organic (VO) compound materials incorporated into buildings (Songdo)
Environmental sustainability	Implements the sust. Singapore plan. The key targets are: (1) 35% reduction in energy intensity from 2005 levels, (2) raise overall recycling rate to 70%, and (3) introduce 50 ha of skyrise greenery (Singapore)
Land use planning	Provides a land-use plan that is based on transit-oriented development (Tianjin)
	Creates centers for each district where local and centralized facilities are provided to serve the needs of residents in each neighborhood
	More land will be converted to organic agriculture. Crop-free and pesticide-free zones in the agricultural landscape will benefit biological diversity and reduce the spread of nutrients and toxins into watercourse and groundwater (Malmö)
	Biological diversity will be preserved and developed hand in hand with nature protection and nature management (Malmö)

Energy—Strategies for this dimension include the adoption of energy-efficient practices particularly in building designs, use of renewable energy such as biogas and wind energy by households, use of smart grid technologies, deployment of energy management systems at the community, building at home levels, education of children through projects on how to save energy, and promotion of the use of e-vehicles and hybrids. Table 7 provides the full listing of the different strategies for the energy dimension.

Transportation—Smart transportation strategies adopted by the programs include focusing on accessibility rather than mobility in transportation planning, provision of networks for nonmotorized transportation (bicycles and walking), prioritization

Table 7 Strategies for energy dimension

Initiative	Strategies
Intelligent energy management	Minimizes energy consumption by deploying the best commercially available international energy-efficient techniques and setting stringent building efficiency guidelines (Masdar)
	City is powered currently by on-site renewable energy (Masdar, Malmö)
	As the city grows, it is targeted that at least 20 % of energy supply will come from on-site renewable sources with remaining power sourced from off-site renewable sources (Masdar)
	Develops and tests new smart grid technologies and solutions by integrating modern information and communication technology with the power system to allow two-way communications between electricity consumers and grid operators (Singapore, Yokohama)
	Introduction of home, building, and community energy management systems (Yokohama)
Energy	Compensating greenhouse gas emissions from municipal activities through increased investments in renewable energy (Malmö)
	Testing green tools for cities to adapt to climate change (Malmö)
	Transition from fossil natural gas to renewable biogas and later to hydrogen (Malmö)
	Introduces large quantities of renewables with solar heating (Yokohama)
	Next generation transportation with e-vehicles—charge and discharge Evs (Yokohama)
	Promoting lifestyle change (Yokohama)
	Developing appropriate governance structure (Yokohama)
Sustainable living	Aims to supply 8000 households with renewable energy (Amsterdam)
Sustainable public space	Smart street incubator testing ground for new climate friendly innovations and experiment (Amsterdam)
	Smart school project where children can learn about saving energy (Amsterdam)

parking for fuel-efficient and low-emitting vehicles in public places, use of e-vehicles for public transport with charging stations provided across the city, integration of land use and public fare collection, and adoption of transit-oriented development in urban planning. Table 8 provides the list of strategies for the transportation domain.

Table 8 Strategies for transportation dimension

Initiative	Objective
Smart transportation	Increases accessibility rather than mobility (Curitiba)
	Allows subway line Songdo International Business District (IBD) to run through the center, and expanded city bus service will enhance the easy access to surrounding areas. Incheon International Airport will also be accessible from Songdo via subway and bus service (Songdo)
	Builds 25 km network of bicycle lanes to facilitate safe, carbon-free transportation (Songdo)
	Five percent of parking capacity within each project block will be set aside as parking for fuel-efficient and low-emitting vehicles. Office and commercial blocks will reserve an additional 5 % of parking capacity for car-pool vehicles (Songdo)
	Locates packing underground or under a canopy to minimize the urban heat island effect and maximize pedestrian-oriented open space above ground (Songdo)
	Integrates infrastructure for electrical vehicle charging stations into parking garage designs to facilitate the transition to low-emission transportation (Songdo, Amsterdam)
Transportation	Provides transport within the city including fuel-efficient, electric, or hybrid buses, electric cars, and other clean-energy vehicles (Masdar, PlanIT Valley)
	Private vehicles will be kept at the city's edge in parking lots that will be linked by public transportation to the rest of the city (Masdar)
	Reduces the need for transportation by providing different types of services and recreation (Malmö)
	Advocacy on the use of environmentally friendly mode of transportation by providing diverse measures such as walking, cycling, and use of public transport (Malmö)
	Intelligent traffic system enabling communication between buses and traffic lights for higher priority in getting green light signals (Malmö)
Transport management	Creates a public transport system and integrates effective land-use principles with advanced public transport fare collection (Singapore)
	Integrates higher-density housing and commercial developments with rail transit for greater convenience and accessibility (Singapore)
	Improves transportation-related decision making through simulation of human and commercial activities, transportation, energy use, and impact on the environment (Singapore)

4.2.3 Implementation Approach

This section briefly examines the development and transitional approach to smart cities. There are two predominant approaches to smart city development:

1. Top-down model—requiring that smart cities are planned, designed, and developed based on some blueprints
2. Bottom-up model—involving retrofitting existing cities with smart features

Examples of the smart cities initiatives based on the smart cities approach include the Masdar City in Abu Dhabi, New Songdo in South Korea, and PlanIT Valley in Portugal.

Bottom-up approaches challenges the conventional top-down approach based on the premise that "smart and real cities are not like army regiment marching in lockstep orders, they are more like a shifting flock of birds or school of fish in which individuals respond to subtle social and behavioral clues from their neighbors about which way to move forward" (Ratti and Townsend 2011). In the bottom-up scheme, people or city inhabitants act as agents of change in creating smart cities. With support infrastructure, the populace can tackle problem of energy use, traffic congestion, health care, and education. Residence in a connected community can exploit their distributed intelligence to evolve activities (Ratti and Townsend 2011). The bottom-up scheme for building smart cities involves:

- Relying on smart devices carried by people as sensors rather than relying only on formal systems embedded into infrastructure, e.g., using the traffic function of Google Maps and exploiting peer-to-peer sensory data sharing
- Citizen-to-citizen service delivery, for example, using the Boston 311 application to make a request to the government which could also be responded to by fellow citizens
- Making government private data warehouses, public to empower entrepreneurs, and listening to citizens to frame their own smart city vision

To support the top-down development of smart cities, Zygiaris (2012) presents a reference model for defining the conceptual layout of smart cities and an architecture for linking or interrelating issues of green cities, connected life, intelligent communities, innovation ecosystems, and environmental and social sustainability with urban growth. The reference model identifies six layers:

- Layer 0: the city
- Layer 1: the green city layer
- Layer 2: the interconnection layer
- Layer 3: the instrumentation layer
- Layer 4: the open integration layer
- Layer 5: the application layer
- Layer 6: the innovation layer

The reference mode is similar to the architecture described in the smart city project which integrates three layers corresponding to (1) physical city comprising people, activities, and infrastructure; (2) innovation ecosystem comprising four processes—

Table 9 Summary of desired outcomes from smart city programs

Environment	Aesthetic value Recycling take-up by residents and businesses Green space per residential unit Recognition—ranking and designation as best practice exemplar Adoption of organic food	*Energy*	E-vehicle adoption Level of biogas production Use of wind energy Energy usage reduction Petrol usage reduction
Transportation	Less congestion Less CO_2 emission Self-sustainability Recognition—ranking and designation as best practice exemplar	*Economy*	Standard of living GDP contribution Unemployment rate Investment friendly environment Recognition—including competitiveness Employment and job creation Foreign direct investment Start-ups

watch, learn, innovate, and market; and (3) applications and embedded systems comprising four types of applications—intelligence, e-learning, co-creation, and marketplace.

4.2.4 Stakeholders and City Transformation Outcomes

This section provides answers to Q1 on the type of outcomes desired by stakeholders of smart city initiatives. Recognition as good practice exemplars featured prominently in the reported outcomes by these programs. These recognitions, which are based on benchmark rankings on smart cities, are considered valuable by the different programs. Other outcomes associated with the programs in different areas are presented in Table 9.

4.2.5 Enablers

This section provides answers to Q7 on mechanisms for addressing the success factors and challenges. The core mechanisms including partnerships and governance mechanisms are discussed below.

Partnership for Smart City Programs Smart city programs are complex and involve a wide range of partners and stakeholders playing different roles. The nature of partners involved in smart city programs include: academia (university and research centers), state-owned enterprises, real-estate firms (e.g., Gale International),

architectural practice firms, investment firms (e.g., TECOM investment), engineering construction firms, technology firms (e.g., CISCO, IBM, Microsoft, Hewlett Packard), international consulting firms (Accenture, Mott MacDonald), government departments and agencies, other governments (e.g., Singapore). While some smart city programs are driven by private sector (e.g., in Malta and PlanIT Valley), government entities always play pivotal roles. Table 10 provides examples of the partners for some of the selected programs.

Think-Tank Support At least four of the smart city programs explicitly developed research and development think-tanks to support the implementation of the respective programs—Smart Curitiba, Masdar Smart City, Smart City Singapore, and PlanIT Valley. To support the Smart Curitiba program, an institution was created to support the development of the master plan and the long-term implementation of the master plan. The Masdar Smart City program also works in partnership with the Masdar institute for its research and innovation needs. The Smart City Singapore program collaborates with Nanyang Technological University, while the PlanIT Valley initiative integrates research into its operations based on the Living Lab framework. In fact, the Smart Curitiba program considers research support as a critical success factor.

Governance Governance actions constitute the second category of mechanisms. Four types of governance actions have been identified across studied programs:

1. Coordination and integration
2. Service integration
3. Participation and coproduction
4. Policy and regulations

- Coordination and integration actions in smart city programs include identification of an agreed set of projects by stakeholders across sectors, use of administrative and legal instruments for conformance, and integrated planning practices involving multiple sectors. Service integration approaches included integrated utility management and use of urban operating systems (UOS) in managing and integrating urban services. Participation and coproduction actions include building multistakeholders partnerships with industry, academia, and residents in addition to the participation of internal firms in the development of smart cities. Lastly, policy and regulatory actions include a master plan, institutional development, certification of practices (e.g., buildings), promotional activities (e.g., low carbon growth), and development of framework acts. Specific examples are presented in details in the toolkit (Ojo et al. 2012b). A summary of governance actions are provided in Table 11.

4.2.6 Challenges

This section presents the answers to Q6 on common difficulties faced in smart city initiatives. A number of challenges were identified across reviewed programs.

Table 10 Examples of partners for smart city programs

Program	Partner	Partner type	Partner role
Curitiba	Curitiba Research and Urban Planning Institute	Academia-research institute	Master plan development
	Mayor	Host government	Coordination
	URBS Urbanizao de Curitiba (URBS)	State-owned enterprise	Infrastructure maintenance and oversight on bus companies
Songdo	Gale International	Real estate	Main developer
	Korea's POSCO Engineering & Construction company Ltd.	Private sector	Setting up Songdo international city development (NSIC) as joint venture company in 2002
	Cisco	Private sector	Creates advanced community connected by information technology (IT)
	Kohn Pedersen Fox Associates	Private sector	Architectural design of Sogdo IBD
	Songdo U-Life	Quasi private sector	Building of ubiquitous infrastructures and ubiquitous environment for u-services
Masdar	Masdar Venture	Private sector	Economic diversification via renewable energy
	Masdar Institute	Academia—research institute	Science and engineering of advanced alternatives
	Mott Macdonald	Private sector—engineering firm	Engineering
Singapore	Ministry of National Development	Host government	Plans, regulates, facilitates, and executes development projects
	Urban Redevelopment Authority	Host government	Promotes architecture and urban design excellence
	Economic Dev. Board	Host government	Planning and executing strategies to enhance Singapore's position as a global business center
	IBM	Private sector	Partner on smarter city initiative
	Singapore–Massachusetts Institute of Technology (MIT) Alliance for Research and Technology	Academia—research institute	MIT-supported research in urban mobility system
	Microsoft	Private sector	Software

Table 11 Governance actions to support smart city programs

Element	Action
Coordination and integration	Human-centered approach Identification of an agreed core set of projects Stakeholder involvement Use of administrative and legal instruments Integration of policy implementation in multiple dimensions—transport, land use, road network, etc., or integrated planning
Service integration	Integrated utility management Integrated land use and transport services Operating system or control system for integrating and managing all urban services
Participation and coproduction	Building multi-stakeholder partnerships with industry, academia, and residents Information exchange Citizen or resident participation Local and international firm participation Agency collaboration
Policy and regulations	Visioning and master plan Providing certifications for different types of practices or activities Institutional development License regulations (e.g., in transportation) Promotional activities, e.g., adopting low-carbon growth policies Developing framework acts Design and engineering standards

These challenges include (1) obtaining buy-in from stakeholders, particularly the private sector; (2) inclusion of poor areas in the program; (3) sustaining stakeholders' interests and participation; (4) resourcing and funding the program considering high development cost; and (5) obtaining residents participation. Specific examples are presented in Table 12.

4.2.7 Critical Success Factors

This section presents the answers to Q5—the success factors for smart city programs. Analysis of the success factors across cases show that (1) political leadership and (2) the adoption of integrated, holistic, and whole of government approach to smart city development stand out as critical factors. Other identified factors include (3) creation of dedicated research and think-tank institutions to support programs, (4) non-compromise on core values, (5) ensuring creativity but affordability of solutions, (6) a comprehensive master plan, (7) regulations and standards for stakeholders, and (8) building stakeholder collaboration and industry partnerships. Examples from cases are provided in Table 13.

Table 12 Challenges associated with smart city programs

Program	Challenge	Keyword
Curitiba	Since changing circumstances require new approaches, Curitiba's most important future challenge is to continue cooperation among a wide spectrum of people and organizations in order to foster economic prosperity	Sustained multi-stakeholder cooperation
	Integrating poor areas and shanty towns in city periphery including those not connected to the sewer system	Coverage of poor areas
Songdo	Hard-wired broadband infrastructure makes development more costly for both the city and individual developers, which may translate into more expensive prices for buildings such as offices, residential or commercial	High development cost
	Creating value for the private sector—"for a public sector undertaking, one needs to create value for the private sector to want to be engaged and invest in the real estate"	Value to private sector
	The most difficult part is really the alignment of interests and commitment to a plan on the outset; getting everybody aligned behind it—(in terms of) what is this level of development going to be, how are we going to ensure all our partners live by the guidelines, and what the anticipated outcomes are	Aligning interest parties
Masdar	Global economic slowdown due to the lack of capital and lower prices of oil	Lack of capital
Singapore	How to continue to sustain economic growth and ensure a high quality of life through careful planning	Balanced growth
PlanIT Valley	PlanIT Valley faced many challenges, not least in terms of convincing others that this vision can become a reality	Buy-in from stakeholders
Tianjin	Setting suitable targets for the eco-city and putting in place an effective monitoring system—targets must be sufficiently stretched so that high standards are set and the eco-city can minimize its carbon emissions and resource utilization to the lowest levels achievable. At the same time, due consideration must also be given to local conditions as well as the impact of the higher standards on the cost of doing business in the eco-city	Target setting
	Ensuring that the eco-city is sustainable long after the construction is completed and it can still meet its Key Performance Indicators (KPIs) and continue to provide a pleasant living and working environment for its residents after completion of physical development	Program sustainability
	Effective mobilization of residents to support and reinforce policies and programs and to help meeting its KPIs and making the eco-city the home of choice for its residents. The city must have the cooperation and support of its residents in waste reduction and resource recycling and management	Resident participation

Table 13 Success factors for smart city programs

Program	Success factor	Keyword
Curitiba	Leadership and adherence to smart transportation planning has helped Curitiba strive towards becoming a sustainable city while gaining its strong reputation as a great example of successful urban planning	Leadership and adherence to plan implementation
	Instituto de Pesquisa e Planejamento Urbano de Curitiba (IPPUC) creation was an essential to ensure long-term implementation of city plans. IPPUC was effective in ensuring planning continuity and success regardless of political, economic, and social challenges and made substantial contributions as a laboratory for finding creative, integrated solutions to urban planning problems	Creation of research and think-tank institution
	The combination of core values expressed in the city plan and IPPUC's creation allowed planning for efficiency and sustainability even in difficult circumstances. Commitment to local values such as accessibility, transparency, social justice, and poverty reduction and efficient resource management are what resulted in Curitiba's sustainable development, which is more than simply "environmental"	Non-compromise to core values
Masdar	Collaborate with a range of partners who share the vision and commitment	Collaboration
Singapore	Successful water management program would not be possible without institutional reform, such as the adoption of demand management in the new water tariff setting, i.e., removal of subsidy for domestic users	Institutional reform
	Comprehensive and long-term planning to ensure economic competitive and quality of life at the same time	Holistic long-term planning
	Prudent land-use planning enabled Singapore to enjoy strong economic growth and social cohesion and ensures that sufficient land is safeguarded to support continued economic progress and future development	Prudent land use

5 Discussion

First, we highlight our experience in using the DSR approach in developing the SCID framework. Our experience shows that the method not only enables a clear rigorous process for building the artifact but also enables detailed attention to our targeted users' needs. However, while we set out to use our cases only as a knowledgebase for grounding our artifact, we discovered that the cases were also a rich

source of information on the potential needs of the users and subsequently provided a detailed requirement specification for a framework.

Second, feedback from users revealed that the options provided by the SCID framework are useful and the use of the framework is aligned with their IT management practices in areas such as portfolio management, strategic alignment, and benefits management.

Third, as we argued in Sect. 1, our objective was not to provide, at least explicitly, a prescriptive model but rather offer possible choices as answers to the questions that smart city policy makers have on developing initiatives. Although the users found the options provided useful, rigorous internal evaluation of the tool revealed that there might be a need to better support how specific choices of the options are decided upon with respect to critical success factors and challenges. Specifically, techniques that are used to support decision making in the context of several factors such as the analytical hierarchical process (AHP; Vaidya and Kumar 2006) could be useful for linking the environmental factors and strategic choices offered by the framework.

Fourth, as the SCID framework relies heavily on a knowledgebase of the analysis of initiatives, the effectiveness and freshness of the choices offered by the tool will depend on how it is able to capture new knowledge from emerging and future smart city initiatives. Our current plan is to update the framework periodically as triggered by requests from users. However, we consider for the longer term a more participatory, crowd-sourced, and social approach for the dynamic update of the SCID framework.

Finally, we intend to carry out further dissemination and evaluation of the tool with smart city initiatives managers in the context of an international collaboration program involving smart city practitioners and researchers across cities aiming to develop smart city programs.

6 Conclusions

This chapter has presented, in some details, a framework that has systematically captured the outcomes of the detailed analysis of ten smart city initiatives. Conclusions from the contents of the framework and underpinning findings include:

- Energy, environment, and mobility are focal areas for smart city initiatives, implying strong focus on sustainability.
- While integration of policy domains is the holy grail for smart city design, our study suggests that smart city initiatives primarily focus on one domain and two related domains, such as energy and environment in a few cases.
- Smart city initiatives involve a wide array of stakeholders, including urban development and real estate, ICT, and investment sectors, making the management of their various interests complex.

- The business case of including poor areas in the smart city initiatives is still to make, thus making the phenomenon of "smart city islands in the sea of urban slum" a possible urban reality in some parts of the world.

As a conceptual framework, we have adopted the SCID framework in studying open data programs designed as smart city initiatives. We adopted the major constructs of the framework for documenting these initiatives and analyzing their impacts. In this regard, we found the SCID framework complementary to the smart city initiative framework described in Alawadhi et al. (2012). Based on this experience, we consider the SCID framework as a general tool that could be used in any context as a conceptual instrument. As a practical guide, the framework contents presented in Sect. 4 provide good starting points for smart city decision makers in developing specific objectives and strategies to meet their peculiar city transformation goals. It is plausible to expect that additional enablers, barriers, and critical factors would apply in different environments.

Given the nature of the SCID framework as a knowledge product, its practical usefulness is contingent only on periodic updates based on analysis of new emerging cases of smart city initiatives. Practical approaches to enable such updates in an efficient manner are currently been investigated.

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Smart Cities Are Transparent Cities: The Role of Fiscal Transparency in Smart City Governance

Nina David, Jonathan Justice and John G. McNutt

1 Introduction

Advocates of technology have long promised that new tools would reform government and enhance the quality of the democratic process (Browning 2006). Citizens will receive current information and the ability to cooperate online. This will lead to a renaissance of democratic ideas. Although this approach had its critics (see Davis 1999), and there are those who feel that technology will create a new political horror show that combined increased surveillance with forced compliance, the truth has been far less dramatic. There are certain benefits that technology brings to government, but those benefits are often limited by a variety of factors.

The growth of smart cities should provide the opportunity to take online political participation to the next level. Most conceptions of smart cities include a provision for participatory government. We would argue that a critical corollary to this capacity would be a commitment to online transparency. Many citizens view their government as one of secrecy, backroom deals, and personal interests that run counter to the common good. This has significant effect on the trust in government, political stability, and the integrity of government operations. Greater transparency in government has been an important goal of many reformers over the past four decades from both within and outside the government. The demand for an open government will, most likely, continue with additional force as time goes forward.

Smart cities should be transparent cities. Information technology should facilitate the open government movement in any municipality, especially in a smart community. Although the process of technology diffusion can lead to a more open and transparent government, there are certainly enough instances where that is not true to warrant vigilance. This argues for a system to assess online transparency within smart cities and among smart cities throughout the world. Our chapter facilitates this by discussing issues and a proposed framework for comparing internal differ-

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entiation and differentiation among municipalities. Using fiscal transparency, as a specific illustrative instance of transparency, we discuss data availability, comparison issues, and theoretical ramifications. This builds on our considerable work at the state and national levels (Justice and McNutt 2014; Justice, McNutt, and Smith 2015). Although this is a conceptual paper, we make use of empirical studies of transparency, as well as the available literature on the issue. There have been a number of attempts to evaluate online fiscal transparency, generally as a result of larger efforts to evaluate e-government efforts. Each of these efforts adds to our understanding of the descriptive nature of this type of phenomenon and provides potential dependent variables for explanatory studies. Sadly, many of these investigations yield conflicting results even within the same set of studies. Our chapter provides a robust set of indicators and a substantial framework developing measurement to support analysis, planning, and programming.

2 Smart Cities in a Political World

The growth of smart cities represents a key ingredient in the global information economy. A smart city represents a hub for intellectual activity that fuels the knowledge economy. What is a smart city? For the purpose of this chapter, we use Caragliu et al. (2011) well respected definition:

> We believe a city to be 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.

This definition highlights the systematic use of technology and complementary investments in human, social, and physical capital to promote effective local democracy, to achieve quality of life, sustainability, and economic development as the defining characteristic of a smart city. The role of information and communication technology (ICT)-enabled transparency in fostering participatory governance is our central concern here, but the issues we raise are critical to many of the other components.

The twenty-first century city is neither just the locus of economic, social, and cultural activity, nor a physical agglomeration of buildings and transportation infrastructure constrained by geography (Graham 1996, p. 3). It is also the hub of an increasingly mobile capital, a global workforce, electronic grids, and massive telecommunications infrastructure. This means that cities today face a unique set of challenges that are physical, technological, demographic, social, cultural, environmental, and economic in nature. The moniker of the "smart city" has been used to conceptualize responses to these challenges (Chourabi et al. 2012b). Smart cities have been otherwise called intelligent cities, digital cities, e-topias, and wired cities. At the most basic level, the common denominator for these conceptualizations is the use of information and communication technologies (Al Waer and Deakin 2011). Some scholars have suggested that conflating smart cities with terms such

as digital cities or wired cities is difficult because it limits the discussion of the smart city concept to the use of technology and hence narrows its scope (Hollands 2008). Consistent with this critique, there is a growing normative concern that the concept of smart cities should include more—that smart cities should be smarter. That is, technology should not be seen as an end in itself, but rather as the means to other normative values and ends. Consequently, smart cities have been envisioned as cities that use the intelligence function to address the ecological impacts and equity of development (Deakin 2011); as cities that promote sustainability, livability, efficiency, social learning, creativity, knowledge production, and innovation (Al Waer and Deakin 2011); and as cities that place a premium on coordinating and connecting their physical, economic, social, and technological infrastructure (Chourabi et al. 2012b).

So what makes a smart city smart or smarter? Due to absence of a single definition of the smart city and in an attempt to provide a comprehensive framework for understanding smart cities, Chourabi et al. (2012b) suggest that smart cities focus on at least eight factors for success. These are: management and organization, technology, governance, policy, people and communities, the economy, built infrastructure, and the natural environment. Similarly, Lombardi et al. (2012) propose that the six key dimensions of smart cities include smart economy, smart mobility, smart environment, smart people, smart living, and smart governance. It could be argued that these factors and dimensions form the basis of sustainable communities (Marsden 2008). There is also an increasing amount of consensus that the use of technology alone will not be transformative and that governance is central to all of the factors and dimensions listed above (Al Waer and Deakin 2011; Coe et al. 2001). Of particular importance to this chapter are calls for smart cities to enable better decision-making, increase citizens' involvement in government, and enhance democracy.

Several scholars have attempted to measure the "smartness" of cities (Caragliu et al. 2011). These efforts have spurned indices that serve as benchmarks for smart cities across various dimensions. Chourabi et al. (2012b) suggest that smart cities should be understood using a framework that includes management and organization, technology, governance, policy, people and communities, the economy, built infrastructure, and the natural environment. Each of these components includes several factors. For example, the governance component includes eight factors, namely, collaboration, leadership and champion, participation and partnership, communication, data exchange, service and application integration, accountability, and transparency. Lombardi et al. (2012) suggest that smart cities should perform well on six key dimensions: smart economy, smart mobility, smart environment, smart people, smart living, and smart governance. Each dimension has several factors and each factor is operationalized using several indicators. For example, the smart governance dimension includes three factors, namely, participation in decision-making, public and social services, and transparent governance. These factors are operationalized into nine indicators: city representatives per resident, political activity of inhabitants, importance of politics for inhabitants, female city representatives, expenditure of the municipal per resident, children in day care, perception of quality of schools, perception on transparency of bureaucracy, and perception on

fight against corruption. These factors and indicators have been used to benchmark at least 70 European cities (see Lazaroiu and Roscia 2012). Alternate conceptualizations and operationalizations of the six dimensions proposed by Lombardi et al. (2012) also exist. For example, smart governance has also been conceptualized as local public spending on ICT (measured as % of public administration expenditure on ICT in relation to the budget); website availability (measured as presence of website); strategic plans to promote e-Government and ICT (measured as presence of e-Government action plan); online public services (measured as percentage of services available online, major online services offered by cities, and administration staff that use internet-connected computers); electronic signature (measured as the use of an electronic signature system); transparent governance (measured as institutional information available online to the public); e-democracy (measured as use of online platforms for citizen participation and electronic voting); and promoting ICT and innovation (measured as the organization of ICT and innovation-related events) (see The Committee of Digital and Knowledge-based Cities of UCLG 2012).

We have argued that the governance of smart cities should emphasize the creation and consolidation of knowledge; the equal and widespread dissemination of knowledge; and deep meaningful engagement. We have also posited that inward and outward transparency (ex ante and ex post) are important for democratic city governance. Finally, we have focused on three key aspects of the definition of the smart city: investment in human and social capital, ICT infrastructure, and participatory governance. Indeed, several e-governance instruments could be used to advance the above mentioned principles and open up channels for communication, participation, inclusion, deliberation, accountability, and transparency. The technology-based tools being developed can increase social and intellectual capital, allow deeper engagement, promote two-way communication, and could be used to enhance both ex post and ex ante participation. These instruments also allow us to go beyond information dissemination (e.g., online presence) and direct attention to the interactive, transactional, and transformative aspects of e-governance (see Evans-Cowley and Conroy 2004).

Political Participation and Smart Cities Smart cities, like all urban areas, are political institutions and their success at least partially depends on their success in negotiating the political challenges that they face. Ideally, this means a system that encourages meaningful participation of all components of the public. In traditional community politics, matters are handled in face to face encounters aimed at resolving differences. Urban politics has always had the reputation of being competitive and less than transparent or participatory.

If smart cities are to become more participatory in the way that they are governed, what would that look like? Political participation depends on a number of factors that limit or encourage how people are (or are not) involved in the political process. These include education, social status, and civic skills and so forth (Verba et al. 1995). Some factors predict who will be involved, while others suggest how successful they will be. As political participation began to move online, there is evidence that many of these factors continue to be important. In a 2008 study by Smith,

Verba, Schlozman, and Brady, data suggested that those who participate off-line are also those who participate online.

We might expect that in a smart city, technology would facilitate the political process. Technology has long been a part of political participation and the growth of new technology and new ways to apply technology to political tasks has only grown (McNutt and Boland 1999; McNutt and Menon 2008). The social media/web 2.0 revolution provided a great many tools to facilitate deliberation and coordinate action. Facebook, Twitter, and Blogging are commonplace political tools. In addition, designed for the purpose political tools are emerging in substantial numbers.

Citizens of a smart city, particularly knowledge workers, will be more likely to use the Internet to connect with their government and with other citizens. This means that they will expect a government that facilitates this type of access.

Governments have developed specific platforms that include citizens in budget deliberations and other types of decision-making. Participatory budgeting is one such effort. Other efforts, under the general rubric of civic technology, are developing daily. Many of these potential applications will require a ready source of information if they are to remain effective.

