

Enabling Factors for Smart Cities: A Case Study

Research-in-Progress

Réka Pétercsák

Maynooth University
Co. Kildare

Reka.Petercsak@nuim.ie

Giovanni Maccani

Maynooth University
Co. Kildare

Giovanni.Maccani@nuim.ie

Brian Donnellan

Maynooth University
Co. Kildare

Brian.Donnellan@ivi.nuim.ie

Markus Helfert

Dublin City University
Glasnevin, Dublin 9

Markus.Helfert@dcu.ie

Niall Connolly

Maynooth University
Co. Kildare

Niall.Connolly@ivi.nuim.ie

Abstract

Smart city initiatives have become inseparable from the modern development of urban environments. Scholars have characterized smart cities as complex and emergent environments and many attempts have been made to create a framework for the enabling factors of smart processes. In this research in progress paper, we aim to contribute to this particular conversation by presenting findings from theoretical and empirical research. Through a systematic literature review we propose a comprehensive ensemble of enabler factors for Smart Cities and determine future directions for scholars and practitioners. Then, we leverage preliminary findings emerging from a research in progress in the Dublin Docklands to draw conclusions about the current understanding of the concept in question. We argue, based on preliminary results, that there must be equal emphasis on the interconnected and process-based nature of the enabling factors, i. e. on the value creation potential of the smart city.

Keywords: Smart City, Dublin Docklands, Case Study, Enabling Factors, Value Co-creation

Introduction

Smart city initiatives have become inseparable from the modern development of urban environments. The toolkit provided by the Information Systems (IS) field therefore provides a unique opportunity to capture these socio-technical processes. To an increasing extent, scholars have characterized smart cities as complex and emergent environments and many attempts have been made to create a framework for the enabling factors of smart processes. This research-in-progress paper presents preliminary findings from an empirical study aiming at contributing to this particular conversation.

To explore the present understanding of the definition and the enabling factors of the smart city, an extensive Systematic Literature Review has been carried out (Maccani et al. 2014a; Maccani et al. 2014b). The responses to our two review questions were systematically collated following (Webster and Watson, 2002)'s Concept Matrix method. As a result of this process, we proposed a comprehensive ensemble of enabler factors for Smart Cities: "Technology", "Social Infrastructure", "Governance", "Triple Helix Partnerships", and "Information Services". These factors were carefully explained in (Maccani et al. 2014a). This paper focuses on structuring the understanding of co-creation and collaboration in Smart Cities. In these regards, the literature emphasises: (1) the need for a collaboration model to actually establish technological and social components as enablers for Smart Cities, (2) that the balance between bottom-up and top-down strategies must be strengthened, (3) that to achieve these goals managerial interoperability across city's smart services, applications, and organizations is required (Nam et al. 2011; Schaffers et al. 2012). These issues reflected those which emerged from our early stage interaction with Dublin City Council as part of their *Smart Dublin* initiative (<http://smartdublin.ie/>). Therefore, the following research question has been formulated for this study: *What are the enabling factors that enhance the co-creation of Smart City projects?*

Building on our previous work, this paper aims at contributing to the IS literature on Smart Cities through introducing preliminary empirical data from a case study undertaken in Dublin, Ireland. The preliminary findings, in part, confirm the findings of the literature review, but also point to a more meaningful understanding of smart city processes. The research in Dublin has brought the treatment of the enabling factors to the forefront. We argue, based on preliminary results, that there must be equal emphasis on the interconnected and process-based nature of the enabling factors, i.e. on the value creation potential of the smart city.

This paper is structured as follows: after this introductory section, a summary of the systematic review of the literature and the subsequent research question are presented. Then, we proceed to details about the research, approach, and methodologies applied. Finally, we conclude by presenting preliminary findings and open pathways for future discussion.

