Technological Forecasting & Social Change xxx (2013) xxx–xxx

Contents lists available at ScienceDirect

Technological Forecasting & Social Change

Towards an effective framework for building smart cities: Lessons from Seoul and San Francisco

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ARTICLE INFO

Article history:
Received 1 November 2012
Received in revised form 26 May 2013
Accepted 28 August 2013
Available online xxxx

Keywords:
Smart city
Case study
Smart city services
Innovation
Sustainability

ABSTRACT

This study aims to shed light on the process of building an effective smart city by integrating various practical perspectives with a consideration of smart city characteristics taken from the literature. We developed a framework for conducting case studies examining how smart cities were being implemented in San Francisco and Seoul Metropolitan City. The study's empirical results suggest that effective, sustainable smart cities emerge as a result of dynamic processes in which public and private sector actors coordinate their activities and resources on an open innovation platform. The different yet complementary linkages formed by these actors must further be aligned with respect to their developmental stage and embedded cultural and social capabilities. Our findings point to eight 'stylized facts', based on both quantitative and qualitative empirical results that underlie the facilitation of an effective smart city. In elaborating these facts, the paper offers useful insights to managers seeking to improve the delivery of smart city developmental projects.

1. Introduction

Globalization, urbanization, and industrialization have been recognized as three important drivers leading human civilization into the 21st century. According to the [41], approximately 70% of the world's population will soon live in urban areas. Cities generate 80% of global GDP, a share that is continually (and sharply) increasing. In the context of addressing essential, urgent issues of climate change and sustainable environment, both central and local governments from around the world have devised plans for existing and emerging cities to become both smarter and greener.

Most leading cities in Europe, the U.S. and in Asia have adopted ICT (Information and Communication Technologies) and green technologies as ways to revitalize economic opportunities and to strengthen their global competitiveness. These initiatives range from small-scale applications of individual clean technologies to ambitious projects to transform entire urban areas through master planning and infrastructure development. Notwithstanding the vitality of these initiatives, smart city research remains at a preliminary stage. Discussions in academic literature of relevant theory or frameworks are few; analysis lags behind the actual practice of how different cities, sometimes aggressively, are moving toward transforming themselves into a smart and green city. The technologies necessary to do this span multiple fields and must be integrated in complex systems to be effective. Even though actual practice often remains fragmented, real world implementation still generally outstrips any discussion in academic literature capable of generalization.

Given the gaps in theory and practice for smart cities, this study aims centrally to lay out a taxonomy for analysing smart city development. This framework enables a more systematic exploration of smart development and implementation. What are the evolving best practices for developing innovative

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0040-1625/$ – see front matter © 2013 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.techfore.2013.08.033

products and service applications for smart cities? What lessons can be learned from particular smart city experiences? How can cities overcome challenges by building effective private–public partnerships, shaping business models that add value, and integrating disparate technologies in a productive ecosystem? What policies and governance structures have been effective in supporting the development and deployment of smart and green industries for cities? What are the driving forces behind these initiatives?

To contribute to meeting these research challenges, this study proposes a conceptual framework laying out a holistic taxonomy for smart city development and implementation practices. The study's goal is to identify the opportunities offered and challenges posed to different stakeholders in the smart city, including central government officials, city representatives, and private sector players. Research objectives of this study thus include:

1 To develop a conceptual framework to better understand smart city practices and more effectively to identify and assess gaps where adaptation and improvement may be needed.
2 To examine and analyse two leading cases from the U.S. and Asia through the lens of this new framework to identify heterogeneous and heterogeneous characteristics in the process of planning and developing a smart city.

The study will bridge some theoretical and practical gaps for a holistic research approach to smart cities, especially in characterizing the implementation of services into a network infrastructure and structure of governance. The paper synthesizes its case study findings to present eight 'stylized facts' intended to offer guidelines to smart city developers. These facts highlight that the process of building an effective smart city is dynamic and relies on the interaction of a number of private and public sectors players, as this is facilitated by an innovation platform. The form of these interactions, that is, the nature of the networked linkages created by private–public interaction will reflect a smart city's developmental stage and embedded cultural and social capabilities. In observing these characteristics, the study provides useful insights to managers on practical smart city development, especially since most existing studies take a piecemeal approach to the analysis of individual projects.