3 Smart Cities and E-governance

Concurrent to the development of scholarly work on smart cities, a body of literature focusing on e-governance including digital, cyber, and virtual governance has also emerged (Evans-Cowley and Conroy 2006; Nijkamp and Cohen-Blankshtain 2013). The smart city and e-governance approaches share several common principles. First, is the emphasis on the creation, accumulation, and consolidation of knowledge. This intelligence function allows cities to better assess and monitor existing conditions (e.g., transportation infrastructure) and plan for the future. Recent interest in "big data" has spurned several municipal level projects in the USA that are aimed at structuring data to enable better decision-making (e.g., the Delaware Valley Regional Planning Commission, Office of Policy and Strategic Planning of the City of New York). This intelligence imperative also allows cities to pool together collective knowledge from a variety of sources, therefore, optimizing interdependencies among municipal and regional agencies.

Second, both approaches promote the sharing and dissemination of knowledge in a variety of forms to a variety of people thus integrating knowledge and technology. Knowledge transfer would help educate citizens about the complexities of municipal problems (e.g., crime data) and the resources available to address those problems (e.g., municipal budgets). The understanding is that the creation of intellectual capital would ease citizens' access to services and help municipal governments deliver better services to citizens. The dissemination of knowledge could also aid in the creation of knowledge networks, pooling of resources, and the sharing of best management practices and solutions across municipal agencies and municipalities (Hollands 2008; Nijkamp and Cohen-Blankshtain 2013). Although there are concerns that the

concept of the smart city might be used as a superficial marketing ploy, the dissemination of knowledge itself could be used as a powerful economic development tool (e.g., business recruitment) (Al Waer and Deakin 2011; Harvey 1989). In sum, the dissemination of knowledge liberates it from the hands of a few and creates a "shift in the balance of power between … business, government, communities, and the ordinary people who live in cities" (Amin et al. 2000 as cited in Hollands 2008 p. 315).

Third and finally, both the smart city and e-governance approaches emphasize interaction, participation, and democracy. The understanding here is that the dissemination of information cannot be unidirectional and that citizens should be empowered to communicate and engage with their government. Opportunities for interactions might be transactional (e.g., e-commerce); administrative (e.g., permit applications, and complaints); and participatory (e.g., discussion boards, and surveys). Both transactional and administrative interactions make it easier and more flexible for citizens to receive government services (e.g., paying a fine online rather than in-person). Coe et al. (2001, p. 92), however, call for a "deeper engagement" where the "real smart city [uses] information technology to enhance democratic debates about the kind of city it wants to be and what kind of city people want to live in" (Hollands 2008, p. 315). For this to occur, smart cities need to expand e-governance options from monologues where planners or government officials provide information to citizens to mutual discourse where citizens and officials engage in two-way communication. In fact, research shows that citizens are demanding more such meaningful communication opportunities of their local governments (Evans-Cowley and Conroy 2006) and there is enough evidence to suggest that citizen participation offers real benefits (see, for example Fung 2006; Gonçalves 2014). For example, citizen participation can enhance policy implementation, increase buy-in, minimize potential conflicts, create social capital, and improve policymaking (Conroy and Evans-Cowley 2004).

Smart cities, therefore, are cities that use technology to promote overall sustainability. If sustainability is defined as achieving the right balance among environmental, economic, and equity goals (see Campbell 1999), then governance plays an important role in finding this balance. Smart cities, therefore, promote smart governance and this smart governance should be transformative. In this regard, smart cities emphasize three principles: the creation and consolidation of knowledge; the equal and widespread dissemination of knowledge; and deep meaningful engagement. We argue that transparency is at the core of the above three principles and that smart cities are transparent cities.

4 The Role of Transparency

Access to information is a key ingredient in how effective participation might be. Information asymmetry places participants at a relative advantage or disadvantage in the political arena in much the same way that it does in the economic marketplace. This means that to some extent the quality of information shared by the participants

in the political process will predict how successful they can be. This is the reason for having a free press and an informed citizenry. In the past few decades there has been growing concern about governmental transparency and a number of efforts to make various aspects of government more transparent.

Political Applications Lobbyists, community organizers, political fundraisers, and activists of any stripe make liberal use of information in their work (McNutt et al. 2013). Social change organizations develop some research on their own, but make substantial use of government information. In a recent study of advocacy organizations, Delaware et al. (2013) found that many organizations reported doing their own research, but relied on information collected by others for other efforts.

Private citizens also make use of transparency information. In this era of emerging technology-enhanced leaderless activist organizations (Earl and Kimport 2011; Brainard et al. 2012; McNutt and Boland 2013) citizens are bypassing traditional advocacy organizations and creating their own efforts. This is the next face of activism.

Journalists, of course are highly depended on government information. This is especially true of investigative researchers. This, of course, suggests that transparency is the foundation of a free press.

Corruption In addition to all of these issues, transparency is a major tool in the attempt to fight corruption and other types of illegal or questionable activity. Corruption reduces trust in government and discourages political participation. There is also evidence that corruption reduces investment, which stymies economic growth (Mauro 1995).

Transparency is central to good governance. In a smart city, with a commitment to participatory governance, it is especially critical. Although there are multiple types of transparency, probably the dominant issue for local and municipal government is fiscal transparency. This looks at how money is spent, by whom, and for what.

5 Fiscal Transparency

Fiscal transparency means understanding where the money flows occur in government and what choices that implies. If you want to understand what government does and what it values, it is essential to be able to follow the money. Having adequate financial information is also necessary to curtail corruption and other types of governmental misconduct. The rise of e-government has led to efforts to move financial information online. This should theoretically increase ease of use and availability. Unfortunately, that is not always the case. Although government entities often provide financial information online, that disclosure is not always timely, complete, or designed to promote meaningful citizen engagement and participation. Information may be provided only to meet legal mandates or bond-market needs, with contents and formats oriented to those specific requirements and experts rather

than the needs of the general public or interested nonfinancial publics. Information is not always made available in formats that take advantage of the online medium and contemporary ICT tools. For example, comprehensive annual financial reports (CAFRs) and budgets are often posted as large, single PDF files, and cities have been slow to publish the underlying financial information using machine-readable data formats such as XBRL.

Advocates of online fiscal transparency have proposed a system called Transparency 2.0. This type of transparency would present information to the public that is comprehensive, one-stop, one-click budget accountability and accessibility (Baxandall and Wohlschlegel 2010). This is the current level of online financial transparency that many governments are attempting to achieve. Since assessment is intimately related to programming, developing excellent measures is a precursor to create adequate programs.

6 Smart Cities Transparency Framework

Transparency has primarily an instrumental or facilitative value in public affairs. Although titillating details of the private lives of celebrities and politicians may be enjoyed for their own sake—at this writing, for instance, we are enjoying revelations concerning French President Francois Hollande's love life—that titillation is not a central goal of public governance (the French public and policy makers are not basing governance decisions on that information). For urban governance, we value transparency to the extent it results in the availability of timely, correct, and usable information that enables public officials and members of the public to know about governments' plans and performance, communicate among themselves about those plans and performance, and make better governing decisions accordingly. To take a familiar example, members of the general public might vote to retain an office-holder whom they credit for good performance or replace one whom they blame for poor performance. Members of narrower, interested publics might choose to take more immediate, direct action to intervene in support of or opposition to disclosed governmental plans as well as past performance.

Transparency may also often be of value for promoting another instrumental value of governance: accountability, by which we mean broadly the habit of any public or private actor of taking into account—consciously and/or unconsciously—when choosing how to act the likelihood that other actors will observe and react to her or his behavior (Justice and Miller 2011).[1] In urban governance, transparency thus can foster accountability by increasing the degree to which public officials' choices and behavior, and the consequences of those choices and behavior, will be observed by

[1] This definition of accountability is meant to avoid the synecdoche of identifying retribution for misdeeds or failures as constituting "accountability" as well as the common but not always correct normative presumption that accountability is always a beneficial force leading to better governance (see for example Dubnick 2005).

other officials, citizens, and watchdog organizations. Additionally, the accountability-promoting effects of effective "inward" transparency that facilitates citizen's knowledge of decisions and actions by city officials and agencies can be enhanced by effective "outward" transparency that facilitates officials' knowledge of citizens' needs and expectations (see Heald 2006, for the taxonomy of transparency).

Recalling Caragliu, Del Bo, and Nijkamp's (2011) definition of a smart city, we can articulate a simple framework for understanding the role of transparency in the governance of smart cities particularly. In particular, we focus here on three elements in that definition: investment in human and social capital, ICT infrastructure, and participatory governance. Our framework begins with the observation that the value of meaningful e-transparency to smart cities is in the systematic use of communication infrastructure to facilitate the mutually reinforcing development of participatory governance and human and social capital.

Figure 1 depicts graphically the facilitative role of ICT investments for supporting transparency and communication to foster mutual learning by citizens and officials, accountability, and participatory governance. These investments in human and social capital, in turn, can promote good governance and the high quality of life and sustainable economic growth identified by Caragliu, Del Bo, and Nijkamp as defining features of smart cities. It should be noted that this chain of causation represents a potential set of relationships, rather than a guarantee. In particular, ICT and other means of communicative interaction must be inclusively and adroitly employed to create transparency that is *effective*: conveying information that is timely, accurate, audience-appropriate, and decision-relevant (see Heald 2003). Any quantity or quality of transparency might result in some form of mutual learning, accountability, and participation, but ineffective transparency is likely to lead to incorrect or

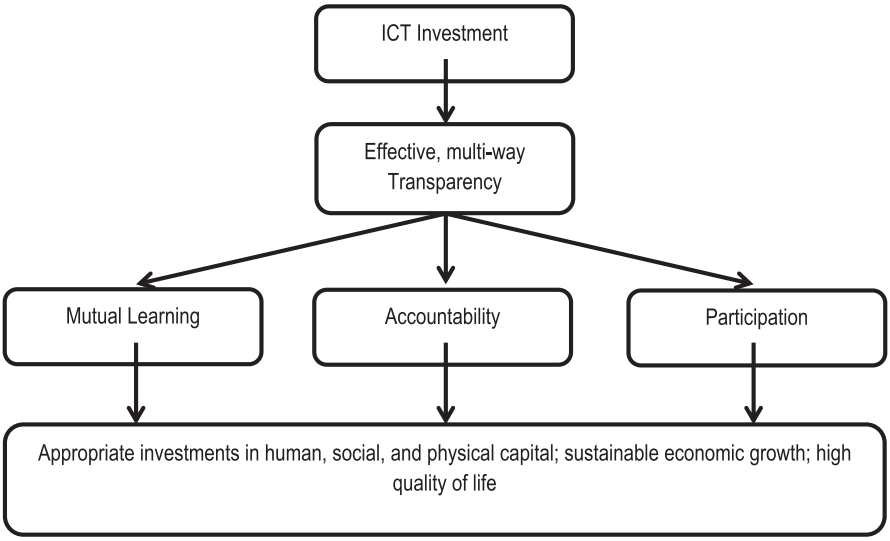

Fig. 1 Transparency as a key intervening variable for smart cities

ineffective learning, misdirected accountability, and participation that is less likely to lead to the desired quality-of-life and economic-development outcomes.

Models of Democracy and Types of Transparency Viewing human and social capital and participatory governance as mutually constitutive implies a primarily developmental model of democratic governance. From a developmental-democracy perspective, participation is desired both as an end in itself and as an institutional arrangement that builds human and social capital by providing citizens with the experience of collective self-governance (see Held 2006). Transparency can serve this purpose to the extent it involves making information available that in its quantity and quality facilitate active and knowledgeable involvement of citizens in public decision-making.

An alternative view of democracy in Held's scheme is the protective model, in which representative and participatory institutions are seen primarily as means to preserve the rights and interests of citizens.[2] Transparency is equally important for the protective aspects of democracy, but the quantity and quality of information required might be expected to differ somewhat, as we will elaborate below, because transparency's primary direct role in protection is to make it possible for citizens to know correctly and soon what their representatives have done, so that they can respond accordingly (hold officials accountable). There is also likely to be some indirect effect on protective democratic purposes of transparency via accountability: public officials who expect citizens to have access to and to react to timely and accurate information about official actions will behave in ways that anticipate that prospective disclosure to and reaction by their constituents.

Transparency itself also needs to be understood as a phenomenon that can exist in manifold forms, and in different quantities as well as to varying degrees of quality within each form (Heald 2006). For present purposes, we begin with Heald's (2006) distinction between inward transparency, the ability of external stakeholders to know what is going on within an organization such as municipal government, and outward transparency, the ability of municipal officials to receive communications from and intelligence about their constituencies. Timing is another relevant dimension of transparency. Retrospective, ex post transparency involves communication of actions and decisions already taken, and can be distinguished from the prospective, ex ante, communication about expectations, plans, and proposals. For either ex ante or ex post transparency, time horizons may vary from a periods of many years to periods of only a few days or less. A third major dimension involves the level of analysis for information. In terms of specifically fiscal transparency, information

[2] Although Held's analytic distinction between protective and developmental goals of popular self-governance is useful for current purposes, neither Held nor the current authors would claim that all actually existing systems of representative government or specific mechanisms and institutions within those systems cannot serve both purposes. For example, participatory budgeting in Porto Alegre and other Brazilian cities appears to serve both protective and developmental ends, by developing human and social capital as well as directing public capital investment in ways that more effectively serve the health and economic needs of low-income communities (see Fung 2006).

Table 1 Models of democracy and types of transparency

Types of transparency	Models/functions of democracy	
	Protective	Developmental
Inward, ex ante, macro, long-term strategic	++	++
Inward, ex ante, medium-/short-term service and fiscal plans	++	++
Inward, ex post, performance and financial reports	++	++
Inward, ex post, micro-level payment and service disclosure	++	
Outward, ex ante[a]	++	++
Outward, ex post[a]	++	+
Interactive	+	++

[a] For developmental approaches in particular, intentional communicative outward transparency that relies on knowing and voluntary supply of facts, values, and reaction by citizens to officials is necessary. Intelligence acquired by officials about citizens' behavior and preferences, but without the knowledge or express consent of citizens might well serve protective democracy (although it can just as easily undermine protection, as contemporary Orwellian events strongly suggest) but is not inherently a means toward the developmental ends of democracy

and analysis might focus on macroeconomic plans or government-wide financial results, or it might focus on payments made by and to individuals by a municipality.

Given the reality of bounded rationality and finite human time and attention (Simon 1978), then, the design of effective transparency, accountability, and participation requires attention to the timing, level, and direction dimensions of transparency as well as to ways in which applications of ICT advance or hinder inclusion and meaningful participation in a particular context. Table 1 summarizes a framework for understanding what broad types of transparency are likely to be useful for advancing the developmental and/or protective functions of democratic city governance. Inward transparency at all levels of analysis and generally would be expected to contribute significantly to the protective functions, by making it possible for citizens to know what their representatives plan to do and what they have already done. For developmental democratic purposes, information about plans and performance in all time frames at macro levels of analysis is valuable. Microlevel disclosures of payments to vendors, employees, and subsidy recipients of the type reported in online checkbooks, however, are not likely to be important information for promoting human and social capital through participation (unless they serve to mobilize otherwise passive citizens). Outward transparency, both ex ante and ex post, provides a valuable complement to inward transparency for protecting citizen rights and interests, making it possible for citizens to make known to public officials their preferences and their evaluations of officials' plans and current and past actions. For developmental purposes, ex ante outward transparency, facilitating involvement of citizens in decision-making, is of greater importance than ex post outward transparency. Finally, the fullest development of citizen capacities through participatory governance requires interactive communications. Interactive transparency will also serve the ends of protective democracy, but seems less frequently critical for that function.

Two of the dimensions of Fung's (2006) democracy cube are particularly significant to understanding the nexus of ICT, transparency, accountability, and participation that defines a smart city. Given the reality of the digital divide and other variations in individual interests and capacities, (1) the inclusivity of participation and access to information, and (2) the level of knowledge and effort required to participate effectively may vary significantly and interdependently as functions of design choices about how to employ ICT in efforts to foster transparency and participation.[3] ICT can make access to information and participation in decision-making communications more convenient for citizens and officials who have access to the technology and are comfortable using it. ICT can make complex data searchable, sortable, and summarizable, so that technology-fluent generalists can more readily make sense of large volumes of specialized information. Yet none of this will make information or participation more inclusive of citizens who lack access or skills to make use of ICT, so that exclusive reliance on ICT for transparency might ironically make a city less smart. Even for the ICT-fluent, the specific choices cities make about what data and what analytic capacities and levels of detail to make available, and when, will shape the decision-usefulness of the data and ICT tools.

If we seek to know whether cities employ ICT and associated institutional design to foster effective transparency, learning, accountability, and participation in ways that are quantitatively and qualitatively sufficient to qualify them as genuinely smart cities, then measurement efforts must also address the proper criteria. In the next section we will review some current measures of fiscal transparency.

7 Measuring Transparency: Current Efforts to Assess City Level Online Transparency

Although there is a substantial number of efforts designed to assess online government, only few focus on transparency. Two of the more notable efforts are reviewed below. Each of these is a comparative/quantitative national study of municipal online usage.

PIRG Transparency in City Spending Study This quantitative comparative study, conducted by the Public Interest Research Group (PIRG) (Davis et al. 2013), uses an updated version of PIRG's Transparency 2.0 index measure to evaluate and rank the fiscal transparency of the 60 largest cities in the USA. It does not include smaller cities or international cities. This is the only major study dealing with online fiscal transparency that is readily available.

PIRG's evolving work on the Transparency 2.0 construct offers a useful illustration of the complexities of what transparency means for smart cities, as for any type of public organization. From its first use in a 2010 study of fiscal transparency among U.S. state governments through the 2012 ranking of state-government trans-

[3] The third dimension of Fung's (2006) cube is how authoritative the decisions of participants are.

parency portals, PIRG's index was heavily weighted to allocate points for making available detailed, searchable information about "who gets what, when and how" from state governments through contracts, other disbursements, and economic-development subsidies (Justice, McNutt, and Smith, 2015). Various aspects of the disclosure of vendor payments added up to more than 70 of 100 total points each year, and tax expenditures and economic-development subsidies another 20 points. The provision of other information and the use of a state's online checkbook site to facilitate two-way communication between officials and external stakeholders accounted for only five (in 2010) to eight (in 2011 and 2012) of the 100 total index points. These iterations of Transparency 2.0 thus focused on a notion of transparency as retrospective, microlevel disclosure of direct and indirect financial distributions with no concern for prospective fiscal choices as embodied for example in budgets or for organization-level retrospective reporting.

The 2013 PIRG large-cities analysis, by contrast, uses an index that implies a significantly broader conception of Transparency 2.0. This fourth iteration of the index still emphasizes disclosure of direct financial distributions (44 points: 34 for vendor payments, 10 for tax expenditures). But it also factors into account more fully, or with more balance, the other dimensions of fiscal transparency, allocating 25 points for posting a file of the city's adopted budget (macro-level, near term), 16 for posting files of prior-year budgets and CAFRs, and 15 for facilitating two-way communication in the form of citizen service requests and for promoting accessibility of information by using a central fiscal-transparency portal.

Rutgers E-Government Studies The quantitative comparative studies conducted by Rutgers University's E-Government Center treat a range of cities in both the USA and internationally. They evaluate five sets of factors including: (1) privacy/security, (2) usability, (3) content, (4) services, and (5) citizen and social engagement. The international Municipalities Study (Holzer and Manoharan 2012) looked at 92 cities for these criteria. The corresponding US Study examined 101 cities (Holzer et al. 2012). Neither study deals with transparency directly but they do assess the technology backdrop of city level government.

Critique of Current Efforts Most of the efforts we reviewed shed at least a little light on the state of online fiscal transparency but subject to a number of limitations of validity and reliability. As we move to a more robust measure, there are several issues that need to be considered. These are prevailing problems that are not likely to be easily solved. Some measures have not been repeated, so that it is difficult to use them to assess improvements (or lack thereof) in transparency over time. Others have been repeated but with changes of instrumentation between measurements. Perhaps most challenging in terms of both validity and reliability of measurement is the complex, purpose-, and audience-specific natures of the e-fiscal transparency construct itself.

Changing Criteria Versus Hitting a Moving Target Perhaps the most serious barrier to research assessing fiscal transparency is the longitudinal stability of the available data. Ideally, in a comparative study, the data is stable from period to period.

Even then, there are multiple threats that can compromise the potential relationship (Campbell and Stanley 1963). Widely differing criteria make comparisons risky or impossible due to what Campbell and Stanley (1963) refer to as instrumentation. Although this seems basic and easily attainable, there are some barriers that are important to note.

First, there are the obvious issues related to method choices. Every research decision is a series of tradeoffs between idea and less than ideal options (see Babbie 1989; Kerlinger 1986). After the data is collected, it is occasionally evident that better choices can be made. If the problems are serious enough, the costs of the revision outweigh other costs. This situation often rears its head in exploratory research situations where the underlying phenomena are less well understood. This makes decision-making difficult by introducing more uncertainties into the mix.

A related situation exists when the phenomena of interest are constantly changing. This is common when dealing with technology and emerging policy issues. Technology changes at an ever accelerating rate. This means that the most common standards of use at one point might be completely obsolescent at another. As technology improves, this interval becomes shorter and shorter. This places the researcher in the position of measuring phenomena that is constantly changing. Add to this the volatile nature of the policy arena in the transparency/open government arena and the problem becomes all the more serious. In a sense, this is an issue in most longitudinal research. This is particularly true in educational and child development research. There is a large body of experience that guides researchers in what changes to anticipate and what types of problems to expect. Unfortunately, that experience does not apply to our particular case.

Because of the newness of the technology and political volatility the barriers are higher than in other arenas. It is also difficult, given the relatively brief experience of these policies, to accurately anticipate changes that might be considered predictable.

State Versus Local Government

Much of the current US e-fiscal transparency research looks at state level transparency although there is a growing amount of local government oriented transparency research. As anyone who studies state-local arrangements knows, the relationship between states and lower levels of government is often problematic. Information sharing is one of those areas where, for multiple reasons, there are issues and barriers. Local governments are reluctant to share certain information and in other cases, they lack the financial or programmatic wherewithal to accurate data. Where state data starts out at lower levels of government, there are multiple issues ranging from inaccuracy, to reluctance and eventually to deception.

Compliance versus Ease of Use

Citizens and organizations use government Information for a variety of purposes including planning and programming, advocacy and lobbying, creating legislative and electoral campaigns, and so forth. Data becomes information when it is processed to make it understandable and to support conclusions. Data processing is foundational to data analysis. If you cannot manipulate the data you analyze it so anything that makes this more difficult slows or stops the entire process. Sometimes

what transparency means is providing the needed information in such a way as to make data use close to impossible. In addition to making the data unusable, governments can impose high user fees which make the cost of accessing the data prohibitive. The data is still available, but for individual citizens and small advocacy organizations it can be out of reach.

Unknown Data Quality
Government data quality is dependent on the quality of the record keeping and reporting (Babbie 1989). This varies widely among governmental units and at different points in the process. Data that was correctly created can be corrupted in the reporting and cataloging process.

Indexes Versus Scales
The indexes underpinning all of the studies that are discussed here are examples of composite measures. A composite measure combines indicators of a concept in some fashion. The principle way that information is organized in these studies is the creation of an index. Indexes differ from scales in that scales have an intensity structure. Scales are generally unidimensional (although multidimensional scaling is an important approach). Although scales are harder to construct, they represent a movement forward in methodology. They offer a more sophisticated approach to measurement and commonly provide more information. We have probably reached the point in studies of online transparency where scale development is warranted.

These barriers and issues make the development of any generally acceptable measure difficult. The workarounds that facilitate other measurement systems have yet to be developed. To drive the field further, a new approach may be needed.

8 Building Stronger Smart Cities by Ensuring Proper Measurement of Online Fiscal Transparency

It is clear from this discussion that smart cities need to be transparent cities. It is also evident that current approaches to measuring fiscal transparency are not achieving the needed results.

Creating Better Measurement Options Transparency needs to be understood as a phenomenon that can exist in manifold forms, and in different amounts as well as to varying degrees of quality within each form. For present purposes, we begin with Heald's (2006) distinction between inward transparency, the ability of external stakeholders to know what is going on within an organization such as municipal government, and outward transparency, the ability of officials to receive communications from and intelligence about their constituencies. This suggests a number of dimensions that must be considered in developing new ways of measuring fiscal transparency in the smart cities context. These include level of analysis, timing, time horizon, qualitative dimensions, quantitative dimensions, accessibility, and a hierarchy of needs.

Level of analysis refers to decisions about what we study. Is it individuals, departments, governments, or even larger units? These choices have important consequences for complexity and data costs. They can also have real significance for the usefulness of information.

Timing is another critical dimension. When do the measurements occur and are they predictable? Do they measure the phenomena before or after it occurs? A related concept, time horizon looks at the interval between measurements. If the interval is too long, it can obscure critical information.

The kind of data used to measure transparency is also important. Quantitative data (documents, data sets, data points available, etc.) can complement qualitative data (accuracy, timeliness, context, etc.) to paint a picture that is both useful and accurate.

Accessibility is critical if transparency information is to have the desired effect on governmental efforts. This can mean access, content, and format appropriate to the audience and usability, including machine-readability and provision of metadata. Heald's effective versus nominal transparency is an important consideration here.

Finally, a hierarchy of needs approach is needed in creating new measures of online fiscal transparency. In a given situation, some information is clearly more important and more relevant than others. As situations change, needs for data change.

Although there might be a relationship between general efforts at transparency/open government and economic development (Gurin 2014), there is very little work on the economic impact of fiscal transparency. Does greater transparency lead to better or less expensive government? There are methodological and conceptual challenges to such analysis, but it would move the discussion forward in a substantial manner.

Then we can understand the origin as well as the evolution of the "Transparency 2.0" construct as it applies to smart cities. We should set Transparency 3.0 as a goal for truly smart cities—design to promote active development, through practice, of citizens' capacities and social capital.

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Evaluating the Performance of Smart Cities in the Global Economic Network

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1 Introduction

In this chapter we explore the crossover between Smart City and World City Network literature. Because a more substantiated definition of smart cities is urgently required (Hemment and Townsend 2013), we argue that this crossover can contribute to the theoretical and empirical development of smart city literature. A tentative bridge between the two literatures can be found in treating smart cities as multilayered territorial systems to maximize their problem solving capacities (Komninos 2002, 2006). Where smart city literature generally defines the social, economic, technological, political, and environmental characteristics that make a particular city smarter than others (Caragliu et al. 2011, World City Network literature stresses that the success of a city is conditional to its relative position within a worldwide economic network, e.g., trade or financial flows between cities (Alderson and Beckfield 2004). The higher the city's rank, the more stable its economy, and the more likely investors will continue to invest in the future. In other words, the more economically connected a city is to other cities in the network, the higher will be its resilience. In network studies, this characteristic is known as "preferential attachment" (Barabási 2003), and means that, for instance, a highly connected city

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like Shanghai, has a stronger future probability of attracting international firms, than a less connected city like Nairobi. Analogous to the smart city literature discussed above, a city's network strength in the world economy is attributed to its social, economic, technological, political, and environmental location factors (Kitson et al. 2004; Wall and Burger 2013). In this sense, both theories argue that a city's performance in the world is related to the level of its urban characteristics, such as business, people, governance, mobility, health, and living.

Based on this reasoning, we hypothesize that if a city gets smarter than its peers, then it will eventually also hold a stronger position within the global economy. Therefore, we argue that the regional and transnational positioning of cities is conditional to being smart, and where the building of dense and diverse economic network relations becomes essential. A similar argument can be found in the PricewaterhouseCoopers report "Cities of the future: global competition, local leadership" (2005), which states that today it is essential "to create smart cities with global linkages and sound sister-city exchanges and goodwill." Hence, we posit that to survive fierce global competition, smart cities must become relatively more connected to the outside world. To test these assumptions, we carry out geographic and statistical analysis, using on the one hand foreign direct investment (FDI) data between smart cities and other cities of the world; and on the other hand, already available smart city indicators. In this way we try to uncover the network and urban characteristics of smart cities and make recommendations how to improve their competitive position in the world economy. Prior to the statistical analysis, this chapter will start off with a comparison of smart city, world city network, social network, and economic network theory, followed by the methodology, results, and conclusions.

2 Chapter 1

2.1 Smart City

The smart city ideal is sought after by an increasing number of cities that de facto develop policies and strategies to boost smart city development, paradoxically, in absence of a clear definition (Hollands 2008). In this light, The Economist (2014) recently launched a debate on the concept of smart cities, in which various ideas are challenged in the quest of a definitive definition[1]. So far, considered definitions have been, the role of technology in linking people and institutions (Belissent and Giron 2013; IBM 2013; Nam and Pardo 2011; Coe et al. 2000); the importance of human capital in bridging the gap between education and productivity (Florida and Mellander 2012; Storper and Scott 2009; Shapiro 2005); and the need for greater environmental consideration in city planning (Fitzgerald 2010). Most of these

[1] http://www.economist.com/debate/days/view/1044

definitions are based on standard indicators, such as education levels, creative class, mobility, Information and Communication Technology (ICT) and environmental quality, (Caragliu et al. 2011). These definitions, however, cannot be distinguished from the fundamental needs of most cities to survive the contemporary world order, and therefore cannot be seen as entirely unique. Essentially, there is a strong need for a more academic definition and explanation, supported by empirical evidence of what makes today's cities smart (Hemment and Townsend 2013).