Systematic Literature Review

Our previous work aimed at systematically exploring the thematic area of Smart Cities and identifying the emerging research challenges related to this topic. More specifically, it explored the factors required to evaluate the environmental and socioeconomic sustainability impact of Information and Communication Technology (ICT) solutions at a city level (Maccani et al. 2014a; Maccani et al. 2014b) as part of an Action Design Research (Sein et al. 2011) project. In particular, the SLR stage of the mentioned work was dedicated to providing an overarching definition of Smart Cities and identifying the enabling factors of Smart Cities. To this end, two key review questions (RevQ) were defined: how is the term Smart City defined in literature? (RevQ1); which are the homogeneous dimensions that fully encompass all the enabler factors of Smart Cities? (RevQ2). From the review we extracted Smart City definitions for analysis. Based on their composition, we could propose the following framing for establishing Smart City definitions: *The Smart City is a [Context] that exploits / uses / leverages / develops an [Infrastructure] with-a-certain / implementing an [Approach] supported by [Factors] to enable [processes] to achieve/ improve / enhance / increase [Goals]*. Enabler factors were sought in literature from both text definitions and various forms of frameworks and models proposed at the time of the research as structured definitions for Smart Cities across several disciplines. In total, after applying various levels of exclusion criteria, we selected 42 contributions for this study. Subsequently, we extracted the mentioned dimensions to conceptualise enable factors for Smart Cities. The output of this step was a complete list of relevant concepts from which we could synthesize our study. Definitions and frameworks were analysed separately leveraging (Webster and Watson, 2002)'s Concept Matrix method in which each key word/notion is related to the author and grouped within the category to which it belongs. The matrix developed for Smart City definitions is proposed in Figure 1.

Subsequently, we went into a greater level of detail aiming at exploring mutually exclusive and collectively exhaustive areas that fully encompass all the enabling factors of Smart Cities. Similarly to Figure 1, a concept matrix was developed for synthesizing this information. A detailed description of the outcome is provided in (Maccani, et al, 2014a). As a result of this process, we proposed a comprehensive ensemble of enabler

the purposes of this study. In fact, case studies are acknowledged to be consistent with inductive reasoning, and qualitative approaches (Eisenhardt, 1989; Orlikowski and Baroudi, 1991; Walsham, 1995; Stake, 2006; Eisenhardt and Graebner, 2007; and Lauckner et al. 2012). These methods also enable the exploration of complex situations allowing for the gathering of multiple perspectives, from a range of sources, including contextual information (Stake, 2006; Flyvbjerg, 2006; Anaf et al. 2007; and Lauckner et al. 2012). In addition, engaging with the stakeholders potentially involved in co-creating Smart City initiatives, and qualitatively developing thick descriptions to generate “themes” (factors), are characteristics of both this research and the case study research methodology.

The Case Study

Dublin’s *Silicon Docks*, which is integrative part of Dublin’s strategy to become a Smart City (officially launched as *Smart Dublin*, see <http://smartdublin.ie/>), was selected as a suitable case for inductively investigating the research question. Dublin’s *Silicon Docks* is home to 40 of the major technology companies including nine out of the ten largest ICT organisations as well as global financial institutions. The Grand Canal Dock and the North Lotts strategic development zones are framing Dublin’s vibrant port area and extend into the city. The *Silicon Docks* is seen as a commercially and culturally vibrant area and is perceived to be full of young, active residents who attained third-level education. Dublin City Council’s aim to devise a strategy for the development of a Smart District has thus found a rich environment in terms of economic, social and intellectual capital. The idea of co-creating a smart district has evoked the participant’s interest as the area is considered an ideal test-bed for demonstrators as well as long-term smart developments.

Data Collection & Analysis

To access the interpretations that participants have regarding the actions and events which have or are taking place, and the views and aspirations of themselves and other participants’ (Walsham, 1995, p.78), semi-structured interviews and the principles of the general interview guide approach are used throughout the interview process. The data collection process has started in late January 2016 and up to date we have conducted 17 interviews. Of these, 10 were analysed at the time of writing this paper. The selection of participants happened through snowball sampling: The stakeholders were referred to us by the local authority and the stakeholders themselves during the course of the interviews. The participants’ roles correspond to the followings: representatives of industry associations for digital business, network management companies, business forums and local authority representatives, community representatives, urban planners and green energy advisors. The format of interviews varied between 1:1, 2:1, and 2:2 settings and lasted generally 60-70 minutes. In order to maximize the effectiveness of the interview-questions we used open-ended questions and allowed the interviewees to elaborate on the questions freely. However, to ensure that the same areas are covered we used a general interview guide approach to direct the conversations. During the course of an interview 10-11 themes are discussed with regards to smart and sustainable development. These included topics such as: the future of the area, best practices, emerging urban challenges in the area, the concept of smart and sustainable development as used by the stakeholders, the principal factors influencing smart and sustainable development in the area, the stakeholders’ concept of the successful of smart and sustainable initiatives, the characteristics of the current stakeholder network and partnerships in the area. Additionally, we allowed space for improvisation, in order to shed light on shared meanings and practices that may complement our data.