This paper is organized as follows. Section 2 discusses relevant literature on the smart city and its practices. Section 3 identifies the six driving forces that undergird our conceptual framework, while a consideration of the paper's data, measures, and methods follows in Section 4. Empirical results applying the conceptual framework to smart cities are presented and analysed in Section 5. Section 6 concludes with a theoretically-grounded elaboration of these 'stylized facts' as they emerge from our empirical results and states the managerial implications of this study.

2. Theoretical background

2.1. Smart city definition

The smart city concept originated from various definitions including those of the 'intelligent city', 'information city', 'knowledge city', 'digital city' and (in a similar term to 'smart city' itself) 'ubiquitous city'. These different 'brands' of the city concept have some characteristics in common, as well as individual elements, while the definitions have a different scope and place different emphases. The concept of the smart city itself is fuzzy and often inconsistent, as [19] points out.

The concepts of an 'information city' and 'a digital city' tend to be set out from within a technology perspective in which ICT is understood as the key driving force in delivering innovative online services [8]. The 'information city' collects information from localities and delivers it to the public via the internet. Yovanof and Hazapis [54] elaborate a comparable definition of the digital city as 'a connected community that combines broadband communications infrastructure, a flexible, service-oriented computing infrastructure based on open industry standards; and innovative services to meet the needs of governments and their employees, citizens and businesses'. Other scholars also have emphasized the importance of a city connecting networked organizations comprising different participants including government, businesses and social groups. Discussion of the 'digital' city has mainly centered on the development of online services for various groups, who capture the 'downstream' side of service value chains.

The 'ubiquitous city' has been understood a further extension of the digital or information city in making data ubiquitously available through an embedded urban infrastructure (e.g. through equipment embedded in streets, bridges and buildings). The term originates from the South Korean government, who refer to 'a city that is managed by the network and provides … citizens with services and contents via the network … with a BUCI (fixed u-City infrastructure) and MUCI (mobile u-City infrastructure), built on high-end technologies such as sensors' [28,43]. The concept would fit out all urban spaces with forms of embedded information infrastructure to provide various services including those for energy and environmental monitoring. Lee et al. [29] have further stressed an idea of the u-City as a convergence of IT services within urban space, accessible regardless of time and location. These services will enhance a city's competitiveness and the quality of life of its citizens. However, the ubiquitous concept places less emphasis on the uses made of social infrastructure from (for instance) a human and social capital perspective.

The notion of an 'intelligent city' focuses on the out-performance of a smart city as this is achieved through innovation in three dimensions: 1) Intelligence, inventiveness and creativity; 2) Collective intelligence and 3) Artificial intelligence. Providers will use ICT to co-create and co-design services, typically through the systemic integration of embedded forms of technology such as sensors and interactive media. [25] understand intelligent cities as leading to a significant, fundamental change in the nature of life and work in a city, rather the space of merely incremental improvements. The theorization of intelligence cities is typically developed within the context of thinking about a 'knowledge economy' that views human and social capital as the most valuable assets [53]. Development (including social development) seeks to leverage these assets into the ability to support knowledge creation and procedures for learning. Technological innovation is central to the intelligent city [39], which positions the concept as analogous to the 'knowledge city', which encourage the nurturing of knowledge.

This discussion has shown that the smart city concept originates from various perspectives, including those of the 'information city'. The concept, though, has incrementally evolved into an idea of an ICT-centered city or open city [39]

Please cite this article as: J.H. Lee, et al., Towards an effective framework for building smart cities: Lessons from Seoul and San Francisco, Technol. Forecast. Soc. Change (2013), http://dx.doi.org/10.1016/j.techfore.2013.08.033