Today, the most empirical smart city definition can be found in the European smart cities research conducted by TU Delft, TU Wien, and the University of Ljubljana in 2007[2]. In this study, the authors explain that through globalization, the changing forces of production, distribution, and consumption have substantially affected city development, resulting in transnational network economies (Thornley 2000). These economies connect large, medium-sized, and small cities together into a complex network that encompasses the entire globe. Nonetheless, the authors explain that the focus of most urban research is particularly on "global" metropolises. This is because most economic ties are directed at powerful cities like Shanghai, Hong Kong, Singapore, London, and Paris. These cities, by virtue of their size, critical mass, resources, and organizational capacity, make it difficult for medium-sized cities to compete with them. Interestingly, the authors argue that in order for these cities to compete in the world economy, they will require additional effort in the form of smart thinking (Giffinger et al. 2007). This, they explain, means that medium-sized cities will have to identify strategic strengths, and ensure comparative advantages in certain key resources. Based on this premise, the authors selected a sample of 70 medium-sized European cities, based on the criteria of population counts, and that they are covered by accessible and relevant databases. This selection was based on ESPON's database of roughly 1600 cities, which includes data on population and various functional indicators. Using 74 indicators, 6 standardized urban characteristics were defined, i.e., *smart economy; smart mobility, smart governance, smart environment, smart living*, and *smart people*, as well as an overall Smart City Index. These characteristics are in line with smart city determinants found in literature, such as the level of education, the presence of a creative class, mobility and transport, ICT governance, and the quality of the urban environments (Caragliu et al. 2011). For more on this, please refer to the authors' site[3].

Limited literature can be found on smart cities as entities within urban systems. Some literature does exist that forms an initial bridge between World City Network and smart city literature, arguing that intelligent or smart cities (regions, clusters, or communities) should be defined as multilayered territorial systems that bring together knowledge intensive activities (learning, cooperation, innovation, communication, interaction, institutions) to maximize their problem solving capacity (Komninos 2002, 2006). In this, it is clear that smart cities cannot be simply treated as isolated entities compared only by their endogenous attributes, but their

[2] http://www.smart-cities.eu/index2.html; http://www.smartcities.eu/download/smart_cities_final_report.pdf

[3] http://www.smart-cities.eu/model.html

exogenous relationships to other cities in the world are also equally important. Smart cities are therefore relative functions of urban systems (social, economic, and environmental) and need to be qualified within the context of network properties.

2.2 World City Networks

Traditionally, academics and developers have focused on regions and cities at the subnational level, considering this as the essential unit of economic activity. In that vein, economic geography has cultivated a self-conception of being the science of the mesoscale (Grabher 2006), and has encouraged an "overterritorialized" view of regional development (Hess 2004). In this context, most studies have not been able to conceptualize regional development in a globalizing world (Dicken and Malmberg 2001). Instead of persistently focusing on regions and cities as locally embedded entities, these entities must be considered as "new islands of an archipelago economy" (Hein 2000), in which transnational network embedding exists, creating collaborative relationships of trust at different, interdependent geographic scales (Henderson et al. 2002; Hess 2004). Conceiving cities within networks dates back to John Friedmann's world-city hypothesis (1986), which posits several pertinent generalizations. First, the extent of a city's functional integration into the world economy is critical for its level of development. Second, primary cities are used by global corporations as hubs in the spatial organization of production and markets. Third, the resultant network enables the arrangement of world cities into a complex spatio-economic hierarchy. Founded in these generalizations, Friedmann (1995) argued that world cities can be ranked hierarchically according to the number of economic ties that they command.

Similarly, Sassen (2001) put forward the modern-day transformation of the world economic system into a complex duality of "spatially dispersed, yet globally integrated organization of economic activity." In particular, she stressed that the centralized functions that are found in hub cities are strongly represented by advanced services, which enable the worldwide control of production. Sassen also argued that the globalization of services would give rise to a world with a new class of service cities, controlling an array of production oriented cities (Sassen 1994). In these studies, it is argued that a city's urban development depends strongly on increasing the quantity and quality of socioeconomic ties to other cities. However, it is important to stress that world city network formation is the product of the decisions of firms to locate in certain cities and economically exchange with others. This means, in this model, that cities do not have agency power themselves, and simply form the locus where firms locate their activities (Taylor 2001). Hence, nodes are actors (firms) and linkages are the social relations taking place between them. Cities can be seen as connected through the links formed by firms within the city.

These theoretical suppositions have been empirically tested to show that (1) indeed cities have become economically dissociated from their local geographies, as their positions in worldwide corporate networks have grown; (2) that although most cities in the world are recipients of international economic activity, only a handful

have the power to control and facilitate global economic production (Wall and v.d. Knaap 2011); (3) that statistically the economic distribution of these cities is highly disproportionate (Barabási 2003)[4]; and that (4) the more specialized and dense the incoming economic ties of a city are, the more developed the urban functions of the city will be (Wall et al. 2011). These incoming ties, e.g., inward investment from other cities into a particular city, are attracted by, and in turn affect, the social, economic, and environmental functions of the city. In social network analysis, the measure for these inward ties is called "indegree," and is a centrality measure of a city's prestige and attractiveness in the world economy (Alderson and Beckfield 2004). However, a city's ability to attract inward economic ties, is not its only virtue. On the other hand, a city can be strong in its ability to invest outward into other world cities. In social network studies, this centrality measure is called "outdegree," and reflects the power and control that a city has over other cities.

Although most cities have the ability to attract a certain amount of inward economic ties, (e.g., foreign investment), only a small percentage have developed the capacity to strongly invest in other cities, and hereby control economic processes elsewhere. Indeed, in a study on the power and position of cities in the global economy, it was demonstrated that only 17% of all cities in the network hold an outdegree status. These cities are the top and sub-top "hubs" of the world economy (Wall and v.d. Knaap 2011). Lastly, there is another important measure that measures a city's importance, but in an entirely different way. The more strategically positioned a city is between all pairs of cities in a network, the more it is able to serve as a broker or intermediator within the economic flows taking place between these cities. In social network studies, this centrality measure is called "betweenness" and represents those actors (cities) that lie strategically on the paths connecting other cities (Alderson and Beckfield 2004). Cities with high betweenness are endowed with the power that they serve as brokers and can control and facilitate the flow of information throughout the network. Betweenness is thereby not a measure of the strength of a city's connections, but represents its intermediate position within a variety of connections. Therefore, cities that are not strong in outdegree or indegree can often excel in terms of betweenness. It is therefore an interesting measure to study the strategic importance of medium-sized, smart cities.

Regardless of the centrality measure, the fundamental characteristic and prerogative of top and sub-top cities, is their ability to optimize, regulate, and strategize competitive flows of capital, knowledge, and human exchange worldwide. The more a city succeeds in this, the more stable it becomes in the system (Barabási 2003). This success is conditional to achieving a complex construct of multiple scales of human interaction, e.g., political and corporate governance, business climate, cultural relations, and variations in human demand (Wall 2009). Hence, it is arguable that World City and smart city studies need to be understood within the context of social and economic network studies.

[4] In power–law relationships, sometimes called scale-free networks, a few nodes act as "highly connected hubs," with a high degree of connectivity (far above the average), while the majority of nodes have low degrees (Barabási 2003).

2.3 Social Networks

This line of thought is supported by literature on networks and innovation. In these bodies of literature it is widely recognized that productivity and added value are gained in informal networks of organizations and actors that are characterized by "loosely coupled relationships" that can be activated and used at any point in time (Bekkers et al. 2011). This idea is supported by Granovetter's (1973) idea of "the strength of weak ties," which implies that new, innovative ideas come from actors who are not in the center of the network, but are relative outsiders (e.g., entrepreneurs and corporate affiliations within smart city economic networks), who are loosely connected to the key players in the network, e.g., multinational CEOs and directorates situated in the headquarters of global hub cities. However, these actors require intensive boundary spanning activities to become more connected to the core of the network (Van Meerkerk and Edelenbos 2013). Boundary spanners can be defined as "people who operate at the periphery or boundary of an organization, performing organizationally relevant tasks, relating the organization with elements outside it (Leifer and Delbecq 1978, pp. 40–41). These people stimulate interconnections and interactions between people at the intersections of different organizations, and on different levels and scales (local, regional, national, and transnational). Boundary spanning corresponds to theories on betweenness as both approaches emphasize and stress the importance of in-between organization and action (c.f. Alderson and Beckfield 2004). This in-between and interconnecting activity can also be called the "structural hole argument" (Burt 1992), which implies the bringing together of new insights, information, and knowledge, which in turn leads to increased variety, which is the foundation to become smart and innovative.

In informal, loosely-coupled connected networks, information and knowledge flow between a large variety of actors, hereby making city networks smarter and enabling actors to find new ways of tackling economic, social, and environmental challenges (c.f. Nooteboom 2002; March 1999). These informal, loosely coupled networks are characterized by the absence of strict boundaries and the free flow of ideas, knowledge, information, and experiences. It also involves an open culture in which "trial and error," experimentation, reflection, and learning are key assets. Innovation takes place in informal spaces where there are not many formal restrictions, as usually identified in "power networks" (Nooteboom 2006). When applied to urban management and specifically smart cities, this type of activity results in a variety of positive spillovers, due to the exchange and creation and commercial exploitation and acquisition of knowledge from the local environment and distant places (Boschma 2005; Bathelt et al. 2004). Urban resilience can therefore be achieved by focusing on key structuring processes that cross various spatial scales, and a variety of sources of capital and skills. Therefore, cities are also increasingly reliant on flows of information between local clusters and global actors (Bathelt et al. 2004; Porter 2000).

2.4 Economic Networks

In the past few decades, FDI has overtaken trade as the primary driver of the global economy and therefore serves as an ideal indicator of a city's level of integration within the world economic system (Dicken 2007). Today, cross-border investment flows are crucial for urban and regional development. Globalization has standardized the conditions for business, accelerated the mobility of capital and other factors of production around the world, and thus intensified competition between cities at local, regional, and global scales (Bristow 2010; Malecki 2002; Begg 1999). The more investment a city or region receives, the more important its status will be within the world economy, e.g., Shanghai, London, and New York. Investments are also important to cities because they bring capital, employment, knowledge, skills, and technology (Dunning and Narula 2004; Kitson et al. 2004). Within this context, one of the best ways to measure the performance of cities in the global network system is by analyzing the complex network of FDI.

Multinational corporations (MNCs) increasingly invest in firms and cities worldwide with the intention of reducing production costs, gaining access to new markets, and exchanging new knowledge and skills. For instance, the top 500 MNCs today account for roughly 90% of global FDI and 50% of world trade (Rugman 2005). Cities therefore compete to attract FDI because it contributes to local economic development, knowledge spillovers, and new technologies. Nonetheless, depending on their industrial sectors and business activities, MNC's are quite particular about the types of cities they invest in (Burger et al. 2013). For instance, MNC's in advanced producer services tend to invest in entirely different types of cities than those in the more primary and secondary industries (Wall and v.d. Knaap 2011). These differences depend on variations of the urban endowments of cities, i.e., social, cultural, political, economic, and environmental location factors (Wall and Burger 2013). On the other hand, as discussed earlier on, although most cities have the potential to attract particular types of investment, only a limited number of cities have the economic power and brokerage to be great investors in other world cities. This requires entirely different types of location factors to wield this kind of power. To conclude this chapter, we consolidate the literatures into six hypotheses:

1. If the provided medium-sized smart cities do have the potential to compete with large metropolises, then expectedly these cities will have a strong global and regional reach in terms of FDI linkages to cities worldwide.
2. Cities with the power to command and control economic activities in other world cities can be regarded as smart. Therefore, it is expected that the provided smart cities will be better at investing in other cities (outward investment), than attracting investments toward them (inward investment).
3. If smart cities are characterized by loosely coupled networks and a high diversity of linkages—due to the free flow of ideas, then we can expect that the smarter these cities are, the higher the dispersion of linkages.
4. If the medium-sized smart cities play an important role in global economic networks, then it is expected that they will hold a relatively moderate position in

terms of outward investment (outdegree), but more importantly, that their strategic position within the network (betweenness), will be stronger than their outdegree position.
5. Because smart cities are medium-sized and need to compete with a vast array of similar sized cities, it can be expected that the higher they score on the Smart City Index, the stronger they will be in the FDI network.
6. Because the Smart City Index is founded on 6 urban characteristics, namely economy, people, governance, mobility, environment, and living, it is interesting to define which are significant to FDI. Because FDI essentially involves financial transactions, decision-making processes by corporate directorates, and is often subjected to urban policy, we expect that the characteristics of *economy, people*, and *governance* will be most important.

3 Chapter 2

3.1 Data and Methodology

Essentially this study is based on two different databases used to explore the above hypotheses. First, we use data from the European smart cities report, which has been explained in the theoretical section. This has been useful to identify 70 medium-sized European smart cities and their 6 characteristic measures of urban smartness, i.e., economy, people, governance, mobility, environment, and living. Second, we use the Financial Times "fDi Markets" database[5], which covers a total of 126,515 global greenfield investments over the period 2003–2012. Of the 70 smart cities, 63 were identified in the fDi Markets database, and can be seen in Table 1 below.

The table reveals the 63 cities ranked by the Smart City Index, and shows 30 positively ranked smart cities, and 34 negatively ranked non-smart cities. Based on this a dummy variable classification was made for the purpose of further analysis. The scores are taken from the original report. Furthermore, the table also shows the amount of inward and outward investment held by these cities. Next, the investments related to the 63 smart cities were extracted from the fDi Markets database. This includes investments from cities worldwide to their respective smart cities (inward investment), and investments from smart cities to other cities (outward investments).

All the cities in the sample were geocoded with Cartesian coordinates, so that they could be mapped with geographic information system (GIS) software, namely ArcGIS. Based on this, we could answer hypothesis 1, by mapping the geography

[5] Greenfield data on the other hand represents investments where parent companies start entirely new ventures in foreign countries. Therefore, greenfield investments clearly indicate traceable developments between firms and are therefore useful in studying their impact on regional development.

Table 1 Smart city rank and foreign direct investment

City	Inward investment (Destination)	Outward investment (Source)	Smart rank	Smart dummy
Luxembourg	114	532	0.81	1
Aarhus	1	0	0.69	1
Turku	12	16	0.60	1
Aalborg	16	34	0.58	1
Odense	11	12	0.55	1
Tampere	17	18	0.53	1
Oulu	7	8	0.50	1
Eindhoven	45	38	0.45	1
Linz	28	42	0.44	1
Salzburg	28	55	0.42	1
Montpellier	41	14	0.40	1
Innsbruck	19	4	0.39	1
Graz	36	62	0.37	1
Nijmegen	8	13	0.36	1
Groningen	11	5	0.36	1
Gent	56	53	0.36	1
Ljubljana	79	94	0.35	1
Maastricht	17	18	0.34	1
Brugge	10	2	0.31	1
Enschede	4	6	0.31	1
Gottingen	2	7	0.29	1
Umea	4	0	0.27	1
Regensburg	5	13	0.22	1
Dijon	24	2	0.19	1
Trier	4	2	0.18	1
Nancy	9	1	0.18	1
Clermont-Ferrand	6	92	0.18	1
Poitiers	8	0	0.15	1
Maribor	10	3	0.14	1
Cork	117	37	0.12	1
Kiel	5	3	−0.01	0
Zagreb	146	34	−0.01	0
Cardiff	61	38	−0.04	0
Portsmouth	16	8	−0.05	0
Aberdeen	99	204	−0.09	0
Tartu	20	9	−0.11	0
Pamplona	11	26	−0.12	0
Plzen	50	9	−0.15	0
Valladolid	30	11	−0.16	0
Usti Nad Labem	16	0	−0.20	0
Trento	5	4	−0.21	0
Coimbra	10	2	−0.24	0
Nitra	27	0	−0.26	0

Table 1 (continued)

City	Inward investment (Destination)	Outward investment (Source)	Smart rank	Smart dummy
Rzeszow	11	7	−0.28	0
Trieste	13	41	−0.29	0
Oviedo	11	2	−0.30	0
Ancona	1	22	−0.31	0
Perugia	3	20	−0.35	0
Białystok	15	1	−0.39	0
Kosice	37	1	−0.39	0
Timisoara	115	2	−0.39	0
Banska Bystrica	12	0	−0.40	0
Bydgoszcz	27	2	−0.41	0
Kaunas	46	27	−0.43	0
Leicester	42	30	−0.44	0
Szczecin	53	4	−0.48	0
Sibiu	57	0	−0.50	0
Kielce	12	4	−0.53	0
Liepaja	13	2	−0.59	0
Miskolc	23	0	−0.73	0
Craiova	29	0	−0.79	0
Pleven	22	0	−0.96	0
Ruse	34	14	−0.96	0
Total	1821	1710		

of smart city investment. To test hypothesis 4, which concerns the outdegree and betweenness centrality of smart cities within the global economy, social network analysis techniques were applied, using UCINET software[6]. Outdegree relationships are a measure of the economic relationships that firms in a particular city have with firms in other cities, and can be interpreted as the "power" that certain cities wield over others (Alderson and Beckfield 2004).

Betweenness measures the brokerage or "intermediacy" of a city within a system of cities (Alderson and Beckfield 2006). It is unlike the other centrality measures because it measures the strategic position of a city in relation to all other cities. To execute this, the matrix of investment data had to be "dichotomized" into unvalued relationships of either 0 or 1, i.e., the presence or absence of relationships, not their strength[7]. Hypotheses 2, 3, 5, and 6 were econometrically tested, using STATA statistical software. It is commonplace in economic network analysis to not use valued economic data, but instead count data. This is because in this type of research count data is more reliable, and we are more interested in the frequency of economic occurrences than their magnitudes. Because we use count data, ordinary least square analysis (OLS) cannot be used and should be replaced by for instance

[6] Ucinet/Netdraw (Borgatti et al. 2002)

[7] For readers interested in these measures, please see Alderson and Beckfield (2004, pp. 288–25), Irwin and Hughes (1992), and Hannemann and Riddle (2005)

Poisson models. Furthermore, because the data also proves to be highly skewed, there is evidence of over-dispersion in the data, and therefore the negative binomial statistical method was used to account for this.

4 Chapter 3

4.1 Results

Hypothesis 1: The Global and Regional Smart City Network In Fig. 1 the outward investment networks emanating from the 63 smart cities (white nodes) to other recipient cities of the world (grey nodes) is seen. It concerns the total investments over the period 2003–2012. The bigger the white and grey nodes are, the more total investment emanated or received. The thicker the dark grey lines are, the more investment has taken place between nodes. It is clear that although smart cities are medium-sized European cities, they have remarkable global reach and connect to the economically strongest and fastest growing cities of the world. This strongly mirrors the networks of global hub cities. Hence, smart cities, although having smaller investments, are not subordinate to large metropolises in terms of global presence. They have similar faculty to control global production processes and form links to big global players, especially in the emerging Asian market. In the map it is evident that smart cities are most powerfully connected to Dubai, Singapore, Shanghai, Houston, Kuala Lumpur, and Perth. Furthermore, the investment focus of smart cities is clearly directed toward Asian destinations. We also see that there are very few linkages to the African continent. This is a similar trait of top global cities (Wall 2009). However, with the recent fast growth of investment in Africa, this is expected to change rapidly (Wall and Pajevic 2013). It is interesting for smart cities to see how they can take advantage of this potential and establish future economic ties with African cities.

Zooming into Europe (Fig. 2) we see that Aberdeen and Luxembourg are the two most powerful smart cities. Where Aberdeen has strength in restricted connections to a few places, Luxembourg excels in smaller, but a larger variety of connections to different cities. In this sense, the high volume of Luxemburg's loosely coupled ties warrants a smarter city, than Aberdeen. It is also interesting to see that although smart cities are well connected to various cities worldwide, they are not well connected to each other. This could be explained by the fact that because these cities are geographically proximate, fall in the same urban league, and carry similar functional traits, they are competitive, and therefore tend to not invest much in each other.

In Table 2, the nature of smart city ties is more evident. The left part shows the strongest bilateral ties between cities. For instance, of all smart cities, Aberdeen has its strongest linkages with Dubai (18 investments), followed by Houston (17), Perth (16), and Singapore (14). Again it is seen that Aberdeen has the strongest ties, but not the highest diversity of destinations. This is more evident in the right part

Fig. 1 The global network of smart city investments

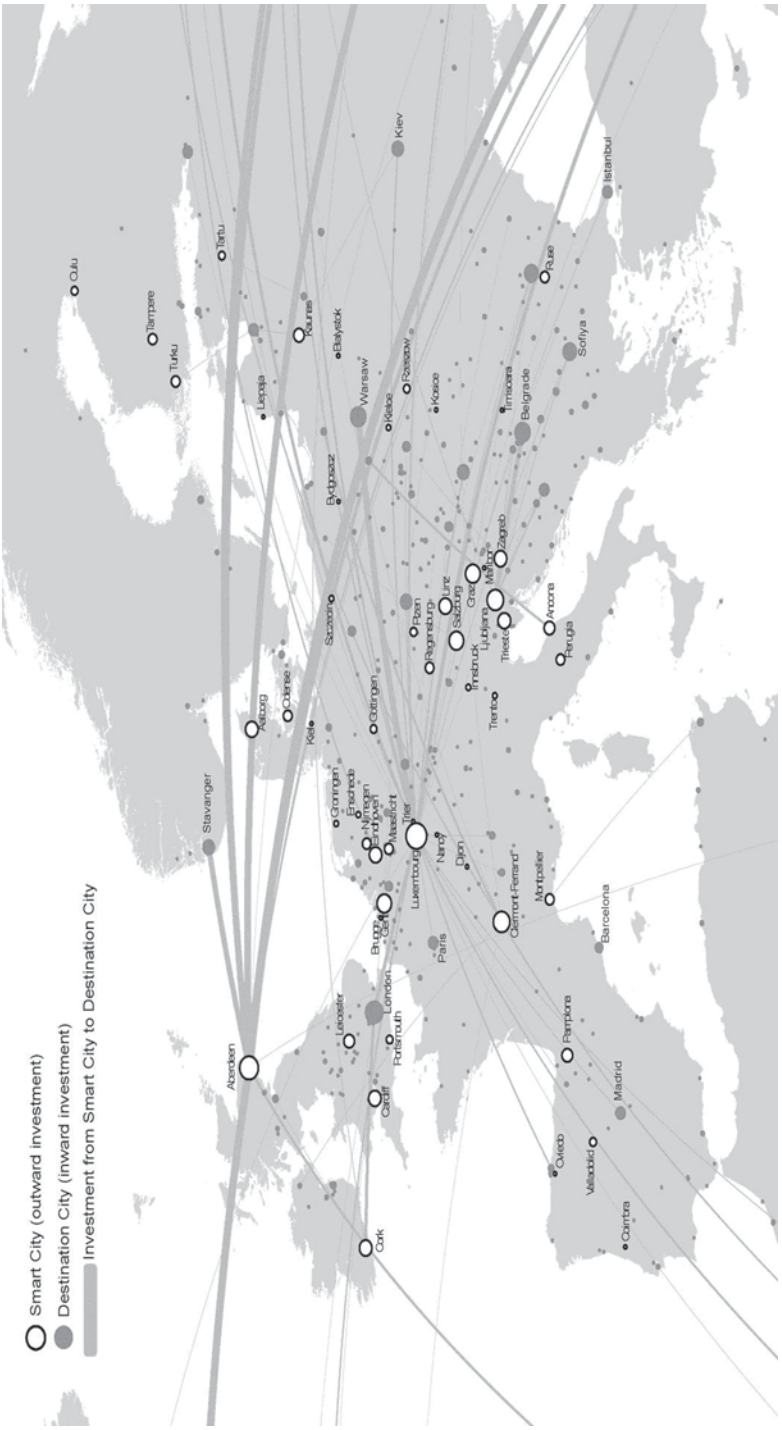

Fig. 2 The european network of smart city investments

Table 2 Smart city investments by linkage strengths and node totals

Top 30 smart city outward investments (linkages)				Top 30 smart city outward investments (node totals)			
Rank	Smart source city	Destination city	Foreign investments	Smart source city	Smart outward investment	Recipient city	Recipient inward investment
1	Aberdeen	Dubai	18	Luxembourg	532	Dubai	35
2	Aberdeen	Houston (Tx)	17	Aberdeen	204	Singapore	31
3	Aberdeen	Perth	16	Liubljana	94	London	27
4	Aberdeen	Singapore	14	Clermont-Ferrand	92	Warsaw	23
5	Luxem bourg	Warsaw	14	Graz	62	Shanghai	22
6	Aberdeen	Kuala Lumpur	13	Salzburg	55	Belgrade	20
7	Aberdeen	Stavanger	13	Gent	53	Houston (Tx)	20
8	Ljubljana	Belgrade	10	Linz	42	Kuala Lumpur	20
9	Aberdeen	Abu Dhabi	8	Trieste	41	Perth	17
10	Luxembourg	Dubai	8	Cardiff	38	Moscow	16
11	Cork	London	7	Eindhoven	38	Rio De Janeiro	16
12	Luxembourg	London	7	Cork	37	Sofiya	16
13	Luxembourg	Shanghai	7	Aalborg	34	Bucharest	15
14	Aberdeen	Rio De Janeiro	6	Zagreb	34	Nyc (N y)	14
15	Ancona	Lodz	6	Leicester	30	Prague	14
16	Clerm ont-Ferr and Cedex	Olsztyn	6	Kaunas	27	Zagreb	13
17	Ljubljana	Zagreb	6	Pamplona	26	Beijin	13
18	Luxembourg	Hong Kong	6	Ancona	22	Kiev	13
19	Aberdeen	Doha	5	Perugia	20	Stavanger	13
20	Clermont-Ferrand	Rio De Janeiro	5	Maastricht	18	Abu Dhabi	12
21	Clermont-Ferrand	Shenyang	5	Tampere	18	Budapest	12
22	Eindhoven	Shanghai	5	Turku	16	Hong Kong	10
23	Ljubljana	Sarajevo	5	Montpellier	14	Madrid	10
24	Luxembourg	Budapest	5	Ruse	14	Paris	10
25	Luxembourg	Gijon	5	Nijmegen	13	Riga	10

Table 2 (continued)

Top 30 smart city outward investments (linkages)				Top 30 smart city outward investments (node totals)			
Rank	Smart source city	Destination city	Foreign investments	Smart source city	Smart outward investment	Recipient city	Recipient inward investment
26	Luxembourg	Kiev	5	Regensburg	13	Sao Paulo	10
27	Luxembourg	M os cow	5	Odense	12	Istanbul	9
28	Luxembourg	Nyc (Ny)	5	Valladolid	11	San Francisco (Ca)	9
29	Luxembourg	Prague	5	Plzen	9	Saraievo	9
30	Luxem bourg	Sao Paulo	5	Tartu	9	St Petersburg	9
Total smart city investments 1710				Total smart city investments 1710			

Table 3 Smart City Index as a determinant of smart city FDI

Destination (*inward investment*)	
Constant	3.351*** (0.120)
Smart City Index	−0.059 (0.283)
Source (*outward investment*)	
Constant	2.996*** (0.187)
Smart City Index	1.782 *** (0.429)

***$p<0.01$, **$p<0.05$, *$p<0.1$; standard errors in parentheses

of the table, where we see the aggregated outward investments of the smart cities[8]. Luxembourg is at the head of the pack with a total of 532 investments to other cities, while Aberdeen has 204. The right part depicts the total number of investments received by other cities of the world. For instance, Dubai, Singapore, London, Warsaw, and Shanghai receive the most investments from smart cities. It is also interesting to note that 50% of the recipient cities are destinations outside of Europe. This further emphasizes the strong global reach of these medium-sized cities.

Hypothesis 2: The Outward and Inward Investment of Smart Cities To test this hypothesis, a negative binomial regression was carried out to test whether a city's Smart City Index score significantly explains its level of FDI attraction (dependent variable). This was done for both outward investment (source) and inward investment (destination). The results in Table 3 show that there is no significant relationship between the Smart City Index and inward investment (note: only values marked by asterisks hold significance). However, there proves to be a significant relationship between a city's power to invest in other cities (outward investment), and the Smart City Index. Hence, as derived from the table, when a city increases its Smart City Index by one unit, the difference in the logs of the expected counts would be expected to increase FDI by 1.782, while holding all the other variables in the model constant. This means that the index expresses a smart city's ability to economically interact with the world, and not their ability to attract foreign investors. From this we can confirm the second hypothesis, that indeed, smart cities have the power to command and regulate economic activities in other cities of the world.

Hypothesis 3: The Diversity of Smart City Investment Linkages The results of Table 4 are used to explore the third hypothesis. The analysis was carried out by

Table 4 Descriptive statistics of smart and non-smart cities by source FDI

	Mean	Standard deviation	N
Non-smart	15.5	35.500	33
Smart	39.433	96.647	30
Total	26.718	71.447	63

[8] Note: The calculations in Table 3.1 include all outward ties and therefore give different rank outcomes than in Table 3.4 which only concern dichotomized (0 and 1) linkages.

classifying the cities into positively scored smart city dummy variables and negatively scored non-smart city variables (see Table 1). In Table 4 we see evidence of a much higher dispersion of smart city outward FDI (standard deviation of 96.647) to other cities, than is the case for non-smart dispersion (standard deviation of 35.5). This means that the smarter a city is, the higher the diversity of loosely coupled ties to other destinations. In other words, smart cities have a higher global scope.