After transcribing the SSI, summarizing field notes and collecting other documents, such as strategic reports on economic development, planning documents, studies on technology use and uptake we started using the following method (Miles and Huberman, 1994; Walsham, 1995; Darke *et al.* 1998): (1) manually review the transcripts, line by line, to uncover key patterns/themes and produce key words/phrases; (2) produce labels/categories of these key words/phrases (3) look for relationship among the factors. To exemplify the process, we have provided the below snippets for consideration. These fragments are taken from a conversation about the best practices & examples the participant wanted to see emerging in the Docklands:

... I think knowing how to actually learn from that project as well and study the lessons learned, like simple issues like the street furniture, where does it be placed on street furniture? How does

it get power up to the WIFI node? (...) I say to people, (...) well you know when you did a big rollout for a pharmaceutical or a data center? Where are your lessons learned logs and where are your missed logs? And they're like well that means somebody did something wrong? And I say no, no, no that's a huge powerful tool. (...) So it's really something that you have to learn when you get into a new project, and then also learn that other people might access it, and like how to actually record what you are doing.

Another participant responded in similar terms when we asked how the success of smart and sustainable initiatives may be measured:

I'd like to see projects that (...) I can put in front of a client, and again this is my perspective, these are the projects that Dublin City has successfully participated in, and these are the ones that have failed as well, but they have the learnings from it. So they know what not to do, you know what I mean, it's important as well. So it's kind of like success stories and failure stories, because its knowledge gained. (...) I don't mind application areas, just to ensure that they are world class differentiated enough, and the other cities can learn from them as well.

Such fragments were labeled 'learning as outcome' as a high-level category. The collection of all the codes together with their frequency within the material comprising of ten interviews (~400 pages) can be seen in Appendix 1. After linking our high-level codes to each other, we have tested our preliminary results against our literature review to see whether there are any insights emerging our empirical data that may shed light on the gap identified by literature (see Appendix 1).

Preliminary Findings

The early insights have enriched our understanding on the following dimensions defined in (Maccani, et al. 2014a): Infrastructure, Approach and Goals. On the basis of our findings we also propose the addition of the category 'Principles' to the matrix.

Infrastructure: our analysis shows support for the following components of the Infrastructure dimension: ICT, Physical infrastructure, Human Capital, Intelligent city. A state-of-the-art ICT infrastructure, a multi-operator platform, a telecommunications-ready location is envisioned by the stakeholders as enabling optimal renting possibilities and thereby swift movement of companies into and out of the Docklands. The urban development plans in the Docklands, the designation of the Strategic Development Zone (www.dublincity.ie/sdz-docklands), and the Master Plan (unpublished at the time of the writing of this paper) for the area are seen to be promoting a new way of sustainable and smart living and working in the Docklands. Additionally, our data enhances the need for intellectual and human capital: the development of the smart district is seen to be enabled by data. However, intellectual capital is considered to be the central component to understand the nature of benefits from smart city initiatives. Smart human thinking ensures that the right data is connected to serve more effective daily processes for businesses, citizens and city governance alike. Following the principle of connected thinking, silos of information have to be broken down so that stakeholders could make use of a common pool of skill and knowledge assets.

Approach: preliminary findings indicate that stakeholders are more than just factors in the Smart City design process. Multi-stakeholder engagement is seen as an approach that induces the initiative and supports its practical implementation. Roles of high-level stakeholders and principles of a strategic program are the key factors within this cluster. The interviewees perceived the ideal scenario as one in which the local authority acts as an enabler of projects as opposed to initiator or director. They have also shared principles regarding the management of such collaborations. Stakeholder engagement is described as the major driver of smart initiatives. These stakeholders, however, have to be carefully selected, willing to share information and resources, and be able to perceive the common goals as individually beneficial. They must perceive of each other as much as cooperative partners as competitors.

Goals: the majority of the stakeholders noted the necessity of an overarching vision to be in place in order to enable participation. Then, strategic steps were envisaged, such as identification of resources and assets and demonstration of long-term thinking. The need for a common brand is envisaged encompassing development efforts and defining the area. Additionally, the deployment of demonstrators and showcases of capabilities are regarded as being important. Communication globally, and awareness locally provides

the ground for building a common story together with the various stakeholders. Finally, the complete program is enabled by a strong leadership figure that ensures consistency of efforts and communication between all stakeholders. The goals of the stakeholders were formulated in terms of how they would like to see the different layers of urban life change. The overarching aim for the area is to become the employer location of choice. This, in the eyes of the interviewees is ensured through three steps. Firstly, the area has to become a multi-operator platform. Secondly, a safe residential zone has to be built that is also a vibrant, attractive location for citizens and visitors over the evenings and weekends. Thirdly, start-up hubs, hackatons, active innovation communities have to be nurtured to boost the overall innovation capability in the area.