Hypothesis 4: Outdegree and Betweenness of Smart Cities In Table 5 we observe the outdegree (left) and betweenness (right) position of smart cities, in relation to other European cities. Both analyses are based on the outward investment of cities, where the data has been dichotomized (0s and 1s). This means that we are not measuring the strength of individual ties, but the diversity of their linkages. To recapitulate, outdegree is a measure of a cities power and control of economic processes in other distant cities. For instance, this concerns multinational headquarters in hub cities that invest in subsidiaries, regional offices, production plants, and service centers in other cities. These hubs have economic power and control over the firms in these other cities (e.g., employees, knowledge, information, and marketing), and hereby also influence the overall development of the recipient cities. In the table we see that London is Europe's main control centre, and competes at the highest level with cities like Tokyo and New York (Wall and v.d. Knaap 2011). It is followed closely by Paris, which is also considered to be a primary hub city. In turn, Paris is followed by secondary hubs like Stockholm, Amsterdam, Munich, Madrid, and Moscow. Interestingly, where Dusseldorf is 6th in terms of tie strengths, it is 24th in respect of its diversity of outward ties (not shown). Amsterdam is 5th in tie strengths and 4th in terms of its diversity of connections (not shown). This makes Amsterdam economically powerful, as well as well integrated with various cities in the global economy. In terms of the strength of outward investment linkages, Luxembourg ranks 10th out of all European cities (not shown). In Table 5 we see that in terms of the diversity of outward investment ties, Luxembourg ranks 34th. For Aberdeen, it holds the 62nd position in terms of outward linkage strength (not shown), and is evidently slightly stronger than Luxembourg in terms of its diversity of outward ties (32nd). This means that Aberdeen is connected to a few more cities than Luxembourg, and therefore is the smart city that is most integrated with the world economy.

In Table 5 we also see that although Amsterdam is 4th in outdegree diversity, in terms of betweenness, its strategic importance drops to 17th position. This clearly shows the effect of different centrality measures. Similarly, where Cologne holds the 16th position in outdegree diversity, it rises to 4th position in terms of betweenness. This means that Cologne holds a strong strategic position between other cities of the network, and serves as a broker that efficiently connects other cities together. London proves to be the European city that holds the strongest strategic position in the global network. Technically speaking, London is the city (actor) that is best situated along the most, "shortest paths" of the network (Freeman 1978). Where Luxembourg is 34th in outdegree diversity, it rises to 25th position in terms of betweenness centrality. It therefore serves as the top smart city broker. It is followed at

Table 5 Outdegree and betweenness of smart cities

Rank	City	Outdegree (normalized)	Rank	City	Betweenness (normalized)
1	London	44.598	1	London	6.11
2	Paris	39.31	2	Boulogne	3.315
3	Stockholm	13.563	3	Paris	2.864
4	Amsterdam	12.644	4	Cologne	2.242
5	Munich	11.264	5	Neckarsulm	1.19
6	Madrid	9.885	6	Moscow	0.699
7	Moscow	9.885	7	A Coruña	0.524
8	Dublin	8.506	8	Espoo	0.406
9	Kazan	8.276	9	Madrid	0.4
10	Podolsk	8.276	10	Barcelona	0.394
11	Barcelona	8.046	11	Essen	0.349
12	A Coruña	8.046	12	Brussels	0.332
13	Milano	7.356	13	Stockholm	0.312
14	Vienna	7.126	14	Helsinki	0.286
15	Helsinki	7.126	15	Stavanger	0.27
16	Cologne	7.126	16	Geneve	0.257
17	Brussels	6.207	17	Amsterdam	0.226
18	Dusseldorf	5.977	18	Munich	0.219
19	Stuttgart	5.977	19	Basel	0.213
20	Geneve	5.287	20	Dusseldorf	0.207
21	Zurich	5.287	21	Helsingborg	0.157
22	Bratislava	5.057	22	Frankfurt	0.135
23	Wolfsburg	4.828	23	Stuttgart	0.131
24	Frankfurt	4.828	24	Dublin	0.103
25	Sofiya	4.598	25	Luxembourg	0.102
26	Gent	4.368	26	Athens	0.102
27	Bonn	4.138	27	Porto	0.083
28	Hamburg	3.678	28	Leverkusen	0.082
29	Istanbul	3.678	29	Cheshunt	0.079
30	Berlin	3.448	30	Gothenburg	0.075
31	Poznan	3.448	31	Istanbul	0.057
32	Aberdeen	3.448	32	Milano	0.052
33	Essen	3.218	33	Aberdeen	0.044
34	Luxembourg	3.218	34	Rome	0.036
35	Rome	3.218	35	Poznan	0.036
129	Ljubljana	0.92	38	Ljubljana	0.028
210	Ancona	0.46	56	Ancona	0.013

a distance by smart city Aberdeen with holds the 33rd position within European city ranks, and is 2nd in the smart city context. Ljubljana holds the 38th most strategic position in Europe, and is 3rd of the smart cities.

Hypothesis 5: Smart Cities Transmit More Investment than Non-Smart Cities Table 6 depicts the results concerning the fifth hypothesis. The asterisks signify

Table 6 Negative binomial on source FDI including smart city dummy

Constant	3.498*** (0.351)
Smart City Index	2.846*** (0.697)
Dummy smart cities	−1.178* (0.638)

***$p<0.01$, **$p<0.05$, *$p<0.1$; standard errors in parentheses

that both the smart city as well as the dummy variable is significant to this result. What the results show is that assuming that a non-smart city has exactly the same characteristics as a smart city; the smart city will attract on average 1.178 investments more than the non-smart city. From this we can think of the smart, non-smart division as a paramount factor that encompasses all the additional and advantageous characteristics that are possessed by smart cities. Smart cities are therefore more empowered to invest in other cities, than non-smart cities. This advantage results in the apparent higher attractiveness of smart cities to investors.

Hypothesis 6: Smart People Determine Outward Investment To answer the sixth hypothesis, we can examine the results in Table 7. This output is the result of the negative binomial analysis in which we try to see which of the 6 urban characteristics that make up the overall Smart City Index, are determinants for smart cities to invest into other cities (outdegree). The results show, denoted by the asterisk, that only the smart people characteristic is significant in explaining outward investment to other cities. In other words, if a city were to increase its Smart People Index by one unit, the difference in the logs of the expected counts would be expected to increase by 1.476, while holding all the other variables in the model constant. The smart city characteristic is itself made up of indicators like *level of qualification, social and ethnic plurality, flexibility, creativity, cosmopolitanism*, and *open mindedness*. These are arguably the types of qualities that are needed to enable entrepreneurs in smart cities to invest in other cities around the world.

Against expectations, smart economy and smart governance do not appear to be important for outward investments. Smart economy is based on measures like *productivity, entrepreneurship, labor market flexibility*, and *economic image*. These are collective, public factors that are essential for attracting investment, but not necessarily important for private firms to want to invest in other cities. Similarly, smart governance is also founded on collective measures, such as *transparent governance*, and *public and social services*, which may be important for the attraction

Table 7 Negative binomial results for the 6 smart city characteristics

Constant	2.941 (0.203)
Smart economy	0.001 (0.000)
Smart people	1.476* (0.840)
Smart governance	−0.000 (0.000)
Smart mobility	−0.216 (0.569)
Smart environment	−0.000 (0.001)
Smart living	0.000 (0.001)

***$p<0.01$, **$p<0.05$, *$p<0.1$; standard errors in parentheses

of inward FDI, but not necessarily the decisions made by private companies. In the case of smart people, implicit measures are the level of the *qualification of people*, their *open-mindedness, creativity*, and *flexibility*. These are measures that are arguably more directed toward the entrepreneurial capacity of people, and for this reason correlate strongly with the ability of entrepreneurs to make investment decisions elsewhere.

5 Chapter 4

5.1 Conclusions

The results show that even though smart cities are medium-sized cities, they mirror the networks of global hub cities in terms of global reach and the ability to economically connect to the strongest, fastest growing cities of the world. Although smart cities emit smaller sized investments, they are not subordinate to large metropolises in terms of global presence, hold similar capability to control global economic processes, and establish links to powerful cities. In this sense, the fundamental characteristic and prerogative of smart cities should be their ability to initiate and regulate competitive flows of capital, knowledge, and human exchange worldwide. Unlike hub cities, smart cities do not necessarily have to hold the strongest ties, but instead should develop their ability to be strong brokers within the system, and hence maximize connectivity to a high diversity of different cities. It is imaginable that the more diverse these linkages are, the more opportunities will be generated, and the more the risks will be spread. In turn, the higher diversity will lead to less vulnerability to economic shocks, and hereby contribute to urban resilience. Conditional to smart cities achieving higher connectivity and brokerage are a complex construct of multiple scales of human interaction. This idea relates back to Granovetter's (1973) idea of "the strength of weak ties," which implies that new, innovative ideas come from actors who are not necessarily in the center of the network, but are relative outsiders, who are loosely connected to the key players in the network. This interconnecting activity, known as the "structural hole argument" (Burt 1992), advocates the distribution of new information and knowledge, which in turn leads to increased variety, and hence forms the basis for cities to become smart and innovative. In application to cities, this type of activity results in a variety of positive spillovers, due to the exchange and creation and commercial exploitation and the acquisition of knowledge from local environments and distant places (Boschma 2005; Bathelt et al. 2002). Hence, urban resilience can be achieved by focusing on key structuring processes that cross various spatial scales, and a variety of sources of capital and skills.

In the resulting GIS maps, it is shown that the majority of smart city investments are into distant global cities, and less so in European cities. This underlines the strong global reach of these medium-sized cities. The study shows that smart cities

are particularly focused on eastern markets, e.g., Dubai, Singapore, Shanghai, Kuala Lumpur, and Perth. However, we also see that there are relatively limited linkages to the African continent. With the recent and projected growth of investments into Africa (Boston Consulting Group 2010; Wall and Pajevic 2013), it becomes interesting to see how smart cities can take advantage of this growth and establish future economic ties with African cities. Not only do the network maps reveal the performance of smart cities within the global network, but also show the missing links, or weak ties, that avert cities from becoming smarter. Furthermore, smart cities are shown to have their strongest European ties with London, Warsaw, Belgrade, Sophia, and Bucharest. The investment focus seems to be particularly directed to Eastern Europe, which is probably because these cities serve as emerging production areas. In other words, smart cities focus on initiating and controlling production processes in East European cities.

The research discloses that, Luxemburg and Aberdeen are the most powerful European smart city investors. Aberdeen proves to be connected to a greater variety of cities than Luxembourg, and therefore is the smart city that is most integrated into the world economy (outdegree centrality). Nonetheless, Luxembourg is shown to be the smart city with the highest strategic position in the network (betweenness centrality). For this reason, Luxembourg serves as the top smart city "broker" and "boundary spanner," and hereby is a pivotal city in the flow of capital, goods, services, and information.

It was also found that although smart cities are well connected to various cities worldwide, they are not well connected to each other. This may be explained by the fact that these cities are geographically proximate, fall within the same urban league, and carry similar functional traits. This makes these cities competitors, and arguably reduces the incentive to invest in each other. Nevertheless, it is interesting to consider a future possibility of a Smart City Network alliance. In this light, it is imaginable that collaboration between these cities, based on economic complimentarity, can be strategically advantageous. In this way, these medium-sized cities can establish a polycentric Smart City Network that can better compete with big hub cities, or other medium and small-sized cities worldwide. By collaborating, individual smart cities may be able to strengthen their position within the system, and hereby become more stable and resilient. Much like the connector hubs in brain networks, smart cities need to continuously calculate and adapt to the cognitive demands of the contemporary world-city structure.

Furthermore, the results indicate no significant relationship between the Smart City Index and inward investment. The smartness of a city, as defined by the original authors, does not apparently attract investors. However, there proves to be a significant relationship between a city's power to invest in other cities, and the Smart City Index. This expresses more the smart cities ability to interact with the world, and less their ability to attract foreign investors. From this we can validate our second hypothesis, that indeed, smart cities have the power to command and regulate economic activities in other cities of the world.

The output also shows that the smarter a city is, the higher will be its diversity of loosely coupled ties to other destinations. Smart cities are therefore more enabled

to invest in other cities, than their non-smart counterparts. This advantage, results in the apparently higher attractiveness of smart cities to investors, and ensures a stronger and more stable position within the global economy. This suggests that smart cities need to be well connected to others in the global network system, so as to remain well informed of any trends or changes taking place at different scales and to translate and activate this increased insight for their specific use; that they need to be well aware of their relative position to that of their competitors within the network; and that they need to focus on establishing stronger links to actors in and related to key sectors of the global economy to maintain a good position in the network, and withstand shocks such as global recessions. In this way, cities can optimize the trade-off between incremental costs of urbanization and the market value of their productive and innovative capacity.

Furthermore, we reveal that only the smart people characteristic is significant in explaining outward investment to other cities, and that the other 5 provided urban characteristics are not relevant. This stresses the importance that local authorities nurture and amplify the power of their people, so as to compete with more powerful cities of the world. This means improving the level of qualification, social and ethnic plurality, flexibility, creativity, cosmopolitanism, and open mindedness of smart cities. These are the types of qualities that are needed to enable entrepreneurs in smart cities to invest in other cities worldwide. Indeed, cities are increasingly reliant on flows of information between local clusters and global actors (Bathelt et al. 2004; Porter 2000). Much literature already exists on human capital and the role of the individual in city-making (Caragliu et al. 2011; Shapiro 2005). It has already been stipulated that governments need to be more supportive of local and peripheral innovation from local bottom-up self-organizing entrepreneurs, and enable greater knowledge transfer across sectors and between different scales (Bekkers et al. 2011). Based on the "glocal" methodology used in this study, we can imagine the need for the integration of top-down and bottom-up processes at local, regional, and global scales. This would enable scalable local business innovation, and open up opportunities for global collaboration. Most importantly this underscores the role of the smart citizen in smart city growth.

Against expectations, smart economy and smart governance did not prove to be important for outward investors. This is arguably because the smart people indicator is more directly related to the generic capacity of individuals, and therefore correlates more directly with the ability of entrepreneurs to make investment decisions elsewhere. However, this may also have to do with the way the different smart city indicators have been conceptualized and operationalized in the utilized smart city report. This may affect our results and pose restrictions on some of our conclusions. For example, a specific definition of smart governance may imply that the connective capacity in multilevel governance settings is not included in the smart governance definition, but may be considered important for future development. All in all, this reiterates the urgency of reconceptualizing and re-defining the indicators used in future smart city research, especially if these indicators are to be used to explain a city's integration, competitiveness, and resilience within the global economy.

Based on the above conclusions, our key findings are:

1. *The smartness of a city is a measure of its ability to invest outward into cities worldwide, and discloses its power to control economic activities around the world*.
2. *The higher a city scores on the Smartness Index, the more it is able to invest in other cities worldwide*.
3. *Smart people are the underlying factor which enables a smart city to invest in other global destinations*.
4. *Smart cities have a strong global reach to important cities across the globe; however connections can be strengthened with cities in several emerging markets in Africa, Asia, and Latin America*.
5. *Smart cities are those cities that do not necessarily hold the strongest ties to other cities, but have the highest diversity of outward "loose tie" relationships to important cities. This will arguably create diverse future opportunities and expectedly improve resilience*.
6. *Smart cities are cities that should optimize their strategic position in the network, and serve as central brokers to as many cities as possible*.
7. *Smart cities are cities which should be highly receptive to changes in the system (e.g., market volatility, emerging competitor, and technological innovation) at local, regional, and global scales, and hence should developed a multi-scalar development policy to act accordingly*.
8. *At present, smart cities are not well connected to each other. However, it is arguable that these cities should in future become more connected and complimentary, and by doing so, herald a stronger competitive position in the world economy*.

Besides these key findings, our study has first and foremost attempted to introduce a more empirical methodology toward future smart city analysis, by uniting methods used in World City Network analysis to that of smart city research. By doing this, we have challenged the mainstream, overterritorialized approach to smart city research, by introducing the importance of understanding cities as components of a worldwide urban system, in which transnational network embedding exists, creating many weak ties and relationships of trust at different, interdependent geographic scales.

6 Chapter 5

6.1 Policy Recommendations

This study emphasizes that municipalities should complement their understanding of how to improve "endogenous" smart city urban characteristics with an "exogenous" understanding of the relative importance of their cities within the global

economic system. In a sense, it concerns matchmaking between how the city consciously develops itself, in relation to changing demand in the world. It is arguable that policymakers build a multilevel urban network policy in which economic actions are interceded across different organizational and geographic scales (Coe et al. 2004; Dicken et al. 2001). Instead of persistently treating cities as locally embedded entities, they must be perceived as "new islands of an archipelago economy" (Hein 2000), in which transnational network embedding exists, creating interpersonal relationships of trust at different, interrelated geographic scales (Henderson et al. 2002; Hess 2004). However, a critical stance is required here that not all cities be treated equally, as cities differ in terms of their history, economic and political structure, and cultural inheritance. Furthermore, they are all influenced differently by their subregional and national boundaries and indigenous government laws and policies (Hollands 2008). This requires that in future research these specifications be taken into consideration and that policy teases out which issues are generic and specific to a particular city's development.

In this study we have shown a relationship between the total investments a city transmits and the urban factors that determine this. Specifically, we have shown that smart people prove to be the essential factor to stimulate outward investment into other cities. These multilayered territorial systems should facilitate knowledge intensive activities (learning, cooperation, innovation, communication, interaction institutions) which maximize the city's problem solving capacity (Komninos 2002; 2006). Therefore, policy makers need to focus on developing the sub-factors comprising the Smart People Index, which include level of qualification, affinity to lifelong learning, social and ethnic plurality, flexibility, creativity, cosmopolitanism and open mindedness, and participation in public life. Again, some criticism is needed on how the smart city indicators have been developed. In this it is arguable that underneath the focus on human capital, the creation of smart communities, and social learning lies a more inadequate political agenda of "high-tech urban entrepreneurialism" (Hollands 2008), in which smart cities prioritize informational business interests and obscure growing social polarization (Harvey 2006) and "neo-liberal" urban development more generally (Peck and Tickell 2002).

Furthermore, it is also important to take note that although cities have some degree of agency through their local administrations, they serve only as the sites of activities, but are not the key actors themselves. Instead, multinational firms represent the prime actors in these processes that determine the degree of connectivity and strategic positioning within the global economic system (Taylor 2001). Based on these critical standpoints we support the need for a relational understanding on the development of smart cities within urban-economic systems, but with a strong appeal to clearly define the different actors, determinants, geographical delimitations—and essentially their interdependencies.

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Stakeholder Engagement in the Smart City: Making Living Labs Work

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1 Introduction

In the course of the past decade, debates about the future of cities have been increasingly influenced by discussion of so-called 'Smart' cities. In parallel, the 'smart city' concept, often with a fairly elusive definition, is being used in a variety of contexts, by cities and organisations or businesses, and by policymakers around the world. In countries within the European Union, the smart city paradigm is taking shape as a twenty-first century policy imperative, linking contemporary urban development factors in a common framework, as highlighting the importance of information and communication technologies (ICTs) and other high-tech solutions for enhancing innovation, growth, competitiveness and sustainability (Caragliu et al. 2011; Komninos 2009; Paskaleva 2009; EC 2010a). Inside this trend, the 'inclusive smart city' approach has gained special interest since it advocates

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the importance of social and relational capital in urban development by focusing, amongst other issues, both on social inclusion in the Digital Age and on involving citizens in service development to have more effective public services that better reflect the needs of the citizens (Ballon et al. 2007; Deakin 2007; Paskaleva 2011). More recent research on FI technologies and services in the European Union has also emphasised the need of applying a citizens-centred approach to the smart city, since this is believed to help form dense social ecosystems that are heavily reliant on Internet technology. In turn, these Internet technologies and applications can greatly influence social interactions (EC 2014a). In this approach, harnessing the potentials for open innovation through stakeholder engagement in living labs environments—where research and innovation processes are merged with local, real-life contexts—has emerged as a promising new instrument for building the smarter city (EC 2010b; Mulder et al. 2008; Mulvenna et al. 2010; Schaffers et al. 2012a). As a result of these trends, a large number of smart cities in Europe are using living labs to shape the applications and services being developed for their citizens, at both micro- and macrolevels. Some high-profile examples include Copenhagen, Amsterdam, Vienna, Barcelona, London, Hamburg, Oslo, Brussels and Frankfurt (Cohen 2012). Despite the wide interest in this approach, however, stakeholder engagement in the smart city living lab is yet to be fully understood by researchers and practitioners alike, as are the effective ways for implementing it along with the real benefits it may deliver.

In the new field of smart city Europe and the FI, there is a growing recognition that open innovation can be a gateway to grasping the nature of this phenomenon (Almirall and Wareham 2008; Carter 2011; Draetta and Labarthe 2010). In an earlier work, one of the authors of this study (Paskaleva 2011, p. 161) observed that '[ ]…open innovation is a new paradigm for the Smart City where government and developers draw on the expertise, skills and knowledge of the citizens to co-produce urban services that are directly relevant to its citizens and their environment'. In this way, she suggested '[ ]…open innovation becomes an integral part of a much broader shift across urban sectors and city networks that are most visible in forming co-productive relationships between the public, private, academic and voluntary stakeholders'. She further stated that 'In the course of this trend, new models of production and consumption of public services emerge, where boundaries between producers and consumers are becoming blurred and involve both formal and informal interactions between the providers and the users, to share the values, abilities and capacities they have'. However, to move forward on this innovative form of collaborative processes, a new logic, principles and agendas appear necessary for the smart city. Amongst these, those relevant to sustainable stakeholder engagement in innovation processes are amongst the most pressing. Clearly, to create a smart open innovation urban ecosystem, we need to first define what constitutes stakeholder engagement in the living lab as well as the conditions and the factors that lead to it operating effectively.

Recently Gould (2012) found that there is a positive relation between open innovation and stakeholder engagement (see also Ayuso et al. 2011). By integrating recent developments in stakeholder theory with a process-based view of

open innovation, Gould claimed that the focus should be on value creation in the building of the relationship. To further the discourse, he also pointed out that more detailed identification and analysis of the specific processes involved in both open innovation and stakeholder engagement are evidently necessary, particularly, as he stressed, '[ ]…in defining and mapping the specifics of stakeholder relationships and engagement processes in the context of open innovation' (p. 3). If a smart city living lab is viewed as an open innovation urban ecosystem, then identifying and involving each city's unique set of stakeholder groups and individual citizens in forming a smart city network for the co-production of new services seems a logical first step forward. However, how to do this remains largely unexplored till now. This chapter is an attempt to advance understanding on this issue. The study reported seeks to further debate about stakeholder engagement in the smart city living lab with regard to the development of FI services. The latter are treated in this chapter as software applications about the city, co-produced with their citizens, in their city and localities, with various ubiquitous computing interfaces such as web through laptops and tablet computers, mobile smartphones with locative and augmented reality content, or open sensor networks and NFC/RFID interfaces (based on Lemke and Luotonen 2009). Two important issues are at the centre of practice domain. First, 'How can citizens be effectively and efficiently involved in the co-production of innovative smart city services?' And second, 'How to engage with the urban stakeholders in ways that provide for not just a better access and inclusion for citizens but also that empower them to act as a catalyst in transforming the dynamics of smart city services?' (SmartiP 2010). It would seem that adopting a living lab approach holds out promise of the wanted answer for many smart cities in Europe. Yet, despite many practical efforts that have already been made, as Paskaleva discovered '[ ] …cities still need to reconfigure what they take to be the underlying role and assumptions that shape stakeholder engagement' (2011, p. 170).

Although much of the current work on the smart city emphasises the role of stakeholder engagement in the co-production of services, discussion about how this should be achieved remains vague and there are far too ambiguities as yet unresolved (Kujala 2003; Schaffers et al. 2012a). For example, most studies talk about 'user participation' and/or 'user involvement', while only a few use the concept of 'stakeholder engagement'. There are no major works that deal with the differences raised by this vocabulary, and what they mean in practice in detail. Important insights about the nature of the process in reality and the factors that influence its success remain lacking. Hence, it is unclear whether stakeholder engagement in the smart city living labs is actually working and whether, in practice, it is producing the desired outcomes as well as the impacts sought. As a result, we still know surprisingly little about this aspect of how the 'smart city' works. In this sense, the vocabulary of stakeholder engagement hides as much as it reveals. Are cities really getting effectively involved in the co-production and in the use of new and innovative smart services? At present, such questions have to remain open. Instead, it seems fair to say that, despite the growing rhetoric and the many EU-funded efforts, whether urban communities in Europe have really risen to the challenge of

delivering the expectations raised for the smart city continues to be an unanswered question.

By looking at leading edge literature across the fields of smart cities, open innovation, living labs, stakeholder theory and participatory design—as well as the experiences of five cities in Europe—this chapter attempts to shed light on the theme of stakeholder engagement in the smart city living lab. In the sections that follow, we present a framework for how stakeholders can productively work together to co-produce more satisfying services for them all. Treating stakeholder engagement as a gradual *process* by which a smart city involves its citizens in the co-production of local services that will enhance their lives and the attractiveness of the city to people, businesses and tourists, our focus is on the underlying conditions that makes this complex engagement 'work'. We touch upon two important dimensions operating here (i) the 'soft relational factors', relevant, as some authors call it, to 'stakeholder involvement', a construct associated with the importance and the personal relevance that users attach to either a particular system or the information society in general (Lin and Shao 2000) and (ii) the 'hands-on' participatory activities which emphasise democratic 'user participation' in system development through prototyping and workshops (e.g. Hwang and Thorn 1999). We stress that the term 'stakeholder engagement' is a wide, encompassing concept that refers to both to the process and to the activities involved in the co-production of innovative urban services along with the social connections and relations that citizens develop within a smart city ecosystem.

We employ a systematic methodology. First, based on a preliminary critique of some of the more rhetorical aspects of how smart cities need smart citizens, we present an overview of the concept of 'smart city stakeholder engagement' and its application in the living lab to the co-production of smart city services. We offer a critical review of previous discussion of such engagement, emphasising the need of breaking up the process into its constituent and sequential stages along with the skills and the expertise necessary to launch these and then maintain successful co-production activities. We then define these components (process stages and related activities) as two main ingredients that are essential to make a living lab'work'. Building on cross-fertilization of state of the art concepts and approaches, our analysis goes further to position stakeholder engagement in the context of the urban ecosystem—the amenities afforded by a specific place and culture—so called 'Arenas' where co-production takes place. We then provide a focussed and operational framework for the stakeholder engagement and construct and present evidence about its meaning in the co-production of smart sity services. The stakeholder engagement practices adopted by the Peripheria project pilots (Linde et al. 2012) are shown to involve a systematic process that moves from stakeholder enlistment and enrolment, through dialogue, to participation in innovation networks. Through this process, the living lab arena becomes populated with both people and their ideas. We identify the elements that can characterise this new urban phenomenon in service production as a means of collaborative design, development and deployment of innovative smart city services. Here we seek to bring clarity to the sequencing of the phases of stakeholder engagement and to identify the expert facilitation

and capacity building necessary to support service co-production. Our analysis thus identifies, through both theoretical contextualisation and grounding in real case studies environments—for the first time to our knowledge—the main phases of the process, their accompanying activities, and the key factors determining its effective implementation in a living lab as an open innovation ecosystem. We try to address the need for empirical verification of the relationship between stakeholder engagement and open innovation by questioning some of the underlying assumptions and contradictions hidden within the concept of a living lab's ecosystems of innovation. To aid this critique, the chapter also explores to the extent to which smart cities can themselves be understood as living lab ecosystems and we speculate on some general principles which would make them more progressive and inclusive. By offering a critical review of Peripheria project's original aspirations as well as its actual performance in the area, we have elaborated a set of lessons learnt from the current state of play in stakeholder engagement activities in the project's five pilot cities. Finally, we attempt to answer 'What is needed to make a Living lab really work?' by outlining a set of propositions about the success factors that are crucial for setting up and running successful stakeholder engagement. These propositions define both a policy agenda and a set of working practices for co-production processes in smart cities.

2 Research Framework

2.1 Underlying Assumptions of Smart City Service Development

In the context of the European approach to the smart city as a twenty-first century paradigm of urban development, the 'smart city' is no longer just about advanced technology and infrastructure. Now it is also about using ICTs to create the more sustainable and inclusive city, in which the social and relational capital are the driving powers. This reflects a belief that more citizens should be included in the building of the smarter city and that social innovation should go hand in hand with the technological changes. In addition, to increase democracy and governance in the smart city, citizens and stakeholders are expected to increase their 'say' in urban decision-making, particularly in relation to the development of public services (see e.g. Deakin and Allwinkle 2007; Paskaleva 2011; Lemke and Luotonen 2009). This conception of introducing stakeholders' social capital into the operation of the smart city constitutes a new paradigm that is closely linked with the recent interpretation of 'open innovation' as being directly relevant to 'stakeholder engagement'.

Political science and innovation theory underline the inventive and collective aspects of open innovation, defining it as an arena of 'altruism', 'creativity' and 'sociability'. In other words: 'The act of creating for oneself and one's fellows is an act

both of self-reliance and of fellowship' (Benkler and Nissenbaum 2006, p. 409). But open innovation is not only regarded as a means of contributing to the individual and to the common good but also as 'a vital force in research and experimentation and an innovation model to create the right products and services' (Thrift 2006, p. 289) so that 'users can innovate to develop exactly what they want and need' (von Hippelm 2006, p. 1). However, as a majority of researchers emphasise the merits of open innovation for product and service innovation, it is Thrift who went further to say that the latter has also the potentials to make space active and galvanise its values: 'A shift is taking place in how the business of invention in today's capitalism process is understood. This shift leads, Thrift stated, to '[…] new fuel sources […]', which activate 'forethought', 'consumer ingenuity' and 'space', thus drawing the attention on the territorial projections of open innovation and to the need of '[…the more active use of space to boost innovation and invention' (p. 290). Taking this perspective forward means that the smart city is an ecosystem in which the citizens can come together to cocreate smart services that are closely relevant to their specific needs and desires, as well as to the functionality and quality of the places they occupy. Collaboration through working with others to produce or create things is rarely an easy undertaking. So the issue of stakeholder engagement in the co-production of smart city services has to be treated as a highly significant theme in the Smart City construct, where living labs are taken to be 'playgrounds' for open innovation processes (EnoLL n.d.).

Despite growing interest, stakeholder engagement in the smart city remains a fuzzy concept, not well defined neither in theoretical research nor in empirical studies. Various meanings have been attached to it. Interpretations vary due to specific contexts and are expressed by the use of multiple terms—'consumers', 'users', 'peers' or 'stakeholders'. Research in successful IT systems development has strongly emphasised that extensive user involvement is not only important but also absolutely essential to system success (Barki and Harwick 1991; Cavye 1995; Harris and Weistroffer 2009; Hartwick and Barki 1994). Often employed indiscriminately, the concept has been used not only to refer to different subjects and issues but also to different stages in the process too. A common assumption, however, has been that stakeholder engagement has a technological context where it means involving the users in information system development for improving system quality and ensuring successful system implementation (Pallot et al. 2010). More recently, with the growth of social media, discussion has also moved on to data creation and its wider use. Yet in the course of recent developments amongst the many EU projects on smart cities and living labs, it has become apparent that to build the smarter city, there is a strong new need to not just involve potential users but also to engage the urban stakeholders, as representative of the broader citizenry, in the processes of service development, by using open innovation models (Peripheria 2010; SmartiP 2010).

As a result, many of the new communities that are growing around smart cities and living labs initiatives are now emphasising the importance of smart citizens and their role as codevelopers, together with a need for constant improvement of the public-private-people collaboration to give an integrated (social, economic, environmental)

meaning to smart city applications and services (ENoLL 2010). Existing studies, though few, provide sufficient evidence that motivating stakeholders to get together in co-design, as an initial stage of the co-production process, has proven a considerable challenge. And so there are many outstanding questions about how better-grounded approaches to engagement can be exploited to develop citizens-driven smart city services (Draetta and Labarthe 2010; Cleland et al. 2012; Pallot et al. 2010). These are accompanied by a series of related issues about what kind of ecosystems, processes and networks are necessary for the smart cities to be driven by demand (application-pull instead of technology-push) (EC 2012). It is becoming clear that with the rising profile of the smart city in Europe and globally, unpacking and answering these questions is becoming a pressing need. In the next section we attempt to identify the key stages and factors in stakeholder engagement in the living lab to make sense of widely differing uses of the more popular concept of 'user involvement' in both literature and practice on the smart city.

2.2 Open Innovation and Stakeholder Engagement

Open innovation is held up as one of the main elements of the strategic European Innovation System, emphasising stakeholder involvement in a Quadruple Helix Innovation Model where seamless interaction and mashup of ideas are created through open innovation between academia, industry, governments and citizens in innovation ecosystems (EC 2014b). Aligned to this is the emerging new Open Innovation 2.0 paradigm which is about value creation, sustainable prosperity and well-being through deep networking and collaboration amongst all actors—here how citizens can engage and contribute to the innovation process is a particular focus of attention (EC 2014c). With the recent advancement of the living labs movement in Europe, opportunities for open innovation in the smart city have grown as well. Since the establishment of the European Network of Living Labs in 2006, more than 300 living labs cities have illustrated a desire to engage users in building up inclusive services and products to improve the quality of life of their citizens (ENoLL n.d.). Commonly defined as user-centred innovation ecosystems based on a business-citizens-government partnership (Pallot 2010), liiving labs are widely viewed as effectively enabling users to take part, not just in the research but also in the development and innovation process in cities and their regions. Using open, participative innovation, living labs can encompass societal and technological dimensions simultaneously in a 'public-private-people partnership' to develop citizens services that are more personal, optimal, and affordable, as service providers (e.g. the public sector) can find new approaches to their service provisions, so making service creation and personalisation more affordable for them as well. In this way, proponents say, living labs can act while open functional platforms where all stakeholders, including end users, can interact and new ideas can be captured in a less costly and more effective way. Benchmark examples of living labs are considered as innovation environments in which technology is given shape in real-life situations and in which (end) users

act as 'co-producers' (Cunningham et al. 2012, p. 22). So, unlike in mainstream approaches of user participation in information system development, which emphasise the involvement of the users in system usage and/or satisfaction (Bourdi et al 1986), in living labs users are not only treated as objects in the innovation process or as mere customers but also as early stage contributors and innovators (Ballon et al. 2007). In living labs all can become innovators in a co-creative process based on connectivity of people operating through their roles within a community. Users come with their different knowledge, skills, experiences, roles, points of view and needs, and all can contribute positively to the innovation process (EC 2014d).

With the recent explosion of user created content on the web, the potential for members of the general public to become co-creators of local services has exponentially increased. Thus, the living lab approach has advanced as a key mechanism for delivering the smart city Europe, based on innovation through the involvement of citizens and all other kinds of stakeholders. An earlier study of smart cities as a nexus of open innovation concluded that understanding these principles at the onset of service or product co-production is an important condition for creating and maintaining successful stakeholder engagement in the living lab (Paskaleva 2011). Beamish et al. (2012), in their book on *Trial Toolkit for User Participation in Living Labs*, concluded that what should be central to the living lab, as opposed to other R&D innovation labs, is their openness, influence, value and sustainability (p. 22). Regretfully, however, they failed to deconstruct the concept in a way that can be useful to those who wish to engage with it seriously. Below we attempt to operationalise this concept. In the literature on system development research, there is an abundance of methods for involving users on offer—such as lead user (Von Hippel 2006), user-driven innovation (Von Hippel 1986), user-centred design (Von Hippel 2006), and user-created content (O'Reilly and Battelle 2008). But there are none so far for stakeholder engagement in the domain of living labs in the context of user co-creation research (Prahalad and Ramaswamy 2000). On the other hand, stakeholder theory suggests that understanding stakeholder engagement requires evaluation of the nature of the multiple interactions and interdependencies between and amongst the stakeholder groups involved (Gould 2012). Frooman (1999, p. 192) underlined the importance of evaluating the relationships between the multiple actors. Rowley (1997) discussed stakeholder theory in relation to social network theory and distinguished between various network configurations. Zietsma and Winn (2008) and Lewric et al. (2007) went further and argued that networks of stakeholder relationships are complex and nuanced. Participants in a stakeholder network may have significant interaction with other participants outside the control of the focal network, implying that these relations should also be studied as part of the process. Lamberg et al. (2008) pointed out the significance of path-dependence in stakeholder relationships, underlining the importance of both initial conditions and the sequence of events that transpire. This aspect is of particular interest to our current research. Clearly, what seems most important here is to identify the key principles of stakeholder engagement, map out the different stages that need to be worked through and the activities that need to be undertaken, and then delineate the mechanisms and forces that keep the process and the structures going, in a

sustainable and effective way (see Sloan 2009 and Pamela 2009). This leads us to the question: what is needed to make this process work effectively?

In many traditions within service or product development, and in other design domains, a major focus for user involvement is on testing and evaluating, with the implication that users come in later in the development process, that is, when there is already something to test. Fundamental to the living labs' approach is to engage users at the very beginning so that they can act as co-designers as well as co-developers. There are strong reasons for trying to achieve this. Not only are there benefits from insights into user preferences but also, and even more important, it can help deliver a more committed level of engagement. Thus, we need to distinguish between 'involvement' and 'engagement' in the living lab.

Twenty years ago, Greenbaum and Kyng (1991), when studying cooperative design of computer systems, came up with the idea that 'user participation does not mean interviewing a sample of potential users or getting them to rubber stamp a set of system specifications. It is only recently that studies start to recognise that the active involvement of users in the creative process, called 'design', is really what matters. Ståhlbröst (2010) also noted that '[ ]…the participation concept is imprecise, and techniques claiming to be participatory treat users as sources of information instead of equal partners' (p. 14). But it was Kviselius and Anderson (2009) who argued that, in the living lab, it is not only users who should be involved: 'Activating of not only customers but also other relevant user groups like staff of living lab partners is a way to increase input of ideas into the innovation process.' (p. 84). Yet, to date, general citizens remain marginal to the scope of how living labs have been operated.

User incentives are considered focal to the process. A living lab should aim at providing user incentives relevant to a specific stakeholder group to increase the range of submitted problems and solutions from these users. Self-fulfilment and learning, joy of everyday innovation, career progress, the call of duty and being part of a bigger whole have all proved to work as strong motivators for user contribution to innovation. Yet in the living lab, the key question about the 'real incentive' to get stakeholders to engage in co-production remains poorly framed. If it was better understood, then perhaps it would not be so difficult to get people to join in co-production activities. Co-production was first mooted when Finland held the EU presidency in 2006. Critics said that it was simply a ruse by which Nokia got its customers to tell them what services they wanted, got them to help design these for free, and then sold them back to the customers. All this suggests that one should not be too dewy-eyed about co-production.

A number of recent studies have delineated various important elements of engagement. Hart and Sharma (2004) showed that engaging fringe stakeholders for competitive imagination is also important for competitive product design. 'Rather than engaging only known or powerful stakeholders concerning existing businesses, such an approach instead seeks to systematically identify, explore and integrate the views of those on the periphery or at the 'fringe'—the poor, weak, isolated, non-legitimate, disinterested and even non-human' (p. 8). The authors offered a 2-step method for involving both powerful stakeholders as well as silent

voices: (a) *Fan-out* in which boundary spanners engage core stakeholders including suppliers, customers, distributors, local communities, NGOs and government agencies to identify further networks of these core stakeholders and the possible negative social and environmental impacts of the operations of each stakeholder in the network and (b) *Fan-in* where close interaction with fringe stakeholders within remote contexts is encouraged to generate new product ideas and business innovations and to transfer tacit knowledge (p. 15). What is more, the authors also suggested that 'stakeholder networks' have to be established that will engage with both the powerful and silent parities. What was not mentioned, however, was that conventional managers, unlike intermediaries who deliberately seek to span group boundaries, do not easily seek stakeholder engagement. Thus, a key question becomes 'How to get managers to do that?' But they left this question unanswered. How to create a will amongst managers for engaging stakeholders with silent voices is another aspect that needs to be explored as well.

Willingness to engage is embedded in the issue of value creation and the benefits that this brings to the individuals and stakeholders involved. The perceived value added of co-production in the living lab, starting with the co-design, has multiple dimensions. In the smart city, the value added to the citizens participating in 'co-production' is that they have a real incentive to become more involved as 'co-producers', as well as 'co-users', of the content and the services available. By doing so, they have access to creative communities, acquire new skills, employment opportunities and service choices that address their real needs and wishes, potentially leading to a better quality of life and better places to live in. Generating long-term benefits also requires making co-production more sustainable and resilient in both time and in terms of relational capital, by embedding a sustainable engagement of citizens in all aspects of the innovation process. Fostering new standards of mutual stakeholder partnership so that people are recognised as assets, and so that their work to make the city more sustainable and socially just is valued, should become a key yardstick. From this perspective, sharing responsibilities for providing local services between public authorities and local citizenry offers a new rationale for making 'public-private-people partnerships'—seen as a viable and desirable leap forward (SmartiP 2010).

Alongside these trends, and the modes of citizens engagement that shape the urban open innovation ecosystem, new forms of 'urban governance' need to occur as well. In 2008, in an effort to draw up the essentials for living labs, Mulder et al. (2008, p. 4) wrote that 'the governance perspective is key to user involvement'. According to them, 'governance' deals with the organisation of the living lab as a whole as well as the interactions between its constituent members. Examples are the commitments and responsibilities accepted by members, financial arrangements for the joint infrastructures, as well as mutual arrangement in respect to using each other's technologies and services. Aspects surrounding priorities for the living lab as a whole and future directions are also part of this perspective. The openness or the closeness of the living lab to other parties, and the amount of public and private funding invested in it, are other key aspects. Last but not least, contextual issues dealing with the overall management structures and the goals of the organisations

involved—whether research driven, innovation driven or business driven—also need to be considered. In addition, as Kviselius and Anderson (2009), in dealing with living labs as tools for open innovation, found out that '[ ]…potential frictions amongst the stakeholders can be handled through emphasizing early discussions among them and putting governance processes in place, including various legal scenarios for commercialization of open innovation products' (p. 90).

Overall, what these authors have emphasised is that 'governance' principles—such as openness, fairness, accountability and democratic decision-making, to mention only a few—should be applied throughout the whole process of stakeholder engagement so that open innovation can facilitate successful co-production activities in the living lab. Otherwise, as Froessler et al. (2007) noted, 'In absence of an overall strategy and related governance structures, other sources of legitimacy and a mandate are needed' (p. 17).

2.3 Applying a Living Lab Approach to Stakeholder Engagement in the Development of Smart City Services

Having looked above at the context of the engagement process and its relationship with open innovation in the living lab, this section attempts to unpack the concept of stakeholder engagement further by embedding it in the phases of producing open innovation smart city services and particularly in the activities leading to successful service co-design. Existing literature on the topic is strikingly limited, constrained primarily to highlighting the importance of 'user involvement' or 'stakeholder collaboration' in the various processes of creation, exploration, experimentation or evaluation—or, as others see them in inception, definition, operation and completion of service development (Carter 2011). Similarly, the vocabulary used about the processes involved varies tremendously—from 'co-production' to 'co-development', 'co-design', or 'co-creation'. All these are in current use and all have different overtones. In this study, the term 'co-production' is preferred because it suggests the development and the deployment of innovative ideas, in which co-design is considered the first step of bringing people and ideas together in a co-creative process (joint innovation). This approach is consistent with a recent high-profile NESTA report on the future of public services in the UK (Boyle and Harris 2009) which revealed that co-production offers a revolutionary way for citizens to participate not just in the design but also in the delivery of services by contributing their own wisdom and experience in ways that can broaden and strengthen services and make them more effective.

In this chapter, we draw on the findings of Mulder et al.'s recent work (2008) to identify the essentials that make a living lab harmonised, from an organisational point of view, by motivating users to participate in the design process because of the individual advantages they each achieve by being part of a living lab. The contextual issues, as they called them, are those that deal with social networking aspects and all kinds of cultural and legal differences between them and the settings. More

importantly, as Schaffers et al. (2012) added in the FIREBALL White Paper 'Smart Cities as Innovation Ecosystems Sustained by the FI', '[ ]…despite the growing rhetoric, there is in fact little evidence that smart cities are realizing their visions first, and even more so there is a lack of attention to engagement and empowerment of citizens, SMEs and other entities realizing their needs or ambitions, and of how citizens are empowered to participate in urban development and social innovation in general' (p. 57).

Clearly, putting more emphasis on stakeholder engagement in the early stage of service development is one key element to setting up effective stakeholder innovation networks. But once the environment is created and the collaboration is initiated, can we just snap our fingers and say 'innovate'. This is unrealistic, given that many stakeholders will have never worked together before (Froessler et al. 2007, p. 17). Supporting the generation of new ideas across a heterogeneous collaborative workspace—the urban ecosystem—is a process that requires sharing of the principles, structures and a common agenda in a continuous process. But as this process seems complex, using unobtrusive methods for seeking harmonisation is essential (Mulder et al. 2008).

In order to maintain working stakeholder collaboration, the role of intermediary, 'knowledge brokers' appears fundamental to the different stages of the engagement process. In the living lab, stakeholders can be drawn into experimentation through targeted approaches by local authorities and associations or by universities and businesses, as multipliers and mediators for indirect recruitment. Activities can focus on mediation and translation between network actors, who may have different interests and different understandings of the problem domain. Though in the initiation stage, only limited number of people can be involved in setting-up a shared understanding of the project, a larger group of people, representative of the different organisations (and interest groups) concerned should be brought to the process, to start the sense-making process (Froessler et al. 2007). This brings two key questions to the fore in the context of a living lab: Who can act as a knowledge broker and who has the capabilities to perform this role? And from which of the parties present—the developer, the city or other stakeholder groups—should this knowledge broker come?

There is also the issue of good project management necessary for making the purpose of co-design clearer and productive. As Levén and Holmström (2008) discerned, consumer co-creation and the ecology of innovation in the living lab depends on establishing active process management from the very start of the joint activities. This is needed to make sure that the essence of the open innovation co-production project is indeed the co-evolution of the network of actors, and affected by any individual actors. The essence here is that 'good management' makes both the benefits to stakeholders and what is expected of them is clear from the outset. Nontechnical participation activities at the initial stage of smart city service co-design appearing are also critical for bringing the stakeholders together (Bergvall-Kaareborn et al. 2010): 'A recurring challenge within participatory design concerns how to communicate the needs of users in such a way that developers can understand them while, conversely, developers need to be able to feed back their understanding of system requirements in a manner such that the users can make sense of it. Therefore

nontechnical participation activities, such as paper-based techniques or open debates, should take place rather than just producing technical prototypes. The process can involve various types of engagement, including focus groups, questionnaires, diaries, and picture-taking, to collect different types of data and also to allow for different formats for user contributions'. As this quotation makes clear, boundary objects (whether paper- or image-based or even vocalised) have to be constructed that are both meaningful and acceptable to all of the parties that are seeking to collaborate. This is necessary because, in the absence of such shared boundary objects, one or more group of stakeholders may feel that they are being marginalised or excluded from the epicentre of co-production decision-making (ibid, p. 324). And since living labs mostly evolve around the use of technologies in the development of products and services, the effective usage of electronic collaboration tools with an emphasis on simplicity and iterative feedback-loops are crucial for inviting users into the living lab open innovation process.

To help cities that were struggling on this front, the Peripheria project developed representation of an open innovation service presented in Fig. 1.

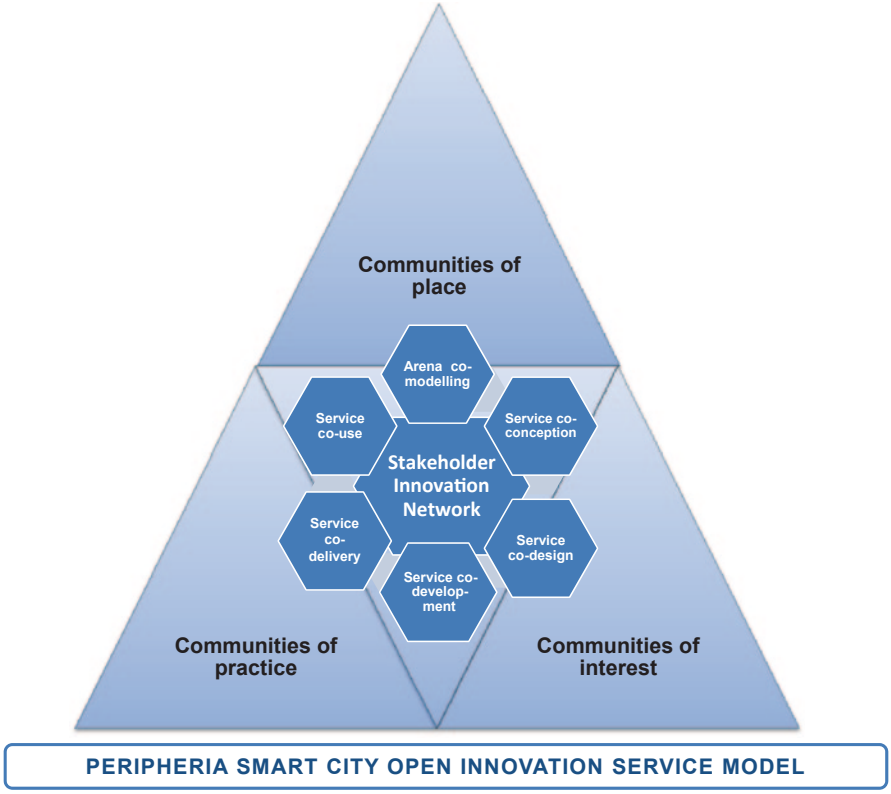

Fig. 1 Peripheria smart city open innovation service model (Paskaleva 2012, p. 9)

This model allows a focus on both process and product—the development of a specific service—aligned with the stakeholders and their networks. In this way, the Peripheria Model illustrates the inter-dependency in the process between the co-production of concepts, design, development, delivery and use. These are revealed as components of a self-sustaining co-evolutionary process that can provide for outcomes of the services, real and/or potential, that are desired by the citizens.

3 Methodological Approach

Based on the proceeding theoretical analysis, a path-dependant and forward looking process diagram for stakeholder engagement leading to service co-design is proposed for this study, presented in Fig. 2:

As Fig. 2 illustrates, there are four main steps of stakeholder engagement which are key to successful service co-design.

Step 1 Stakeholder enlistment (i.e. identification and enlisting of stakeholders who need/wish to be engaged).
Step 2 Stakeholder enrolment (i.e. approaching stakeholders and persuading/motivating them to become involved).

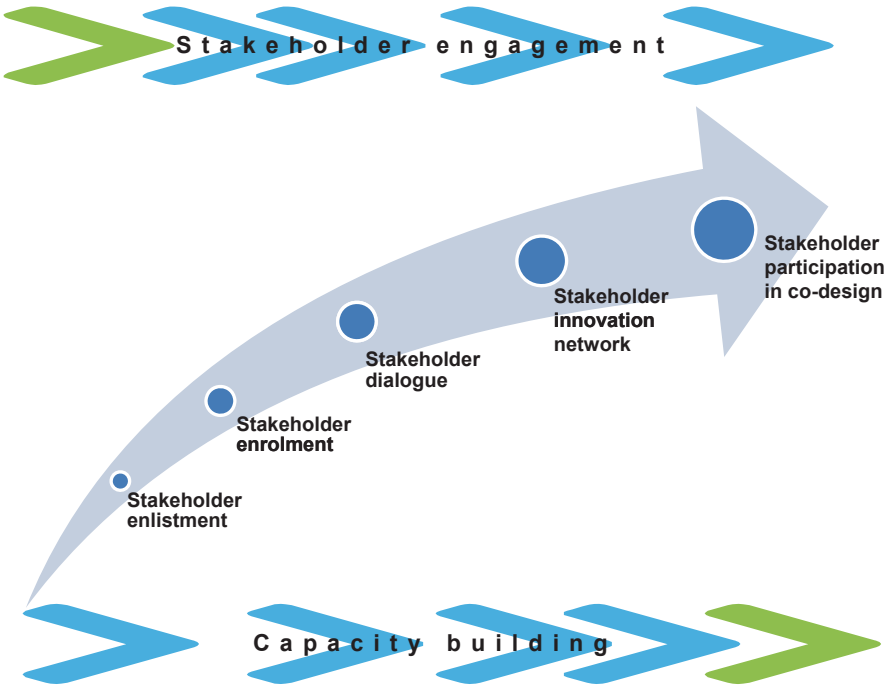

Fig. 2 Smart city stakeholder engagement process in the living lab leading to co-design

Step 3 Stakeholder dialogue (i.e. introducing stakeholders to each encourage them to talk to each other with the objective of constructing some sort of consensus (shared vision, scenario) about what needs to be done).
Step 4 Stakeholder innovation network (committed stakeholders and actors form a coalition for working together on an agreed agenda and process of service co-production, leading to active co-design).

This sequential approach is based on an appreciation of the need for a parallel set of stakeholder capacity building activities supporting engagement from the start which enables stakeholders to co-design smart city services by developing their skills, knowledge and techniques for collaborating and co-producing. This sequencing allows for the analysis of, and support for, the multiple steps in stakeholder engagement leading to successful co-production. The approach also draws attention to the need to identify the roles of stakeholders and to finding out the key drivers of their willingness to engage in a participatory co-design process. Finally, it signals the importance of those factors that sustain and enhance their engagement throughout the process—whether they represent institutions, communities, whether they are present as organisational leaders and motivators, or acting as intermediaries.

By attempting to track how, in practice, such stakeholders were enrolled and engaged in a dialogue, and why certain types of forms and events were used by the Peripheria pilots, we aimed to learn more about how sustainable engagement of the urban stakeholders in the co-production of smart cities services can be successfully facilitated.

4 State of Play

4.1 The Peripheria Project

The objective of the Peripheria project (Networked smart peripheral cities for sustainable lifestyles)—an initiative funded by the European Union's Smart Cities portfolio of projects, which ran between 2010 and 2013—was to deploy convergent FI platforms and services for the promotion of sustainable lifestyles in emergent smart cities in Europe. A guiding principle of this action research-based project was that if smart cities are to deliver a better quality of life in more attractive urban areas, new ways of engaging with citizens need to emerge not just to provide them with better access and inclusion but also to empower them as a catalyst in transforming the dynamics of the development and management of city services. Attaining these goals required adopting sustainable methods for involving urban stakeholders, using *bottom-up* approaches and living labs methodologies. Peripheria's FI Platform is convergent with *social interaction* being central, occurring at the 'run-time' moments in which infrastructures and services can be jointly and dynamically discovered, invoked and composed, in concrete situations and places (Paskaleva 2011). In Peripheria, social interactions occurred around and within var-

ious urban ecosystems, called ‘Arenas’. These were considered as particular types of urban settings, each with their own social, economic and environmental attributes and infrastructural characteristics where technological and social innovation blend, and where multiple actors participate to co-create the services they want, by driving the convergence of technologies and applications based on their needs and wishes (Peripheria 2010).

From an urban ecosystem perspective, a city street, square, park, or a neighbourhood can be labelled as an ‘Arena’—seen through its past, presence and future, as a mixture of urban fabric, local communities, events and activities. It is in such arenas that urban policies become coupled with the specific aspirations and wishes of citizens about their wellbeing now and in the future. In the Peripheria Arenas, these elements came together, driven by citizens’ and/or policy-makers’ initiatives—called in the project a ‘Challenge’—so that problems were clearly understood and key stakeholders were engaged and their contributions defined. These Challenges developed shared visions of new services and applications that could be launched to co-produce new smart city services (Marsh 2013, p. 13). In the participating cities, service co-production occurred in five archetypical arenas:

- *Smart Neighbourhood*: where media-based social interaction occurs (Malmö, Sweden)
- *Smart Street*: where new transportation behaviours develop (Bremen, Germany)
- *Smart Square*: where civic decisions are taken (Athens, Greece)
- *Smart Museum and Park*: where natural and cultural heritage feed learning (Genoa, Italy)
- *Smart City Hall*: where mobile e-government services are delivered (Palmela, Portugal).

By using a citizen-centric, discovery-driven approach, each arena was treated as a space where smart city components came together to initiate co-production processes for new urban services. But different stakeholders groups—civil servants, citizens, academics, business groups or ICT providers—did not have to all come together in one single place or process: rather they constituted an innovation network that could be drawn upon when demands from citizens came. Understanding when, where, as well as who should get engaged, was found to be key for making an arena active for co-production. Achieving this posed many problems as described below.

4.2 Setting Up of the Pilots

The following analysis draws on the stakeholder engagement model proposed above. Both the process and the activities of the pilot cities are the focus of attention here. In practice, engagement with stakeholders in the each of the cities’ arenas was launched in the absence of a comprehensive understanding of what this approach needed to involve. The current study occurred as a result of the demands and

the problems that the cities started to experience in setting up their co-production process. As such, it looks backwards to reflect on those developments and their results as reported by the pilots themselves.

4.2.1 Stakeholder Enlistment

To identify the relevant stakeholders in each of its pilot cities' arenas, members of the Peripheria project found that creating a 'smart citizens' community'—to bring together citizens, government and developers—was an effective mechanism for achieving the goals of creating new, dynamic, and viable networks and relationships in the smart city. This approach built on the notion that, when local organisations and other types of stakeholders are well-connected within their communities, they can bring detailed and locally specific knowledge, and a grounded understanding about local needs and how they can be met, as well as access to local assets and resources. This experience led to the suggestion that stakeholder engagement should involve not just key experts and institutions in the field of smart city services but also a variety of different kinds of communities of stakeholders:

- Communities of place (CoP) (e.g. resident associations)
- Communities of interest (CoI) (e.g. sports associations and environmental groups), and
- Communities of practice (CoP) (e.g. educational groups and university departments)

In the Peripheria project, communities of place were expected to act as the "champions" of mapping exercises because they were expected to be located directly within the arenas, physical spaces of the city. Communities of interest and practice possess spatial boundaries, but these may extend further—regionally, nationally or even internationally. Involving each kind of community in the (networked) pilot framework and platform meant asking participants located in the arenas to help identify other major stakeholder groups that would need to be engaged in co-production of new services (Cooper et al. 2011, p. 35).

In the early stages of the project, a general framework for stakeholders' identification was developed (this was later called upon for evaluating Peripheria's success) (Cooper et al. 2011). The aim here was to show the range of stakeholders, pilots had identified as key actors to be involved in their smart city arenas. A list of the stakeholders was built in each arena through an exercise started at Peripheria's first Plenary Meeting in Genoa in February 2011. Representatives of each pilot city were asked to identify whom they currently saw as major stakeholder groups that would need to be engaged through co-production activities conducted in their respective arenas, including both:

- Stakeholders that influence decisions, and
- Stakeholders impacted by decisions (typically taken by others).

The intention here was to make city pilots' representatives explicitly aware that these categories are not discrete and that in the context of the living labs, both 'powerful' and 'silent voices' needed to be considered. The stakeholder groups identified through this exercise are shown in Table 1.

As Table 1 reveals, all pilot cities intended to engage multiple groups of stakeholders in their co-production activities. Malmö and Athens were seeking to engage with most and Bremen with least. However, this only refers to the different types of stakeholder groups that each pilot was seeking to engage. Bremen, for instance, planned to engage a wide range within a specific stakeholder group—business organisations. All of the cities were seeking to engage with high-level city officials, especially Athens, Genoa and Palmela. This reflected the central position of city administrations in these pilots. Most were also focused on engaging citizens, particularly residents. At that time, only Bremen declared a specific interest in engaging with visitors to its Arena (in the form of shoppers). Later Genoa did so, since its Arena was a museum open to visitors—both local residents and tourists—in a public park.

Locally based citizens were identified as a key stakeholder group in all five arenas. Individual businesses and business associations were mentioned frequently, with the former being perceived as harder to engage than the latter. Only one type of community of place—residents' associations—and one type of community of practice—educators—were cited in this early stage. Both were seen as relatively easy to approach and engage. Most of the other types of organisations cited were only identified in one pilot each; such communities of interest, it was expected, would be relatively easily to access and engage. Two stakeholder groups were identified as difficult to access and/or engage—young people and ethnic groups.

In the initial phase of stakeholder engagement, the most common approach used by the pilots was to start enlistment activities using established networks and contacts and then evolve the network by adding new contacts over time. When a new stakeholder group was included, its networks of contacts were often approached. One example is how WFB (the Economic Development Department) in the Bremen pilot helped to establish contact with the Lloyd Passage Management Association to develop the new services. In a similar way, the Athens pilot started with staff working within the municipality and used their contacts to reach out to external groups, networks and communities; for instance they recruited a specific volunteer team as a contact to minority communities. The Malmö Pilot also used previously known stakeholder groups such as the 'The Voice and Face of the Street' organisation (RGRA) to make contact with other stakeholders such as the Herrgårds Women Association.

4.2.2 Enrolment

One major challenge that the pilot cities faced was how to motivate stakeholders to get involved in co-production activities. Agreeing to the 'shared outcomes' was seen as one way forward. Early on in the engagement process, an effort was made to

Table 1 Initial list of major stakeholder groups in the Peripheria Arenas

Pilot cities	Athens	Bremen	Genoa	Malmö	Palmela	Total
Arenas	Square	Street	Museum in park	Neigh' hood	City hall	
Types of stakeholder groups identified						
Government organisations and departments			☐			1
Mayor's office	☐		☐			3
Elected city council members	☐		☐		☐	3
City council departments/officers	☐	☐	☐	☐	☐	5
District/street office				☐	☐	1
Transport agency						
Housing co-operative				☐		1
Developers, financiers			☐			1
Residents' association (CoP)	☐					1
Women's group (CoI)				☐		1
Environmental group (CoI)	☐		☐			2
Labour association (CoI)				☐		1
Business association (CoI)	☐			☐	☐	3
Educational group/university department (CoP, CoI)			☐	☐		2
Young people's organization/university students (CoI)			☐	☐		2
Ethnic group (CoI)	☐			☐		2
Faith group (CoI)				☐		1
Charities and other voluntary groups, including NGOs	☐		☐	☐		3
Other public or civic bodies or agencies (hospital, theatre, tourism)	☐	☐				2
Businesses		☐		☐	☐	2
Citizens (residents)	☐	☐		☐		4
Visitors (tourists)		☐				1
Community interest group (unspecified)			☐		☐	2
Totals	10	5	10	13	6	

identify what desired outcomes stakeholders were seeking against five main categories of success that Peripheria had set up for evaluating for its services—wellbeing, prosperity, privacy, security and governance (Cooper et al. 2012, p. 36). The project used these desired outcomes as proxy indicators for what motivated stakeholders to become involved.

Members of the Project's Social Innovation Strand identified, through an all partner exercise, a wide range of 'desired outcomes' being sought by their most significant stakeholder groups. These ranged from 'people feeling that their voice is being heard', to 'improved safety and security/and 'an increased sense of belong'. Each of these desired outcomes was expressed in the form of an imperative to indicate that this is what the co-produced FI services would have to deliver to meet stakeholders' desires.

Establishing specific 'desired outcomes' as success criteria in each of the arenas was considered an important next step. In Athens, for example, stakeholders agreed on a set of desired outcomes such as:

- Being counted
- Being heard
- Becoming more green in their everyday lives
- Becoming proactive and actually participating in co-design procedures
- Forming a new living lab

Subsequently, these desired outcomes were used as key success indicators. Narrowing down was sometimes necessary. For instance, in Bremen 'well-being' was taken forward as a desired outcome as access to 'Information Lounge about occupation of special parking bays and local surrounding of a car park'. Key indicators for this were:

- Time saved for finding free parking bay
- Amount of reduced stress during parking bay finding
- Number of interesting events found through Information Lounge.

As work in the arenas progressed, the stakeholder groups represented in Table 1 changed and grew. More stakeholder groups were identified as significant and so attempts were made to enrol them. Cities also tried to engage more actively with those stakeholder groups that they had identified as 'silent voices' or 'hard to reach', such as workers, tourists and immigrants. Using personal communication and face-to-face meetings for the 'enlistment' of the stakeholders built better stakeholder networks because it is not easy to enrol people in activities that were beyond their everyday experience. Building trust in network relations called for using available personal contacts at the start and then 'snow balling' to gain further contacts. In two of the pilots (Athens and Malmö), the role of digital communication platforms and social media increased as pilot activities intensified.

Contextual differences and city-specific objectives had to be taken into account by pilots in deciding which strategies for stakeholder engagement to use: no 'one-size-fits-all approach' was applicable. In Athens, for example, invoking a co-design

and co-development process that went beyond the client/consultant model arose as an important sustainability principle. The objective of their Smart Square Arena was to create a new open innovation service model. The city worked on stimulating stakeholder activities through existing client/consultant structures and processes, even while adding new actors. In Bremen, some stakeholders (e.g. the shopkeepers' association in Lloyd Passage and the Tourism Department) identified synergies for collaboration involving leading edge technology and/or potential business opportunities. Palmela needed to include representatives from rural areas so addressing local issues with local people was targeted as being of primary importance. In Genoa, accounting for and taking advantage of the specific cultures of the different city offices—along with their existing capacities—meant that engagement within their 'back office' was seen as a first and essential step for ensuring that appropriate external stakeholders could then be brought in.

4.2.3 Dialogue

Getting to know each other and building mutual trust was considered one of the most important issues in the early phases of stakeholder engagement. Just how the cities did this varied considerably. Most initially they focused on discussing online participation with their stakeholder, such as using blogs and social networked media available in their arenas. Malmö, engaged directly with its stakeholders in their existing real-life activities first. Then, as their activities progressed towards service co-design, issues of access and availability of online information were addressed. Online forums, such as Facebook groups used by the climate coaches at the housing co-operative in Malmö, proved of the effectiveness of piggy-backing on already established platforms. This happened in Bremen too. Here, at the suggestion of the Tourism Department, 'Bremen.de'—the local web presence for Bremen—was used to reach out to citizens. Malmö also used the municipality's website as a springboard for public discussions on open innovation issues relevant to developing new services. The main aim here was to understand stakeholders' needs and desires for new services, while building trust amongst them through social interaction and participatory activities. Unobtrusive methods of data collection were used, such as intimate face-to-face meetings where stakeholders engaged in co-modelling their arena's 'Challenges' and linking them to their visions and strategies for the new services, through shared user scenarios and cases.

Technologies, particular ICTs, played a key role in engaging stakeholders in all activities of the pilots. For instance, in Bremen, stakeholders' participation grew as they became involved through workshops in testing and experimenting with new concepts using ICT (e.g. mobile end-devices). Conversely, Palmela worked through focus groups on automotive and e-government technologies as the centre of gravity of its workshops. Using technologies, the pilot cities stimulated their stakeholders to work on three specific themes:

- *Demo-ing* mobile end-devices in Palmela and in Bremen. In Malmö, where many stakeholders had limited technological literacy, a technology developing company was invited to workshops to demo not only ready products but also prototypes. The 'imperfectness' of these provoked co-design aspirations amongst participants on how to improve them.
- *Co-creating scenarios* was central to the approach adopted for developing Peripheria's new services. In Malmö, the delivery partner MEDEA, set itself the goal of co-creating a repository of scenarios to motivate and drive its participants' engagement. Small group brainstorming techniques were used to generate scenarios at a 'Girls' Design' workshop by students and other working with municipality officers and another with climate coaches from housing co-operative. Other pilots undertook scenario building later on, after the establishment of the Peripheria Convergent FI Platform, and mostly enacted them online rather than face-to-face.
- *Public experiments* were also used to drive stakeholder engagement. For example, in Malmö, a public experiment was designed with young people from a particular neighbourhood area using a simple SMS engine for mobile gaming. Performing these games provided a narrative, which was then iteratively referred to by many different stakeholders. Stakeholders' motivations differed; some were interested in potential business models, some in the social interaction the games provoked, and others in the technology itself. The game prompted them to reflect on their practice while using technology to explore models for open innovation leading to more sustainable lifestyles.

The knowledge gained through using technologies was also relevant for other formative purposes. For example, conducting public experiments meant that participants were also enacting their values. Tackling the question 'What shall I do?' gave expression to their intentionality: this might be congruent with what already existed or expressed deviation from current normative practice.

4.2.4 Innovation Network

Pilots differed in how successful they were in engaging with stakeholders through their living labs. Malmö demonstrated consistence in using its networks to create ideas and scenarios collaboratively amongst its participants. In the other arenas, groups of stakeholders might more accurately be described as having used their interaction to pursue their own self-interests. Malmö benefited here from long-term relationships. It ran a living lab before the Peripheria project. Once the project was launched, the co-design of the arena scenarios 'travelled' between different alliances and activities in its already established networks, gaining new meanings as they were interpreted and appropriated by new sets of actors. The Fig. 3 below illustrates how its innovation network was set with stakeholders who each had their own agendas, but displayed a readiness to enter into alliances working on specific and shared challenges through a dedicated development process.

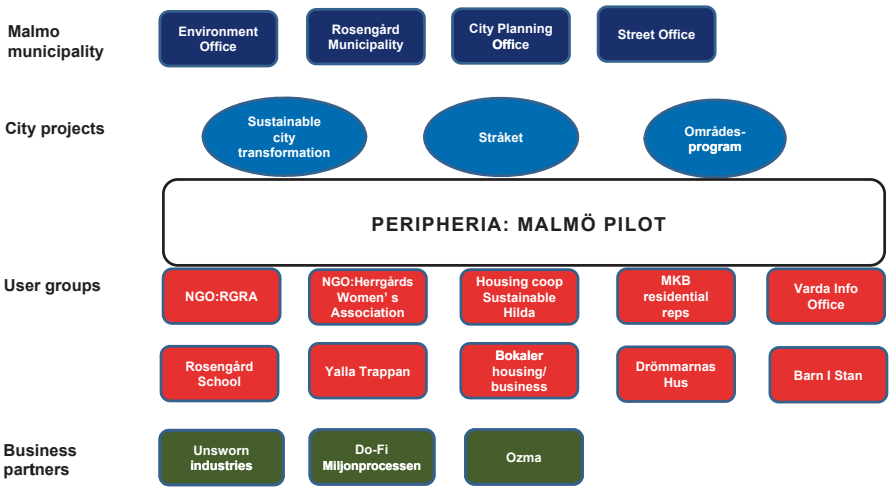

Fig. 3 Malmö stakeholder innovation network

4.3 Interpretation of the Results

The experiences the five pilots had engaging with stakeholders in their specific arenas varied. This variation reflected their different cultural and political contexts, the institutional affiliation of their lead partners, as well as in the practices they adopted to manage their co-production processes. All of the pilots sought to promote engagement. But, beyond the enlistment stage, MEDEA (the project partner in Malmö) was recognised as being the most successful because of its previous experience of employing a range of techniques and methods such as brainstorming, focus groups, design oriented workshops, the public experiment and planning meetings (MEDEA n.d.). Its strategy of aligning its project activities with its stakeholders' existing interests proved effective for building collaborative scenarios, including alignment with projects that the city of Malmö itself had initiated for example, 'Sustainable city transformation; 'Stråket' and 'Områdesprogram' (see, e.g. Malmö Stad n.d.). Developing new services aligned with the work of other business partners and with the aims of different user groups such as NGOs also proved effective. Such alignment meant that the pilot tapped into the energy and motivation of such stakeholders who were able to continue to concentrate on their everyday concerns while collaborating on the project. Not moving far away from what they already were doing, made it easier to start the project quickly. MEDEA recognised that, because people were busy, it would have been difficult to involve them in an entirely new project. Experience showed that this rang true for Peripheria's other pilots as well.

Each of the Pilots needed to collaborate effectively with their stakeholders through all four steps outlined above. Early in the project, it became clear that doing so was presenting them with real difficulties. In February 2012, during a Peripheria

Project Management meeting, a workshop-based formative evaluation was carried out with the pilot city partners, aimed at developing a forward plan for co-production activities for each of them. The workshop was also used to identify what each Pilot was finding most difficult about establishing and running their living lab effectively. The evaluation revealed that there were major differences in the difficulties facing each city. In Athens, 'the most difficult thing to date has been to get stakeholders to come to the table because of the lack of 'proof' of a concrete e-service and Platform to demonstrate to them'. In Bremen, 'the problem here is that it is difficult to get motivation and engagement 'for free'. In Genoa, 'one of the main difficulties is that people have no awareness about or sensitivity to the opportunities offered by a Living Lab'. This last statement gave voice to a general difficulty. It is not easy to establish a living lab and to get people to take part in co-design if they do not understand what co-design or a living lab are. And, if they do not know what the product of co-design will be, or if they do not understand what is in it for, then stakeholders may have little incentive to collaborate.

Building stakeholders' capacity to take part in co-design requires appropriate tools and techniques so they can be encouraged to work together collaboratively on the shared design of desired services. In this chapter, we have argued that these four steps outlined above are substantively different areas of activity, effective deployment of which each requires specific skills and expertise. Analysis of the pilot cases showed that the leaders of pilots had explicitly recognised Steps 1 and 2. They had implicitly assumed Steps 3 and 4, but without acknowledging that specialist skills and expertise were needed to implement them effectively. Rather, they had been led to assume that if pilot city partners could identify the relevant stakeholders and convene them, then (without any further guidance or support), they would be able to make a living lab/co-design appear. This notion found explicit expression in an early suggestion from the Project Management Team that:

- 'When you have a large number of stakeholders at the table, you have a Living Lab' (Cooper et al. 2012, p. 38). Experience gained on the Peripheria project amply illustrated that this simply was not the case. Steps 3 and 4 need to be as actively managed and facilitated as Steps 1 and 2.

4.4 Propositions for Stakeholder Engagement in the Smart City Living Lab—Setting Up the Founding Framework

Through our experience on the Peripheria project, we have been able to identify nine working assumptions—'propositions' that need testing—for more effective stakeholder engagement in co-design of services in living labs. Given the slender experience base currently available for generating these propositions, let alone for testing them, their underlying assumptions need to be treated with caution. Those seeking to apply them would do well to subject them to SWOT analysis to see how well they might operate in their own particular circumstances.

When establishing a living lab, it is not enough just to understand the everyday practices and needs amongst stakeholders being brought together. It is also essential to build mutual trust that extends outside specific project activities. Moving beyond simple enlistment towards meaningful engagement in co-production activities makes it necessary to include stakeholders, not as mere users—consumers of services provided—but as empowered actors. Strongly engaged in their co-design, co-development, co-implementation and co-evaluation. Their needs and desires have to be understood from the beginning. Just as important, during the engagement process, mutual trust should increase, so unreasonable or false expectations have to be explicitly managed so that stakeholders' levels of commitment can grow. These requirements frame our understanding of when actors should be involved, as well as about the degree of involvement required. This is formulated in our first Proposition:

1. Involve stakeholders early in the process, before projects are clearly formulated. Work together on joint articulation of aspirations and concerns as a starting point.

Identification of 'needs' and 'problems' to be addressed should include exploring potential not yet realised through a mutual learning process that gives co-designers and co-developers possibilities to learn and understand each other's practices and wishes. Stakeholders can learn about how to increase their own potential through interaction, not only with technologies and services but also with other collaborators in the living lab being set up. An iterative learning process is clearly implied here as necessary for a living lab to progress and evolve. Engaging a wide range of diverse, but complementary stakeholders is also important so participants can see how their interaction with others enriches their own skills and capacities. They also can then foresee an action space that increases their own potential by collaborating with differently situated actors—each profiting from continuing and deepening their engagement with one another.

2. Engage users with diverse backgrounds, competencies and agendas and stress how, through their collaboration, they will complement and learn from each other.

Each group of stakeholders' motivational drivers for engaging have to be identified. The living lab needs to ensure that each set of participants should be able to gain by taking active part. Mapping out their interests and their potential gains from engaging is critical here, as is understanding their everyday activities and concerns, their agendas and interests, their membership of other communities of place, practice and interests, along with the knowledge, resources capacities that each one will bring to the network. Tease out what they each expect to gain from collaborating along with any potential conflicting interests that might arise.

3. Identify and work upon what participants can gain from taking part. Active engagement rests upon how beneficial it proved to be for each individual partner.

In the early phases of co-production activities, it is important that specific individual stakeholders' interests are not allowed to become dominant. Activities have

to be facilitated that make sure that those interests are rewarded, but the focus has to be on getting everybody's voices heard and on how participants can strengthen and support each other. A balance between 'top-down' (civic interests) and 'bottom-up' (other stakeholder interests) in co-production activities has to be sought. However, for a living lab to have impact, stakeholders that are close to ('top-down') civic decision-making have to be brought on board, especially when aiming at behavioural changes to extend the project's impacts beyond its lifetime.

4. Assure different levels of impact, both in terms of the direction of political decision-making and significance for other communities represented by influential participants.

Conflicting interests and other factors that could potentially derail co-production activities should not be overlooked. These need to be dealt with constructively, leading to a better understanding of how to keep different stakeholders engaged. This can help, for example, when focusing on the relationship between those stakeholders capable of influencing decisions and those affected by them (but lacking such influence). Björgvinsson et al. (2010) stressed how underlying rhetoric in innovation often focus on the market economy, which increasingly thrives on the speed of producing novelty products, and which is treated as if it were a precondition for democracy. Defining what innovation is, quite who innovates, and where and under what conditions innovation occurs—all of these are part of an important battleground over decision-making within society today. Such issues need to be handled with sensitivity, if potential conflicts are not to limit, not just the internal structure of a network but also relationships between participating actors to those outside of the living lab. More than just economical rationales need to be considered here: there are also ethical issues about trust, informed consent and privacy operating here (Mulder et al. 2008).

5. Be sensitive to possible sources of conflict, not only internally within the network but also outside of the network with important others.

Methods employed for initially enlisting stakeholders should make a distinction between direct and indirect recruitment. In the latter case, third parties are used to act as mediators. 'These methods, defined as 'networking' consist of asking potential users to designate other users to form a chain, hence mobilising the relational resources. Considering that it might be hard to engage end-users, especially often under-represented groups (elderly, women, migrants, etc.), this strategy poses a viable way to reach those groups.

6. Use both direct and indirect methods for recruiting.

Where possible, use a strategy of alignment—enlist stakeholders who are already engaged in everyday activities and agendas aligned with the objectives of the living lab. This alignment can be used both as a means of 'match-making' and accelerating 'buy-in' to what the living lab is attempting to achieve.

7. Use alignment to achieve match-making and accelerated buy-in.

Co-production activities have to define their own 'action space' by going beyond 'what is already out there' and so add value for stakeholders by setting the stage for new alliances and new sets of challenges and achievements. This illustrates the 'but for' principle for evaluating the effect of what is being done. What needs to be demonstrated here is that: 'But for the existence of the living lab, this outcome would not have been achieved'.

8. Ensure co-production creates a unique project space with outcomes beyond what might have happened in any case.

Setting up a clearly dedicated development process helps stakeholders—with diverse agendas—but with a readiness to form themselves into different alliances (so-called coalition of interest)—by providing clear governance structure within which to operate. This clarity will help them to working together to achieve their own and shared objectives. These arrangements about how relationships and decision-making with the living lab will be governed can have wider benefits. Agreements about the co-design of service scenarios can allow them to 'travel' between different alliances and activities in a smart city's other networks and so gain new meanings as they are interpreted and appropriated by new sets of actors. Establishing a narrative to support this type of transference has to start early on. Paying attention to governance of stakeholder engagement in the living lab should be seen as an attempt to systematise and make co-production accountable. Agreeing a vision and a plan for co-production with clear timescales and responsibilities is a helpful first step here.

9. Secure good governance structure and mechanism in the living lab from the beginning. As the living lab grows larger and more complex, the need for formalisation of its governance structure will become stronger and more evident.

5 Conclusion

This chapter has sought to present a critical review of the concept of stakeholder engagement and its implementation in living labs as a means of co-producing new and innovative smart city services. The experience rehearsed here indicates that setting up an effective living lab—capable of supporting meaningful co-production of services—is far from being a trivial task. Previous literature on living labs has tended to treat the process of stakeholder engagement as monolithic, without breaking it down into its constituent and sequential steps. It has also tended to overlook or take for granted the extensive skills and expertise needed to launch and then maintain successful co-production activities. In this chapter, we have drawn on the (admittedly limited) experience gained on the Peripheria project to begin to address these two missing ingredients essential for making stakeholder

engagement ‘work’. We have provided a focussed and operational framework for the ‘stakeholder engagement’ construct and have presented experience about its meaning in the co-production of smart city services. By offering a critical review of Peripheria project’s original aspirations and its actual performance in its five urban Arenas, we have tried to identify the importance of placing a special emphasis on the ‘front end’ of the engagement process as a necessary prerequisite of co-designing innovative FI services. We have sought to answer ‘What is needed to make a Living lab really work?’ by drawing up a set of working assumptions—our propositions—about key factors that are crucial for setting up and then running successful engagement of disparate stakeholder groups. These propositions—although tentatively expressed because of the slenderness of our evidence base—point both to a policy agenda and to working practices for co-production activities in smart cities.

Experience gained on the Peripheria project suggests that, in practice, a step approach to stakeholder engagement is necessary to co-produce innovative civic services. In turn, this suggests the need for a new strategic agenda for smart cities in Europe, one focused on ensuring effective engagement of citizens and other diverse stakeholder groups (representing communities of place, interest and practice) for creating the services they need to ensure them a better quality of life and a more attractive urban environment. Given the fast pace of innovation in smart cities, existing civic engagement strategies need to be rethought and restructured. If this is not done, European cities may lose out on effectively realising the opportunities for open innovation offered by living labs. Policy-makers, entrepreneurs and citizens alike all need to be able to cope with the demands that the living lab approach brings if they are going to be able to exploit its innovation potential for the smart city.

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Smart City as a Mobile Technology: Critical Perspectives on Urban Development Policies

Patrizia Lombardi and Alberto Vanolo

1 Introduction

This chapter aims at providing a critical analysis of the potential relations between the project of construction of smarter cities, on one hand, and urban neoliberalism on the other hand. In this sense, the goal of the chapter is to emphasise some perils and potential critical elements in the sphere of urban politics, connected to the implementation of new technologies and smart city projects. The analysis is mostly grounded in critical urban studies literature, and it takes advantage of Ahiwa Ong's concept of global assemblage, that is briefly presented in this section.

As a starting point, it is worth mentioning that a number of scholars, in urban studies, have investigated the changing relation between urbanism and capitalism in the global scenario. The city is an important space for capital accumulation (see for example the classic contribution of Harvey 1989a); at the same time, the way cities are understood and interpreted in relation to social and economic phenomena has progressively changed after the neoliberalism stream (cf. Brenner and Theodore 2002; Leitner et al. 2007).

According to Osborne and Rose (1999), a specific feature of globalisation and liberal societies is the affirmation of a 'diagram of power' that changed the way of visualising, programming and governing urban spaces. This has been done particularly by replacing conventional patterns of political representation and social consensus, traditionally based on class self-consciousness and on the provision of social services like safety or social security, in which the State was once retaining

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an exclusive role of regulation, turning individual citizens and local communities into increasingly responsible subjects in pursuing their wellbeing (cf. Rossi and Vanolo 2012).

This phenomenon can be defined as a kind of 'governmental rationality' and can be also recognised in the way cities represent themselves as 'collective actors', responsible for the accomplishment of their own economic development goals. This governmental rationality has been largely put into practice through the adoption of *entrepreneurial* modes of local authority's behaviour (see Harvey 1989b; Jessop 1997; Hall and Hubbard 1998); for instance, cities today devise strategies to regenerate urban environment and attract external investors, through the organisation of hallmark events, the development of technopoles, the invention of exhibition spaces for cultural activities and a host of other initiatives capable of enhancing the material and imaginary position of the city within the political and economic frame of globalisation.

As a consequence of the above change, cities are often considered as 'engines' of economic growth, more precisely as centrepieces for processes of economic-relational networking reconnecting local economies to the global flows of capitals, commodities, information and policy discourses. A number of international institutions, as the OECD and World Bank (see OECD 2002; World Bank 1991, 2000) contributed to the diffusion of this understanding of cities and urban policies.

More recently, a related view on economic policy and urban development issues emerges from the European Union's (EU) 'Territorial Agenda' (EU 2007). The document stresses the interdependence between economic competitiveness and 'territorial cohesion', a broader variation of the notion of social cohesion. This interdependence is pursued through the identification of objectives, such as the creation of job opportunities, the promotion of a knowledge-based society, the improvement of governance mechanisms (Vanolo 2010). The sociopolitical implications underlying the adoption of such objectives are evident; for instance, concentrating public spending on the promotion of knowledge-based activities may marginalise low-skilled workers, while professional training programmes alone are not sufficient to address this issue. At the same time, regeneration initiatives—as the popular *smart cities* initiative—highlight the influence within the European policy field of the strategic framework of urban entrepreneurialism, in a context in which the EU itself does not assume an explicitly direct role in the field of urban planning, which remains under the control of the Member States.

It is quite overdeterministic to conceptualise the relation between globalisation plus neoliberalism and urban development policies as a simple global/local deterministic dichotomy. Evolutionary city trajectories could not be unilaterally caused by the 'unavoidable' forces of globalisation and neoliberalism (see Amin 2002; Marston et al. 2005). Somehow, these relations assume hybrid and non-isomorphic spatial forms, and particularly in translocal and transnational spatial patterns (Amin 2002; Collier and Ong 2005).

In order to conceptualise these spatial patterns, we can refer to the analytic idea of *global assemblage* (Collier and Ong 2005; Collier 2006; Ong 2007), distinguishing between the global quality of phenomena, and the ways they are articulated in

specific situations, i.e. in territorial assemblages that define new real and discursive relationships. Specifically, the smart city can be considered as an engine of growth, sustainability and technological upgrades, as well as, from a global issue perspective, a highly mobile *technology of government*, shaping cities and urban policies.

In a Polanyian perspective, the term 'technology' is intended as social technology, made-up of devices enhancing control over human activity through new regimes of visibility and discipline (cf. Collier and Ong 2005). According to this, it does not strictly imply technical issues (i.e. choosing the most appropriate mean for achieving goals), but also political (i.e. choosing the appropriate form of juridical institutions in solving collective problems) and ethical ones (Collier and Ong 2005). Therefore, this chapter argues that a smart city policy may be interpreted as a mobile social technology of government which is adapted in different cities across the Europe (Peck 2011; Prince 2012; Vanolo 2014). The analysis is based on a critical examination of the idea of 'smart city' in the logic of neoliberal urbanisms.

The chapter is organised as follows: next section introduces the concept of smart cities and discusses the main urban development policies which have been adopted in order to achieve this goal. The third section analyses the idea of smart city in relation to the current neoliberal scenario. Finally, concluding remarks summarise critical elements concerning the new smart city urbanism.

2 The Smart City in Urban Development Policies

In the current urban literature there is not a unique nor widely agreed view of what a smart city is, as emphasised by Hollands (2008) and others (Lombardi et al. 2012a, b), bust most commonly the idea of smart city relies on the implicit assumption that urban infrastructures and everyday life are optimised and 'greened' through technologies provided by information technology (IT) companies. In other words, the implied 'soft transformation' from resource-intensive traditional industries towards much more resource efficient knowledge and service industries of a dynamic information society is assumed to contribute to a more sustainable development. It is in fact well known that the current giant environmental problems, as global change, are mainly *urban* problems because of the growing global urbanisation and the ongoing rise of giant megacities in the global South, more and more characterised by huge environmental problems and growing levels of energy consumption (Davis 2010).

The assumption that smart technologies will help to cope with the global problems of urbanisation has not yet been proved and new metrics are needed to measure progresses, that is, to establish the contribution that ITs are making to overall economic and social progress as well as to environmental improvements (Lombardi 2011). In addition, little understanding is provided to the more fundamental principles or ideas underlying the smart city as a model, beyond the self-advertisement of IT companies and municipalities (Söderström et al. 2014). At the same time, a number of cities all above the world are apparently taking various kinds

of benefits from the implementation of new 'smart' technologies. For example, the case of Copenhagen, a city characterised by a relatively low carbon footprints (per capita) in the world and an ambitious carbon reduction plan, aimed at becoming carbon neutral by 2025 by introducing new energy efficient technologies and green building standards. In this framework, the International Business Machines Corporation (IBM) is developing data analytic technologies in order to reduce the city's energy consumption and to make efficiency improvements to buildings[1]. Another example may be offered by Amsterdam: *Amsterdam Smart City* is a public–private partnership focused on using the city as an urban laboratory for the use of open data, the development of new mobility solutions, and for achieving improvements in the local quality of life[2]. A number of smart city projects, ranging from smart parking to the development of home energy storage for integration with a smart grid, have been implemented for this purpose. And examples of smart city projects may be detected as well in cities of the global South: Rio de Janeiro, for example, has been recently awarded at the Smart City Expo World Congress in Barcelona because of the implementation of a number of new technologies that will improve the life of the citizens, from a new Operations Center, developed in partnership with IBM, allowing permanent monitoring of what is happening in the city, to a new integrated transport system supposed to improve mobility around the slums[3].

In order to explore the concept of smart city, a revised triple helix model has been recently proposed by Lombardi et al. (2012b), focusing on the production of knowledge by universities and governments. This model presupposes that the three helices operate in a complex urban environment, where market demand, governance, civic involvement and citizens' characteristics, along with cultural and social capital endowments shape the relationships between the traditional helices of university, industry and government (Etzkowitz 2008; Deakin 2010). The results of the above study has shown smart cities in terms of their dual roles as generators of intellectual capital, creators of wealth and regulator of standards (university, industry and government), as well as supporting the social learning and knowledge-transfer abilities which are needed to meet the requirements of their regional innovation systems.

Currently, the debate on smart cities led to the identification of a number of macro-dimensions associated with this term, such as economic development, environmental sustainability, e-governance, human capital promotion, culture and leisure enhancement. These dimensions connect with traditional regional and neoclassical theories of urban growth and development and specifically with theories of regional competitiveness, transport and information and communication technology (ICT) economics, natural resources, human and social capital, quality of

[1] http://smartercitieschallenge.org/scc/executive_reports/SCC-Copenhagen-Report.pdf (accessed June 2014)

[2] http://amsterdamsmartcity.com (accessed June 2014)

[3] http://www.smartcityexpo.com (accessed April 2014); see also http://www.wired.com/2011/02/st_riogondola (accessed April 2014).

life and participation of citizens in the governance of cities. In particular, the most quoted definition of smart city is the one provided by Giffinger et al. (2007), which recognises six main components or 'soft factors' as follows:

- Smart economy, an aspect linked to a spirit of innovation, entrepreneurialism, flexibility of the labour market, integration in the international market and the ability to transform;
- Smart mobility, referred to local and supra-local accessibility, availability of ICTs, modern, sustainable and safe transport systems;
- Smart governance, related to participation in decision-making processes, transparency of governance systems, availability of public services and quality of political strategies;
- Smart environment, understood in terms of attractiveness of natural conditions, lack of pollution and sustainable management of resources;
- Smart living, involving the quality of life in terms of availability of cultural and educational services, tourist attractions, social cohesion, healthy environment, personal safety and housing;
- Smart people, linked to the level of qualification of human and social capital, flexibility, creativity, tolerance and cosmopolitanism and participation in public life.

The articulation of the concept into these six characteristics runs the risk of naturalising and depoliticising political choices. For instance, flexibility of the labour market is not assumed as an option, but as a goal of a smart economy together with conventional keywords such as 'social cohesion' and 'participation'. On the contrary, it is useful here to recognise the smart city discourse as the assemblage of several pre-existing urban imaginaries.

On one hand, smart city is obliged to policies and planning ideas from North America, in particular the concept of Smart Growth developed within the framework of New Urbanism which originated in the USA in the eighties (Falconer Al Hindi and Till 2001; Hollands 2008; Krueger and Gibbs 2009). In a nutshell, 'new urbanism' in planning aimed at improving the quality of life in cities by promoting communitarian ideas and by limiting urban sprawl, land consumption and private mobility. One of the major intellectual results of the 'new urbanism' is the idea of Smart Growth, a planning strategy aimed at making cities more compact and less greedy and soil-consuming. Furthermore, Smart Growth was a political idea of grassroots movements, especially in urban social movements in the nineties (Beatley and Collins 2000). Yet, the deployment of the smart city in Europe is not necessarily the same as smart growth as in the USA tradition because of the central role of ICTs (March and Ribera-Fumaz 2014).

On the other hand, the adjective 'smart' is indebted to the concept of 'intelligent city' (Castells and Hall 1994; Komninos 2002; Hollands 2008; Lombardi et al. 2009, 2012b; Deakin et al. 2011), mainly involving the relationship between urban space and technology, and including issues such as the ability to generate innovation, transition towards forms of e-governance, social learning and the possibility

to provide ICT infrastructures. Singapore has probably been the city that identified most with the imaginary of the intelligent city. In fact, it funded a huge computing infrastructure project destined to both businesses and citizens as part of its branding as an 'intelligent island' (Arun and Yap 2000; Olds and Yeung 2004). However, many more cities around the world have integrated the vision of the ICT city into their development strategies.

Without going into much detail, it is reasonable to imagine that the smart city concept party stems from the overlapping and assembly of these two concepts of 'intelligent city' and 'smart growth' (Hollands 2008; McFarlane 2011; Allwinkle and Cruickshank 2011) and, not surprisingly, the expression 'smart city' has been literally used in some former publications related to the two concepts (Arun 1999; Brooker 2012).

Yet, looking at the evolution of the smart city narrative, it is not an academic concept that has progressively informed urban policies and that has subsequently raised the interest of economic actors, as, for example, 'creative cities' introduced by Richard Florida (2002), and then implemented at a global scale (Peck 2005). In the case of the smart city, the discourse has been firstly (and mostly) developed by a small number of multinational companies (cf. Graham and Marvin 2001; Paroutis et al. 2013; Söderström et al. 2014; March and Ribera-Fumaz forthcoming). Cisco, for example, began to adopt the smart city concept in the late nineties. IBM is now a major player in the development of smart city projects, mainly involving data collection systems and public administration management: the company has already started partnerships with cities like New York, Chicago or Madrid in order to work in the fields of urban safety management, healthcare and energy distribution; in Italy, IBM has signed an agreement with the city of Genoa to develop 'a new smart city model' and officially filed the term 'smarter cities' to be registered as a trademark (Söderström et al. 2014).

It is recent, and mainly in Europe, that the concept of smartness has become extremely popular, especially after the expression smart city became part of the complex mechanisms of EU research funding (Vanolo 2014). The Seventh Framework Programme for Research and Technological Development and the current Horizon 2020 (that represent the main financial instrument for those EU countries, like Italy, where national research funding is quite low) introduces the term 'smart city' in the energy policy issues. More specifically financial support is provided to facilitate the implementation of a Strategic Energy Technology plan (SET-Plan) which provides several funding schemes related to an initiative called 'smart cities and communities'. The goals of the initiative include a 40% reduction in greenhouse gas emissions by 2020 through improvement in the energy efficiency of buildings, energy distribution networks and transport systems. Furthermore, the 'smart sities and Communities European Innovation Partnership',[4] launched in July 2012; intends to (p. 2):

[4] Communication from the Commission 'Smart Cities and Communities—European Innovation Partnership', COM(2012)4701 http://ec.europa.eu/eip/smartcities/ (accessed January 2014).

> catalyse progress in areas where energy production, distribution and use; mobility and transport; and information and communication technologies (ICT) are intimately linked and offer new interdisciplinary opportunities to improve services while reducing energy and resource consumption and greenhouse gas (GHG) and other polluting emissions.

Without going into the complex organisation and ramification of European projects supporting research and innovation, it is clear that abundant resource—i.e. several billion Euros—have been allocated in the pursuit of energy and technology-efficient cities. Such a vast deployment of resources, at a time of widespread crisis in urban economies, has a fallout effect on the strategies of European countries and cities.

3 The Smart City as a Mobile Technology

In this section, the analysis of smart city urbanism is developed in relation to the changing configuration of the urban environmental and technological discourse. According to mainstream interpretations, cities are today key sites for the environmental question for at least three reasons.

First, not only cities are the centre of economic and social activities, but also integral to climate change mitigation and adaption strategies worldwide. Although accounting for merely 2 % of the earth's surface (UNEP 2011), cities comprise over half the world's population[5] and contribute to more than 75 % of greenhouse gas emissions through energy use, waste management and land use changes (World Bank 2008). Heating and cooling the urban built environment alone is responsible for an estimated 35–45 % of current carbon emissions, whereas urban industries and transportation contribute to another 35–40 % (Davis 2010).

Furthermore, the steadily increasing urban population, 95 % of which will occur in emerging countries, exerts enormous pressure on water supplies, sewage, the living environment and public health (UNEP 2011). In this context, the current environmental crisis, and specifically the problems of climate change, are understood as unsustainable urbanism.

Secondly, if cities are the main agents of unsustainably, cities are, and will be in the future, the main targets of global change and environmental disasters in general. Scenarios of global warming, floods and other 'natural' disasters refer specifically to cities and to their billions of inhabitants, as testified by a growing literature on urban resilience (see Vale and Campanella 2005; Newman et al. 2009; Felli and Castree 2012; Swyngedouw 2013).

Finally, cities are assumed as main agencies for elaborating responses and solutions to global environmental problems (cf. Evans 2011). Despite the above challenges, sustainable urban solutions have great potential to contribute to climate

[5] United Nations, Department of Economic and Social Affairs, Population Division, *World Population 2012: Wallchart*, www.unpopulation.org (Accessed January 2014).

change mitigation while addressing key socioeconomic concerns, for example, by developing and managing sustainable urban infrastructure, energy systems and incentive schemes. Additionally, urban high density could lead to significant efficiency gains, technological innovation and enhanced access for weak brackets of population.

Specifically, it is possible to imagine two ideal-types of responses to the environmental and socioeconomic crisis. On one hand, according to critical scholars, a massive change in urban lifestyles and in the inner mechanisms of capitalism is needed: the only possible solution is to promote a 'post-carbon' transition, subverting the logics of neoliberalism and consumerism (Žižek 2008; Davis 2010; Chatterton 2013). However, most of the mainstream discourses promote the less radical goal of a 'low-carbon' transition that will basically allow to preserve current lifestyles and to reproduce the current mode of regulation of urban life and global economy, whereas at the same time reducing environmental stresses, thanks to new technologies. Particularly, the concentration of people, infrastructures, goods and information in the city provides an ideal setting in order to experiment new technologies in fields as water, sewerage, mobility, recycling, energy provision, heating, etc. (cf. Hodson and Marvin 2009). In synthesis, technologies and innovations are supposed to be the lifebelts to get away from disaster.

The proliferation of more and more complex technologies regulating the even private aspects of social and biological life, coupled with the rhetorical assertion 'technologies will save us', are at the basis of a number of techno-centric approaches, utopias, experiments, new visions of urbanism. The smart city is arguably the last and most popular urban vision embodying a possible strategy for dealing with global environmental problems. Furthermore, in current scenario of economic recession, the smart city project, as many other initiatives of green entrepreneurialism, may offer new possibilities for capital accumulation (While et al. 2010). In fact, according to Raco and Flint (2012), even the concept of sustainability has changed with the crisis: during the 1990s, in a period when globalisation was emerging and expanding, sustainability provided a bridge between the competing objectives of economic competitiveness on one hand, and social justice and environmental protection on the other (cf. EU's Lisbon Strategy developed in 2000[6]; Gordon 2005; Brandon and Lombardi 2005). However, the crisis has influenced the ways in which dominant discourses and understandings of the policy problems and solutions shape ways of thinking about sustainability and change. Under the guise of a postcrisis recovery agenda, conservative administrations have already introduced reform measures across Europe such as increasing the retirement age of workers, creating leaner and less protective welfare state systems and erecting new barriers to the flow of international migrants. Therefore, the crisis has emphasised the commitment of many Western countries to support and sustain the neoliberal economic systems (Whitehead 2012).

A key element in this scenario is the role of the private sector in the development and implementation of welfare and development policies. With the affirmation of

[6] http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/ec/00100-r1.en0.htm (Accessed January 2014).

entrepreneurial urban policies, public–private partnerships are seen as a role model for how corporate interests, government agencies and civil society could work together towards common ends.

Today, with the economic crisis, public–private partnerships in cities have become even more development-focus with the urgent need for the promotion of growth and development interests, and city managers are constantly tempted to privatise large parts of the welfare state (Raco and Flint 2012). The project of the smart city fits well in this framework.

It is just the case to stress, once more, that there is not one single and homogeneous 'smart city' concept here: the label refers generically to efficient cities managed through new technologies, specifically ICTs. It is evident that there are a number of very different urban experiments, branded and identified in terms of smartness: Songdo and Amsterdam may be two rather different examples.

The smart city is, at the same time, a very appealing policy idea and urban vision, and for this reason we are assisting right now to the growing circulation, mutation and adaptation of ideas and strategies of smartness. It is a matter of fact that urban policy regimes today are characterised by the pragmatic borrowing of 'policies that work', by compressed reform horizons, by iterative constructions of best practice, by enlarged roles for intermediaries as 'pushers' of policy routines and technologies, and by a growing reliance on prescriptively coded forms of front-loaded advice and evaluation science (Peck and Theodore 2010; Peck 2011).

In this context, the smart city is today a global *dispositif*, i.e. a global technological device of government and a model of new urbanism for cities all over the world. Specifically, the smart city technology provides responses to all the three domains identified by Collier and Ong (2005) and described in the introduction of the study.

First, the smart city idea offers a solution to a number of *technological* problems, and at the same time reframes social problems in the form of technological problems. In the words of Bell (2011, p. 73), the smart city is 'an ontological standpoint that frames all urban questions as essentially engineering problems to be analysed and solved using empirical, preferable quantitative methods.'

According to Morozov (2013), smart technologies are imbued with problem-solving attitude ('solutionism'), intended here as a neo-modernist philosophy reducing complex social problems to simple issues for a quick-and-easy solution, often embodied in the ideal-type technology of the 'app'. Morozov (2013, p. x), ironically predicts that 'humanity, equipped with powerful self-tracking devices, finally conquers obesity, insomnia and global warming as everyone eats less, sleeps better and emits more appropriately'.

A crucial point is, many smart approaches presume that all the ambiguities and opacities of politics or daily human life are potential forms of inefficiency, and therefore 'problems' to be tackled. However, we have also to consider that 'inefficiencies' are expressions of human society, and certainly no one would wish a dehumanised future, made up of high-efficient systems of specialists in education, medicine, planning or politics.

The powerful technologies developed by multinational enterprises and/or the Internet geeks all over the world carry the promise to made everything more efficient,

and therefore to improve everything in our day-to-day action, from mobility choices to market behaviours. According to the well known sentence that 'if all you have is a hammer, everything looks like a nail', a risk is that this technocratic governance may be quite myopic (cf. Morozov 2013; Kitchin 2014).

Secondly, and partly connected to the previous point, the smart city is a *political* answer, even if powered by post-political perspectives (Swyngedouw 2007; Vanolo 2014). This means that the smart city may increasingly become a generic and easily agreed target, a kind of metaphor unifying and universalising the problems of cities, without proper critical discussions and, above all, without 'politics', intended as debate between different positions (Catney and Doyle 2011). In this perspective, a large number of global demands—cutting greenhouse gases, stopping the exploitation of specific resources, opposing crime—are conceptualised as technological 'problems' to be unavoidably linked to a single, universal and 'always adequate' political response, that is the implementation of 'smart' solutions. In the current scenario, consensus is built around all the followings (Swyngedouw 2007; Kitchin 2014):

- Globalisation and neoliberal capitalism as an economic system;
- Parliamentary democracy as the political ideal;
- Humanitarianism and inclusive cosmopolitanism as a moral foundation;
- Technology as the definitive form of social and human progress.

From the above discussion, it derives the promotion of managerial, economist and technocratic approaches to urban government. The planning of urban life is conceived as a managerial function which aims at improving efficiency, and therefore it is deprived of political dimensions.

Third, smartness is an *ethical* and *moral* discipline. Here, Foucaultian readings on governmentality and on construction of active citizenships are pivotal (Marinetto 2003; Brand 2007; Summerville et al. 2008). Urban environmental management practices are powerful in the way in which they convert technical policy into personal concerns and ethical arguments. For example, environmental care unequivocally demands individual commitment and personal decision-making. Examples include (Brand 2007, p. 625):

- Intrusions into domestic life: domestic waste separation, energy and water saving, composting and care of private green space;
- Demands on self-care: eating and drinking, exercise, stress management, risk assessment;
- Influence over lifestyle: green consumption, ecological tourism, fair trading and local exchange markets, personal ecological footprints;
- Conditioning of the residential environment: compactness, high densities, promotion of the virtues of locality and community living;
- Codes of social behaviour: the stigmatisation of smoking and obesity, the criminalisation of waste, the validation of surveillance;
- Taxation and public spending: favouring of the environmentally responsible citizen, especially with regard to energy and transport.

In this perspective, the environment can be seen as constituting a field of social regulation, which intrudes personal/private life. The proper 'management of the self' became a question of personal adequacy. At the urban level, this requires to be an enterprising citizen in entrepreneurial cities.

As discussed by Summerville et al. (2008), in Agenda 21 the rights-bearing community generate a space through which the participatory conduct of subjects is ethically shaped by implicitly coding notions of inclusion, local knowledge and capacity building within a sustainability framework. Similarly, one can argue that smart city projects run the potential risk of operating as devices of moral legitimisation of entrepreneurial projects; if the adhesion to smart projects, the adaptation to smart environments and the participation to urban smart living is a moral obligation, there is little room for critical thought and political negotiation. Ultimately, the inner language of smartness imposes a strong semantic dichotomist imaginary: what is not 'smart' is inherently 'dull' or 'stupid'. To question the appropriateness of smart cities and smart technologies would be similar to questioning 'Civilisation' or 'Modernism' in the late past: the myth of technological perfection and absolute efficiency may provoke 'unreasonable' or 'unthinkable' dissent.

It is just the case to mention that in many cases the development of smart cities, just as any other urban project of the past, is a political act producing advantages for few stakeholders rather than for others. Clearly, multinational enterprises developing, providing and managing smart technologies have the opportunities of gaining huge amount of capitals, as testified by the money currently spent in these projects (March and Ribera-Fumaz forthcoming; Söderström et al. 2014).

In a crisis scenario, characterised by privatisation and externalisation of urban utilities and services, the smart city might be framed as a new model of capital urbanisation. But clearly we have to be aware of risks of private-led provisions of public services, where public sectors are merely coopted in a marginal position or simply subsidy privates. Also, as discussed by Graham and Marvin (2001), the provision of technological infrastructures by private may enhance urban fragmentation, as in many cases it has led to functional separation between sealed-off technological enclaves and leftover marginalised spaces.

4 Conclusions

As discussed in the introductory section, smart technologies, ICTs and new technologies in general are fundamental tools in order to improve the life of people, to archive a more just world and/or to response to many environmental problems. The critical argument presented in this chapter is not meant to deny or diminish the importance of new technologies and new ways of managing cities. Instead, the aim of this study is to reflect on the risks linked to the diffusion of a sort of 'template urbanism' (paraphrasing Tonkiss 2011), i.e. the idea that smart technologies, and the quest for efficiency in general, will always produce positive and desirable outcomes.

The mantra of efficiency may reduce the capability to think about radical alternative imaginaries (like the postcapitalist; see Gibson-Graham 1996), to invoke the freedom to experiment alternatives, to debate or even fight for pursuing alternative forms for our common daily social space, that is what Henri Lefebvre, in 1968, defined 'the right to the city'.

In particular, the chapter has critically analysed the relation between smart city and neoliberal urban governance. It has argued that, in the current scenario characterised by economic crisis and unsustainable life styles, the smart city policy represents an attempt to attract and coopt private actors in the provision of urban services. The affirmation of smart cities as a kind of universal 'template urbanism' is linked to the nature of the smart city as a mobile technology of government. Particularly, when local governments are more and more challenged in the provision of urban services, the smart cities paradigm offers the possibility to create a new space of potential economic profitability for private companies and a new urban governance where private actors contribute to the financing of local welfare (Catney and Doyle 2011; Flint and Raco 2012). Furthermore, it has been discussed how the provision of technological infrastructures by private actors pursuing profit may enhance urban fragmentation, rather than cohesion. From this point of view, it is crucial to elaborate a smart city that is not limited to the technological or environmental spheres, but that fully acknowledges its nature of 'mobile technology of governance' and neoliberal 'mobile development paradigm'. In fact, most mainstream discourses on global human problems, and particularly the environmental and economic crisis, are discussed as urban problems to be tackled through appropriate, efficient technologies developed by a limited number of multinational enterprises and technological 'gurus'. The dream for a technological, green and just Eden is so appealing that smart urbanism is becoming a sort of conventional wisdom, or a post-political mobile device that may be implemented everywhere in the world without critical debates and with popular support (cf. March and Ribera-Fumaz forthcoming).

The implication, for urban policy makers, is to always look with caution to smart city projects. The evaluation of smart projects is not just a technical problem to be dealt with, but also complex models and with technological expertise. It is also a social, political and cultural question having a massive impact on the life of the inhabitants, and only by assuming such a perspective it will become clear why, all over the world, many activists oppose apparently airtight smart city projects. According to this perspective, there is a great need for social critical analysis, questioning the appropriateness of any smart city project.

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An Investigation of Leadership Styles During Adoption of E-government for an Innovative City: Perspectives of Taiwanese Public Servants

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1 Introduction

Governments of many countries are now striving to use technology to move official services to the Internet, enabling citizens to have more convenient access. Adopting technologies by the government represents an innovative process which can help create an innovative organizational form of e-government. Citizens' enjoying more and more services provided by governments' development and implementation of technologies conceptualizes smart cities (Alawadhi et al. 2012; Anthopoulos and Fitsilis 2013; Gil-Garcia and Aldama-Nalda 2013; Lee and Lee 2014; Nam and Pardo 2011; West et al. 2009).

Taiwanese governments, city- and county-level service units, have expended significant effort toward adopting technologies for both services and infrastructures necessary for e-governments. All personnel, including e-governmental leaders, in Taiwanese governments are public servants, and the official service units operate as service providers in Taiwan. With regard to the organizational characteristics of e-government, the literature suggests that adoption of online services, such as those offered by private companies, involves a process of innovation (Chowdhury et al. 2006; Ho 2002; Molinari 2012; Ndou 2004; Gil-Garcia 2012; Scholl and Scholl 2014). E-governmental leaders play important roles in the innovation process; however, unlike private companies, the official service units represent nonprofit organizations, and e-governmental leaders' performances do not influence

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salaries and positions (Berman et al. 2013; Puccio et al. 2007; Weerakkody 2013). The existing literature contains no in-depth investigation of the key roles played by e-governmental leaders' adopting technologies. The leadership styles perceived by e-governmental leaders' subordinates when they accept tasks or commands is worthy of exploration.

This study, therefore, investigates public servants, especially e-governmental leaders' styles of leadership, as perceived by subordinates. It also explores the influence of subordinates' demographic variables such as age, educational level, gender, and years of service on perception of their supervisors' styles of leadership. Motivated by the intended purposes and current literature, this study presents a new research approach that employs visual sensibility testing, a derivative of cognitive psychology, to investigate, accurately, the public servants' perceptions of direct supervisors' styles of leadership during the process of adopting the innovative organizational form of e-government.

2 Literature Review

The American government's 1993 national development retrospective report, *Reengineering Through Information Technology*, was the first proposal for the concept of e-government, also known as digital government, online government, and connected government. The proposal emphasizes the importance of reforming government's operating methods. The United Nations Division for Public Economics and Public Administration, and the American Society for Public Administration, in the 2002 report, *Benchmarking E-government: A Global Perspective—Assessing the Progress of the UN Member States*, formulates a broad definition of e-government. The report asserts that "e-government can include virtually all information and communication technology platforms and applications in use by the public sector." A subsequent report provides a more concrete definition: "e-government is defined as utilization of the Internet and the World-Wide Web for delivering government information and services to citizens."

The government of Taiwan began developing e-government in 1995 and focused on accelerating the development of Internet applications in administrative agencies. After participating in the *Internet 1996 World Exposition*, Taiwan's Executive Yuan, the Research, Development and Evaluation Commission (RDEC), formally defined e-government in 1997 as "the overall concept characterized by the use of information and communications technology (ICT) to form internal and external networks, and the employment of different information services and facilities for government agencies, enterprises, and citizens at their convenient times, locations and methods to provide automated services." The four-stage e-governmental program, implemented from 1998 to 2016, is currently in its fourth stage which has a vision of "service without boundaries, improving everyone's life," and includes three aspects necessary for completion: internal operational management, external public service, and fair participation strategies.

The summary of definitions of e-government proposed in the literature (Bolívar et al. 2010; Graham and Aurigi 1997; Gil-Garcia 2012; Ndou 2004; Weerakkody 2013; Scholl and Scholl 2014) reveals that the use of ICT and Internet applications are the key elements for initiation and development of e-government and campaigns to promote digital government. Governmental websites represent services' useful and basic platforms, which can simplify administrative processes, provide online services, strengthen cooperation and commercial interchange between agencies in all cities and counties, and finally increase the degree of transparency of enacted policies.

2.1 Development of E-government in Taiwan

Compared to other countries with emerging economies, the development of Taiwan's e-government is, arguably, mature. With an informational infrastructure established throughout Taiwan, governmental agencies transmit documents in electronic forms and publicize information on governmental websites. The digital divide among citizens, including minorities and those living in remote areas, has shrunk in Taiwan as citizens are enabled to access applicable information, submit applications for obtaining copies of individual records, or apply for a driving certificate. In view of the development of e-government in Taiwan, officials promised to provide citizens with secure and reliable services and ultimately expect citizens' satisfaction with e-governmental services (Huang and Wu 2007).

To provide e-government services, new operating methods through acquisition of various types of informational technology (IT), such as systems for online documents, require public servants' familiarization. With the assistance of IT, public servants have the authority to respond to and transmit decision-making information, allowing rapid reactions (Alawadhi and Scholl 2013; Daniel and Doran 2013; Fountain et al. 2011; Katz and Halpern 2013; Weerakkody 2013; Scholl et al. 2012). In addition, the use of IT enables public servants to quickly discover problems and then propose solutions, thereby enhancing the effectiveness of decision making (Chowdhury et al. 2006; Bolívar et al. 2010; Katz and Halpern 2013; Scholl et al. 2012). Also, the style of leadership of e-governmental leaders has changed delegation of authority to subordinates at central or local levels. However, while public servants enjoy greater autonomy and authority from e-government, they bear responsibility for organizing vast amounts of information. The expectation is for public servants to increase senses of accomplishment from efficient completion and high quality responses to policies.

Traditionally, Taiwanese government tends to have a hierarchical structure that is formal and centralized. Such structure has long hampered communication and mutual understanding between officials and subordinates. Currently, the government's organizational structure has evolved to fewer barriers. Official agencies at central or local levels are able to better interact and to respond to rapidly changing societal conditions; however, due to the adoption of various informational technologies, an-

other challenge for public servants has arisen from dissimilar degrees of familiarity with IT, which affects evaluations of administrative performance.

In sum, Taiwan's e-governmental services should boost administrative efficiency and effectiveness. While public servants ensure implementation of e-governmental policies, they must maintain awareness of the organizational changes in operations due to differences in styles of leadership.

2.2 E-governmental Leaders and Styles of Leadership

In the literature, the concepts of leader and manager have varying definitions in terms of roles and responsibilities (Bass 1999; Bossink 2007; Dargan and Shucksmith 2008; Isaksen and Tidd 2006; Kotter 2012; Maccoby 2000; Mumford et al. 2002; Robbins and Coulter 2002). A leader is usually able to influence the behaviors of organizational members for improving quality, performance, production, and services. However, a leader may not enjoy a formal appointment from an organization as a manager who possesses the authority to reward or sanction employees for actions assigned by an organization. In other words, if a manager possesses a leader's ability to influence organizational members' behaviors to achieve objectives while performing managerial functions within the organization's formal hierarchy, this manager's particular style of leadership, in practical terms, produces a leader.

The conventional style of leadership of officials cannot effectively yield innovative administrative methods, and subordinates are without motivation to actively set goals or draft new strategies for tasks when superiors' active support and encouragement is absent (Johnson 1998). As a result, the public may find that the government's delivery of services appears unreliable. Taiwanese public servants, in the past, often perceived themselves as situated in a huge national organizational system and could exert no influence on any governmental plans. Sometimes, suggesting or disseminating innovative ideas concerning governmental policies produced internal conflicts and sanctions for these employees and their direct supervisors.

Differently, e-governmental leaders should cultivate creativity, and then encourage creative transformation within their organizations (Puccio et al. 2007). In addition, e-governmental leaders should fully understand the benefits, motivations, effects, and needs of providing online services. Leaders must consider the public as partners and understand the public's needs for services to meet those needs. Thus, the emphasis is cooperation, direct communications, multidirectional networks, rapid feedback, and responses through advantages of emerging, new, informational systems. Also, e-governmental leaders should encourage subordinates to accept all changes during the processes of e-governmental development, despite potential crises and challenges encountered due to huge responsibilities required for adopting informational technologies (Anthopoulos and Fitsilis 2013; Fountain et al. 2011; Ho 2002; Ndou 2004). In other words, the foundation to ensure long-term success of an innovative organization is innovative leadership, in which proper interaction between individuals, processes, and environments is always present. In addition, the

literature underwrites the necessity of a close relationship between an innovative organization and innovative leadership (Chortatsiani 2003; Chowdhury et al. 2006; Isaksen and Tidd 2006; Podsakoff et al. 2000; Scholl et al. 2012).

Classification of leadership encompasses three styles: transactional, transformational, and laissez-faire (Bass 1999; Bass and Avolio 1994, 1997; Burns 1978; Howell and Higgins 1990; Podsakoff et al. 2000). Earlier in the twentieth century, most leaders employed transactional leadership, focusing on mutually beneficial transactions by emphasizing the personal benefit gained from the organization. Today's innovative organizations employ transformational leadership, which prescribes leaders' striving to enhance subordinates' morale, motivations, and behavior. A so-called laissez-faire style of leadership implies that the leader does not seek feedback or encourage subordinates with compensation. The leader may be unaware of problems occurring from the process of implementing a decision and interferes little in subordinates' affairs. Such style of leadership commonly accompanies slow decision making.

Accordingly, except the laissez-faire style of leadership, leaders employing either transactional or transformational styles can produce significantly high performance in the organization. Specifically, the transformational style has greater influence on performance than the transactional style since the former inspires trust, respect, and loyalty among subordinates (Bass 1999; Howell and Higgins 1990). In addition, transformational leadership, as perceived by an organization's members, can directly initiate radical organizational change since the leaders tend to change members' values and beliefs, develop potential, and enhance confidence, thereby motivating contributions to the organization beyond expectations (Bass and Avolio 1994).

2.3 Measurement of Perceived E-government Styles of Leadership

To measure subordinates' perceptions of supervisors' styles of leadership, Bass and Avolio (1997) developed an important reference, the Multifactor Leadership Questionnaire (MLQ), to measure the attributes of transformational, transactional, and laissez-faire leadership. The MLQ has undergone several revisions and has had wide application in varied industries and differing cultural contexts. Prior studies verified the effectiveness of using the MLQ to identify the characteristics of a style of leadership (Antonakis et al. 2003; Rowold and Heinitz 2007). In the MLQ, the transformational style has four aspects: personal charm, encouragement, intellectual stimulation, and individual concern. The transactional style has two aspects: contingent compensation by reward and passive management by exception. The laissez-faire style has only one aspect: a laissez-faire attitude.

In addition, previous literature concerning "perceived style of leadership" often uses terms such as consideration, concern for people, and relationship-oriented personality to describe a leader's willingness to establish relationships of mutual trust

with subordinates and to understand subordinates' feelings (Robbins and Coulter 2002). Thus, the measurement of this type of perception is more appropriately drawn from cognitive psychology, which discusses the relationship between the researcher's symbolic stimulus and participants' consistent responses. The study by English and Steffy (1997) used movies and short films to represent symbolic stimulus and to clearly portray the characteristics of a style of leadership among different occupations, during different time frames, and in different places. Research participants viewed the films that clearly portrayed the styles of leaderships' differences between genders, among different cultures, and from different historical backgrounds. The participants observed leaders' actual thinking processes, types of followers developed, and consequences of leaders' decisions. The current study uses a similar technique, the visual sensibility testing method, to measure a participant's psychological perceptions of a style of leadership (VanRullen and Thorpe 2001). This method has two stages: viewing different visual inputs (i.e., animated scenarios) and describing realizations derived from those inputs.

3 Research Methods

The purpose of this study is to investigate the leadership styles among governmental officials as perceived by subordinates during the process of institutionalizing e-government. In addition, the study explores the influences of subordinates' demographics: age, educational level, gender, and years of service. Notably, the study's context is Taiwan, where all personnel employed by government are "public servants." The scope of this study focuses on the development of e-government at the city level despite Taiwanese governing bodies consisting of city- and country-level service units.

3.1 Research Participants

The study began with submitting an official proposal to one city-level government. After receiving a confirmation from an official in the middle of January 2009, this study recruited participants from 31 governmental agencies, which verifiably were continuously developing e-governmental systems, and the personnel were using mature systems to provide e-government services to citizens. Then, the city-level, e-governmental leaders' direct subordinates from those agencies received invitations by e-mail to participate in the study. The e-mail provided links to different animated scenarios presenting styles of leadership and a questionnaire. With the consent of the e-governmental leaders, the subordinates responded freely to the questions which sought perceptions of supervisors' styles of leadership as represented in the animated scenarios. The study collected demographic data with the same instrument.

3.2 Questionnaire Development

Based on the purposes and the literature review, this study developed an online questionnaire which adapted each aspect of leadership style into animated scenarios from the textual form proposed by Bass and Avolio (1997). Also, this study draws from perspectives of cognitive psychology to employ visual sensibility testing to avoid repeating prior studies (Antonakis et al. 2003; Avolio et al. 1988; Den Hartog et al. 1997; Rowold and Heinitz 2007), which used Likert-type scales to measure different aspects of leadership. Arguably, previous studies' questionnaires produced unclear descriptions and induced a low willingness to participate (Klooster et al. 2008). Therefore, the current study presents a new approach by designing animated scenarios (Macromedia Flash 8) of styles of leadership to induce visual stimuli and employs the Bass and Avolio concepts of MLQ to develop the questionnaire's items.

To ensure reliability of the animated scenarios, this study attended to the time necessary to process animated information. Although humans can scan multiple, complex images and rapidly understand the content, the average time needed to view an image and immediately prepare a response is roughly 75 ms (VanRullen and Thorpe 2001). Thus, the design for animated scenarios in this study paused for approximately 75–80 ms, and participants had sufficient time and had the opportunity to repeat the number of times a given scenario appeared before responding directly to a screen (Biederman 1972; Boyce and Pollatsek 1992; Hegarty 1978). Since this study seeks to investigate perceptions of leadership style without attempting to assess the degree of expression of a style, emphasis was on immediate, accurate comparisons of personal experiences and animated scenarios. Thus, this study's options for responses were: "have seen" the scenarios, "have not seen," the scenarios, and "not sure."

The study's online questionnaire consisted of two parts. The first part presented seven aspects distributed among three styles of leadership. The transformational style included four aspects, the transactional style included two aspects, and the laissez-faire style included one aspect. Two animated scenarios along with descriptions presented all seven aspects. The second part requested participants' demographic data, including age, educational level, gender, and years of service.

To ensure the validity of the animated scenarios' content, a pilot study with 57 students who had received on-the-job training in a known governmental department responded, in writing, without bias, to the scenarios. Then, according to the students' written responses, revisions to the descriptions of the scenarios ensured interpretive accuracy for the primary instrument. Since the characteristics of each leadership style appeared clearly in the scenarios, the description of each scenario would obtain accurate results (Muenjohn and Armstrong 2008). The design of the final instrument for the research contained 14 animated scenarios and 14 questions:

1. Transformational leadership—personal charm: (1) A leader emphasizes that everyone must have the same goals. (2) A leader hopes that subordinates will communicate any doubts or questions concerning goals.

2. Transformational leadership—encouragement: (1) Leaders clearly express the urgency of future goals. (2) A leader uses pictures or metaphors with symbolic meaning for encouragement.
3. Transformational leadership—intellectual stimulation: (1) A leader encourages subordinates to view problems from many different angles. (2) A leader guides subordinates in reconsidering or doubting previous conceptions to facilitate breakthroughs.
4. Transformational leadership—individual concern: (1) A leader is willing to spend time guiding subordinates. (2) A leader expresses concern for subordinates who tend to be ignored.
5. Transactional leadership—contingent compensation and reward: (1) A leader understands what subordinates expect to obtain after accomplishing the leader's expectations. (2) As long as subordinates cooperate fully with the leader, they can obtain what they want.
6. Transactional leadership—passive management by exception: (1) A leader only notices certain incidents of unmet standards. (2) A leader will be satisfied with subordinates' work situation only when all work is going smoothly.
7. Laissez-faire leadership—laissez-faire attitude: (1) A leader will avoid involvement when important or troublesome matters occur. (2) A leader has trouble finding the crux of a problem when difficulties arise.

3.3 Data Collection and Analysis Methods

This study expected to collect more than one hundred responses from the online questionnaire to measure the 14 variables presented as animation in conjunction with the sentences describing the animations. The expected number of responses coincides with the suggestion of Hair et al. (2010) that the sample should be at least five times the number of measured variables. A password-protected database collected the responses when participants clicked a "Submit" button upon completion.

Organization of the participants' responses to the 14 animated scenarios assigned one positive point for a "have seen" option, one negative point for a "have not seen" option, and no point for a "not sure" option. In the transformational leadership section of the questionnaire, the possible range of responses is 8 to −8; while, in the non-transformational leadership section, including transactional and laissez-faire styles of leadership, the range of responses is 6 to −6. Subtraction determined a net score, per participant for these two sections. If a participant's scoring was greater than 2 points, the conclusion is that perception of the participant's actual leader is a display of innovative style of leadership (i.e., transformational style). Conversely, a score of 2 points or fewer indicates a perception of non-transformation leadership.

The participants' demographic data, organized by categorical variables, included age (29 years and under, 30–39, 40–49, and 50 years and older); gender (male and female); educational level (high school and below, university or college, graduate

school); and years of service (4 years and under, 5–16 years, and 17 years and more). Recording and encoding of all data occurred in a Microsoft Excel® spreadsheet.

This study used SPSS 15.0 (Statistical Package for the Social Science) as a data analysis tool to calculate the frequencies and percentages of the participants' demographics. Responses to each animated scenario underwent reliability analyses to determine whether or not the responses obtained by the same group of participants in the same context were consistent. Since Cronbach's alpha was in excess of 0.70, a high level of reliability exists for the responses. Conversely, a value of less than 0.35 suggests low reliability; also, for analysis of validity, Pearson's correlation suggests preference for a smaller coefficient of correlation among questions of different styles of leadership (Hair et al. 2010). A coefficient in excess of 0.80 indicates a high level of correlation; a value between 0.40 and 0.80 indicates some correlation, and a value of less than 0.40 indicates low correlation. Finally, a Chi-square test presenting a cross-tabulation investigated which demographic variables caused significant differences among subordinates' perceptions of direct superiors' styles of leadership.

4 Research Results

This study received 336 valid responses (response rate: 28%) from the public servants of the city-level e-government in Taiwan. A summary of the demographic data of the participants appears in Table 1. The reliability analysis of the participants' responses to the questions concerning perceptions of direct superiors' styles of leadership revealed a Cronbach's alpha of 0.734 from all responses (transformational leadership: 0.655, non-transformational leadership: 0.665). This result indicates that this study's new approach possessed a high level of reliability (Hair et al. 2010). Also, Pearson's test for correlation coefficient yielded a value of 0.248, which indicates a low level of correlation between the participants' scores for transforma-

Table 1 Frequency and percentage of each demographic variable

Background variable		Frequency	Percentage (%)
Gender	Male	138	41.1
	Female	198	58.9
Age	29 and under	62	18.5
	30–39	105	31.3
	40–49	111	33.0
	50 and older	58	17.3
Educational level	High school and under	37	11.0
	College and university	216	64.3
	Graduate school	83	24.7
Years of service	4 and under	109	32.4
	5–16	108	32.1
	17 and more	119	35.4

tional and non-transformational leadership. In other words, the animated scenarios designed for this study were highly distinctive and could represent two completely different styles of leadership. These two analyses support the data's reliability and validity.

4.1 Participants' Perceptions of Supervisors' Leadership Styles

Since the dependent and independent variables were categorical, a Chi-square test investigated the influence of demographic variables for significant differences among participants' perceptions of supervisors' varying styles of leadership, and Table 2 summarizes the Chi-square results. Apparently, participants' educational levels had a significant influence (Chi-square = 17.785, $p = 0.000$) on responses.

Then, to determine which educational levels accounted for this difference, the calculated adjusted residual (AR) value (Haberman 1978) derived standardized values obtained by subtracting expected frequencies from observed frequencies. The probability distribution of standardized AR values approaches a normal distribution, and if the p value derived using the two-tailed test is 0.01, the critical AR value is 2.58. Table 3 shows that a significant difference exists between "high school and under" and "college and university" groups, implying that participants with an educational level of "high school and under" perceived direct supervisors' style of leadership tending toward non-transformational leadership (AR = 3.3); while, the other group perceived direct superiors exhibiting transformational leadership (AR = 3.9). Although participants with an educational level of "graduate school" perceived superiors tending toward non-transformational leadership, no significant AR value appears.

Table 2 Chi-square test results of participants' responses to perceptions influenced by background variables

Demographic variable/perception		*A*	*B*	χ^2	*p value*
Gender	Male	84 (39.8%)	54 (43.2%)	0.373	0.542
	Female	127 (60.2%)	71 (56.8%)		
Age	29 and under	39 (18.5%)	23 (18.4%)	4.339	0.227
	30–39	74 (35.1%)	31 (24.9%)		
	40–49	64 (30.3%)	47 (37.6%)		
	50 and older	34 (16.1%)	24 (19.2%)		
Educational level	High school and under	14 (6.6%)	23 (18.4%)	17.785	0.000[a]
		152 (72.0%)	64 (51.2%)		
	College and university, graduate school	45 (21.3%)	38 (30.4%)		
Years of service	4 and under	71 (33.6%)	38 (30.4%)	2.576	0.276
	5–16	72 (34.1%)	36 (28.8%)		
	17 and more	68 (32.2%)	51 (40.8%)		

A refers to responses tending toward transformational leadership; *B* refers to responses tending toward non-transformational leadership

*$p < 0.01$

Table 3 AR values for the variable: educational level

Educational level	*A*	*B*	Sum
High school and under	14 (6.6%)	23 (18.4%)	37 (11.0%)
AR value	−3.3	*3.3*	
College and university	152 (72.0%)	64 (51.2%)	216 (64.3%)
AR value	*3.9*	−3.9	
Graduate school	45 (21.3%)	38 (30.4%)	83 (24.7%)
AR value	−1.9	−1.9	

A refers to responses tending toward transformational leadership; *B* refers to responses tending toward non-transformational leadership
AR adjusted residual

4.2 Cross-Analyses and Chi-square Tests for Background Variables

Table 4 summarizes the results of the cross-analysis and Chi-square testing of gender and the three other demographic variables (i.e., age, educational level, and years of service). Differences in participants' responses exist between gender and educational levels (Chi-square = 18.422; $p = 0.002$). Table 5 reveals that "female" respondents with a "high school and under" education perceived supervisors displaying non-transformational leadership (AR = 2.9).

Table 6 summarizes the results of the cross-analysis of different age groups and two additional background variables (i.e., educational level, years of service). Since the number of cells with a frequency of less than 5 exceeds 20% of the number of all cells, the Chi-square test is not applicable (Greenwood and Nikulin 1996).

Table 4 Results of cross-analysis with gender and three additional variables

Demographic variable/ perception		*A B*	*A B*	χ^2(p value)
		Male	Female	
Age	29 and under	15 (7.1%) 11 (8.8%)	24 (11.4%) 12 (9.6%)	7.804 (0.350)
	30–39	32 (15.2%) 19 (15.2%)	42 (19.9%) 12 (9.6%)	
	40–49	19 (9.0%) 14 (11.2%)	45 (21.3%) 33 (26.4%)	
	50 and older	17 (8.1%) 10 (8.0%)	17 (8.1%) 14 (11.2%)	
Educational level	High school and under	5 (2.4%) 7 (5.6%)	9 (4.3%) 16 (12.8%)	18.422 (0.002*)
	College and university	54 (25.6%) 23	98 (46.4%) 41 (32.8%)	
		(18.4%)	20 (9.5%) 14 (11.2%)	
	Graduate school	25 (11.8%) 24 (19.2%)		
Years of service	4 and under	29 (13.7%) 22 (17.6%)	42 (19.9%) 16 (12.8%)	7.610 (0.179)
	5~16	23 (10.9%) 14 (11.2%)	49 (23.2%) 22(17.6%)	
	17 and more	32(15.2%) 18(14.4%)	36 (17.1%) 33 (26.4%)	

A refers to responses tending toward transformational leadership; *B* refers to responses tending toward non-transformational leadership
* $p < 0.01$

Table 5 AR values for variables of gender and educational levels

Demographic variable/perception		*A*	*B*	Sum
Male	High school and under	5 (1.5%)	7 (2.1%)	12 (3.6%)
	AR value	−1.5	1.5	
	College and university	54 (16.1%)	23 (6.8%)	77 (22.9%)
	AR value	1.5	−1.5	
	Graduate school	25 (7.4%)	24 (7.1%)	49 (14.6%)
	AR value	−1.8	1.8	
Female	High school and under	9 (2.7%)	16 (4.8%)	25 (7.4%)
	AR value	−2.9	*2.9*	
	College and university	98 (29.2%)	41 (12.2%)	139 (41.4%)
	AR value	2.5	−2.5	
	Graduate school	20 (6.0%)	14 (4.2%)	34 (10.1%)
	AR value	−0.5	0.5	

A refers to responses tending toward transformational leadership; *B* refers to responses tending toward non-transformational leadership

Table 7 summarizes the results of the cross-analysis of educational levels and years of service and reveals existing differences (Chi-square = 20.284; $p = 0.009$). Table 8 shows that participants with an educational level of "high school and under" and years of service of "17 and over" perceived supervisors displaying non-transformational leadership (AR = 2.7).

5 Discussions, Suggestions, and Conclusions

This study investigates the perceptions of city-level Taiwanese public servants' perceptions of direct supervisors' leadership during the process of adopting an innovative organization of e-government. Analysis results of the data obtained from participants viewing animated scenarios and responding to questions, online, reveal that participants' educational levels could significantly influence perceptions of direct superiors' leadership styles. Particularly, the participants with lower educational levels and employed for more than 17 years tended toward perceiving non-transformational leadership. This is true for most senior public servants who have long employment in governmental agencies right after receiving high school or under educations. These individuals engage in simple tasks, and thus easily perceive supervisors displaying transactional or laissez-faire styles of leadership. Recently, due to the development of e-government in Taiwan, public servants with higher levels of academic achievement have entered public service and gain empowerment from supervisors to attend to more challenging tasks, beyond routine assignments.

Table 6 Results of the cross-analysis of age and two additional variables

Demographic variable/ perception		*A*	*B*	*A*	*B*	*A*	*B*	*A*	*B*
		29 and under		30–39		40–49		50 and older	
Educational level	High school and under	1 (0.5%)	2 (1.6%)	2 (0.9%)	0 (0.0%)	5 (2.4%)	12 (9.6%)	6 (2.8%)	9 (7.2%)
	College and university	27 (12.8%)	14 (11.2%)	55 (26.1%)	16 (12.8%)	45 (21.3%)	22 (17.6%)	25 (11.8%)	12 (9.6%)
	Graduate school	11 (5.2%)	7 (5.6%)	17 (8.1%)	15 (12.0%)	14 (6.6%)	13 (10.4%)	3 (1.4%)	3 (2.4%)
Years of service	4 and under	38 (18.0%)	23 (18.4%)	30 (14.2%)	15 (12.0%)	3 (0.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
	5–16	1 (0.5%)	0 (0.0%)	42 (19.9%)	16 (12.8%)	26 (12.3%)	18 (14.4%)	3 (1.4%)	2 (1.6%)
	17 and more	0 (0.0%)	0 (0.0%)	1 (0.5%)	0 (0.0%)	36 (17.1%)	29 (23.2%)	31 (14.7%)	22 (17.6%)

A refers to responses tending toward transformational leadership; *B* refers to responses tending toward non-transformational leadership

Table 7 Results of the cross-analysis of educational levels and years of service

Demographic variable/perception		*A*	*B*	*A*	*B*	*A*	*B*	Chi-square value (*p* value)
		High school and under		College and university		Graduate school		
Years of service	4 and under	2 (0.9%)	2 (1.6%)	48 (22.7%)	19 (15.2%)	21 (10.0%)	17 (13.6%)	20.284 (0.009*)
	5–16	2 (0.9%)	5 (4.0%)	55 (26.1%)	18 (14.4%)	15 (7.1%)	13 (10.4%)	
	17 and more	10 (4.7%)	16 (12.8%)	49 (23.2%)	27 (21.6%)	9 (4.3%)	8 (6.4%)	

A refers to responses tending toward transformational leadership; *B* refers to responses tending toward non-transformational leadership

* $p < 0.01$

Table 8 AR values from the cross-analysis of educational levels and years of service

Demographic variable/perception		*A*	*B*	Sum
High school and under	4 and under	2 (0.6%)	2 (0.6%)	4
	AR value	−0.5	0.5	1.2%
	5–16	2 (0.6%)	5 (1.5%)	7
	AR value	−1.9	1.9	2.1%
	17 and more	10 (3.0%)	16 (4.8%)	26
	AR value	−2.7	*2.7*	7.7%
College and university	4 and under	48 (14.3%)	19 (5.7%)	67
	AR value	1.7	−1.7	19.9%
	5–16	55 (16.4%)	18 (5.4%)	73
	AR value	2.5	−2.5	21.7%
	17 and more	49 (14.6%)	27 (8.0%)	76
	AR value	0.3	−0.3	22.6%
Graduate school	4 and under	21 (6.3%)	17 (5.1%)	38
	AR value	1.0	−1.0	11.3%
	5–16 AR value	15 (7.1%) −1.1	13 (3.9%) 1.1	28 8.3%
	17 and more	9 (2.7%)	8 (2.4%)	17
	AR value	−0.9	0.9	5.1%

A refers to responses tending toward transformational leadership; *B* refers to responses tending toward non-transformational leadership

Certainly, the supervisors, of IT-assisted areas of responsibility will assume greater duties for leading governmental activities, and thus the attendant style of leadership, as perceived by subordinates, will be different.

Overall, this study finds that city-level, e-governmental leaders gain benefit from instituting a transformational style of leadership, and are better able to change direct subordinates' values when performing assigned tasks during the process of adopting online services. For example, supervisors should interact with subordinates, actively monitor subordinates' working processes, and specifically encourage

subordinates' interest in continuing education. As a result, subordinates may recognize additional capabilities, willingly commit to achieving the goals of implementing e-governmental processes, and display dedication to adoption of online services. Since subordinates with low educational levels typically receive routine assignments, little opportunity exists to interact with their supervisors. Consequently, this study suggests encouraging subordinates to participate in on-the-job training to allow increased opportunities to undertake more challenging tasks.

In addition, this study finds that a significant variance exists between male and female public servants' perceptions of styles of leadership according to levels of education. In particular, female public servants with educational levels of high school or less displayed a tendency to perceive non-transformational leadership. According to the findings, reported by Kim (2005), among public servants of Seoul, South Korea's city government, the most significant differences in satisfaction exist between males and females. In terms of salary, autonomy, and opportunities for promotion, male public servants in Seoul display greater satisfaction than female public servants. Dollar et al. (2001) also found that, in a sample of 100 countries, women employed in governmental units obtained relatively fewer opportunities for promotion. Thus, the current study suggests that leaders should attend more closely to female public servants with relatively low levels of education to ensure that both female and male public servants can jointly provide online services during implementation of e-government. Additionally, since the supervisors may not know subordinates' educational levels due to confidentiality, assigning tasks may reveal the subordinates' capabilities. Thus, this study recommends that leaders assign challenging tasks at appropriate times to subordinates, provide substantive rewards when warranted, and entrust employees with different types of tasks.

The value of completing this study lies in creating awareness among public servants in governmental units, especially e-governmental leaders or supervisors, of their roles in innovation-oriented organizations. E-governmental leaders need to accept responsibility for these key roles in the process of adopting the innovations necessary for implementing e-governmental policies and procedures. Consequently, awareness of the impact of a style of leadership on administrative performance is essential. Future e-governmental leaders may also consider employing online leadership methods to achieve the objectives of providing e-governmental services (Berman et al. 2013; Brown and Gioia 2002; Chowdhury et al. 2006; Hahm et al. 2013; Larry 2008; Zhao et al. 2014) similar to those multinational, profit-seeking organizations which adopt advanced technologies and systems for implementing effective policies (Bolívar et al. 2010; Fountain et al. 2011; Yiu 2012). In brief, e-governmental leaders may consider employing online leadership methods to achieve the objectives of providing services. Finally, future studies may further explore differences in perceptions of direct supervisors' leadership among personnel employed in Eastern and Western governments.

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Conclusions

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1 Concluding Remarks

In the past years, cities are becoming smart aiming at increasing citizens' quality of life, and improving the efficiency and quality of the services provided by governing entities and businesses. The use of information and communication technologies (usually ICTs) and data has been considered as the means to promote cities in becoming smart and to solve city's economic, social, and environmental challenges in this process (European Parliament 2014; Centre for Cities 2014).

Nonetheless, many of the challenges to be faced by smart cities surpass the capacities, capabilities, and reaches of their traditional institutions and their classical processes of governing, and therefore, new and innovative forms of governance are needed to meet these challenges. Therefore, the growth of smart cities is helping the increase of government use of ICTs to improve political participation, implement public policies, or provide public sector services.

This book has tried to analyze different experiences in how governments are facing the process of cities to become smart. First of all, we need to frame clearly what a smart city is. At least, the perspectives on which this concept is built on. In this regard, Anthopoulos (2015) analyzes the difficulty in approaching the definition and meaning of a smart city because it does not describe a city with particular attributes, but it is used to describe different cases in urban spaces (web portals that virtualize cities or city guides, knowledge bases that address local needs, agglomerations with ICT infrastructure that attract business relocation, etc.). Therefore, a holistic literature review about the concept of smart city is necessary. According to Anthopoulos (2015), a smart city can be viewed with four disciplinary perspectives

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and all recent ICT trends were also found related to that concept. Finally, eight different models have been introduced for smart city analysis, which can all align to a common conceptual framework consisting of eight perspectives (application domains, Resource, Transportation, Urban infrastructure, Living, Government, Economy, and Coherency).

All these domains are dealt into this book but taking all together through platforms that have been used to govern smart cities. In this regard, Anttiroiko (2015) analyzes the question of how platform approach contributes to the success of urban restructuring by taking a closer look at one of the "innovation factories" of Tampere, the New Factory and one of its platforms, Demola, which exemplify the new trend in platform building. This approach involves active and talented people, encourage and enhance creativity, create knowledge-sharing culture, and integrate activities especially within the loosely connected programs and platforms of local innovation environment. It makes the utilization of local assets effective and helps to gather the main aspects of attraction factors into one hub, which has a potential to match local strengths with the interests of external actors. Nonetheless, openness and managerialism in development processes have to be balanced in this approach.

Also, Lombardi and Vagnolo (2015) aim at providing a critical reflection about the relation between smart city and neoliberal urban governance in which local governments are more and more in charge of providing urban services, whereas the smart city paradigm offer new areas of economic profitability for private companies promoting technological solutions. This situation may enhance urban fragmentation, rather than cohesion, which makes crucial to elaborate a smart city that is not limited to the technological or environmental spheres, but that fully acknowledges its nature of "mobile technology of governance" and neoliberal "mobile development paradigm" (Lombardi and Vagnolo 2015). Therefore, policy makers need to look with caution to smart city projects, evaluating them, not only from a technical point of view, but also from the social, political, and cultural perspectives.

The way in which e-government projects are managed, as main elements of smart initiatives, is also under evaluation into this book. So, Hsieh et al. (2015) have investigated public servants' styles of leadership as perceived by subordinates during the process of developing an e-government in the Taiwanese government. They also investigate subordinates' demographic variables, such as age, educational level, gender, and years of service to know if these variables could affect their perception regarding the public servants' styles of leadership in e-government projects. Authors find that the city-level, e-governmental leaders gain benefit from instituting a transformational style of leadership, and are better able to change direct subordinates' values when performing assigned tasks during the process of adopting online services (Hsieh et al. 2015). In addition, demographic variables such as gender and educational level have a significant impact on perceptions of direct supervisors' styles of leadership (Hsieh et al. 2015).

In addition, cities need environment to become smart (Wall et al. 2015). In this regards, the regional and transnational positioning of cities is conditional to being smart, and where the building of dense and diverse economic network relations becomes essential. Therefore, municipalities should complement their understanding

of how to improve "endogenous" smart city urban characteristics with an "exogenous" understanding of the relative importance of their cities within the global economic system, although not all cities be treated equally, as cities differ in terms of their history, economic and political structure, and cultural inheritance (Wall et al. 2015). Furthermore, it is also important to take note that local administrations serve only as the sites of activities, but are not the key actors themselves. Only smart people have proved to be the essential factor to stimulate outward investment into other cities, which makes policy makers to focus on developing factors that affect this issue (Wall et al. 2015).

Finally, Ojo et al. (2015) offer researchers, policy makers, and practitioners a framework (smart city initiatives design framework (SCID)) to support the planning and design of smart city initiatives, analyzing the experience in ten flagship smart city programs around world. The framework enables users to link smart city objectives with concrete impact or changes in different city aspects, and consequently city and stakeholder transformation goals. Indeed, feedback from users revealed that the options provided by the SCID framework are useful, and the use of the framework is aligned with their IT management practices. In any case, this framework needs to be updated and a more participatory, crowd-sourced and social approach for the dynamic update of the SCID framework is needed to achieve this aim.

Therefore, as smart city is understood as a participative city, Paskaleva et al. (2015) analyzes the experience of five European cities using an open innovation approach to citizens' engagement in the coproduction of smart city services. In this regard, a large number of smart cities in Europe are using Living Labs to shape the applications and services being developed for their citizens, at both macro- and microlevels. This way, Paskaleva et al. (2015) make a critical review of the concept of stakeholder engagement and its implementation in Living Labs as a means of coproducing new and innovative smart city services. According to their research, setting up an effective Living Lab—capable of supporting meaningful coproduction of services—is far from being a trivial task. Paskaleva et al. (2015), using the experience of the Peripheria Project, provide a focused and operational framework for the "stakeholder engagement" construct, and present experience about its meaning in the coproduction of smart city services. To make it successful, Paskaleva et al. (2015) point both to a policy agenda and to working practices for coproduction activities in smart cities.

In any case, a participative city also means transparent cities (David et al. 2015). Smart cities bring with them the promise of a new period of participatory government, facilitating the open government movement in any municipality but especially in a smart community (David et al. 2015). For urban governance, transparency implies the availability of timely, correct, and usable information that enables public officials and citizenry to know about governments' plans and performance, communicate among themselves about those plans and performance, and make better governing decisions accordingly. In addition, transparency is understood as an essential tool for accountability. It means that transparency is not only "inwards" transparency, but also "outwards" that facilitates officials' knowledge of citizens' needs and expectations. All this makes necessary to measure transparency in which

a number of dimensions become relevant such as Level of Analysis, Timing, Time Horizon, Qualitative Dimensions, Quantitative Dimensions, Accessibility, and a hierarchy of needs (David et al. 2015).

In sum, the book collects relevant studies that highlight the need for analyzing smart cities from the point of view of the governance of the city. Many different experiences have been analyzed in this book to contribute to this knowledge, but future research should be lead to widen this knowledge and the factors that could affect the style of governance in a smart city. In general, smart cities' development seem to be positive for citizen engagement and for efficiency in public sector tasks, but the development of smart cities needs to consider some main internal and external challenges that have been identified in the empirical studies included in the book, such as smart people or social, political, and cultural perspectives of smart initiatives.

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