Principles: the above dimensions are underpinned by various principles.

a, Transparency: key conditions to ensure long-term participation and balance in cooptation, are trust and transparency.

b, Technology as enabler: in the analyzed interviews technology plays an enabling role. The Smart city in the eyes of the stakeholders enables the innovation or knowledge economy.

c, Learning as outcome: the outcomes of the different smart city initiatives are often described in terms of information processes. Stakeholders perceive a failed project as a beneficial component of the overall learning process once it is logged and communicated widely. The measure of success is very often imagined similarly. A success story of organizational participation in or successful application of a solution to a smart city project considered a valuable asset, an intangible, but prioritized benefit.

d, Creative financing & procurement: financing a private-public long-term endeavor is a sensitive topic for all stakeholders. Motivation to collaboration is maintained through active participation and traditional procurement processes drawn innovation efforts. Many of the participants therefore envisage the need for more creative financial instruments that ensure the effective and timely implementation of projects. The lack of short-term financial return on investment is not seen as a barrier if long-term shared revenue models are in place.

e, Citizen centric thinking: Stakeholders strongly believe that citizens should be in the focus of the smart development of the Dublin Docklands. Their safety, comfort, the quality of their everyday life is formulated to be the key driver in the development process. They also envisage their active participation as a key condition. Especially in the problem formulation and feedback stages of smart projects citizen engagement is needed to ensure that solutions are created to real needs and not the other way round.

Conclusion and Future Work

The early insights emerging from our preliminary findings complement the systematic literature review in four ways. Firstly, they support most of the components in the Infrastructure dimension. Secondly, they indicate a complementary approach to the ones emerging from literature, namely a multi-stakeholder engagement approach. Thirdly, they identify a unique goal for the urban area in question. Lastly, they complement these with detailed governance and management principles.

Smart Cities have been defined in various ways. Preliminary findings on the Infrastructure dimension echo (Kitchin, 2014)'s definition of Smart City that 'on the one hand, [is] increasingly composed of and monitored by pervasive and ubiquitous computing and, on the other, whose economy and governance is being driven by innovation, creativity and entrepreneurship, enacted by smart people'. But are also indicative of a phenomenon referred to as the Intelligent City (Kominos, 2015), one that makes use of innovation cycles and knowledge architectures to enable innovation for all. Using information as a central concept, (Cosgrave et al. 2013) also perceive the systemic flow of assets such as knowledge, data, ideas/trends and expertise as a condition to sustainable smart development. In a knowledge-intensive environment data and information serve as a basis for knowledge creation but it is induced by human experience and expertise. Our interviews support the view according to which top-down and bottom-up approaches, demonstrative and scalable solutions are both desirable and they are required to function complementary. These *Information Marketplaces* (ibid.) allow for value creation potential to appear across the information value chain.

The participants propagate the multi-stakeholder engagement approach to governing and enabling smart city initiatives. However, it also allows us to point out that the view according to which 'a single coherent provider of urban social functions may provide a panacea for city officials is not aligned with the inherently participative and evolving nature of the democratic public sphere, where heterogeneous stakeholders dynamically interact and co-create their habitat. Rather, public domain action (i.e. the provision of social services, public policy making, collaborative decision-making, etc.) is realized by an evolving landscape of heterogeneous stakeholders with often competing ambitions' (Paulin, 2016:330). Using engagement as a central concept, the literature describes the interconnectedness of the different social strata with human experiences (Ramaswamy, 2015). In this scenario, corporations appear as a competence base aiming to incorporate intellectual capital from diverse external resources at various stages of the innovation process. But of course, the multi-stakeholder approach is widely contested, as it brings forth questions about the corporate influence on government and by extension on the city's life. As described in our interviews; joint vision, branding of effort and locale, co-financing schemes are needed to ensure that joint resources are invested into a *platform of engagement*. (ibid.) The components of these platforms are the assemblages of people, processes, interfaces, and artifacts. From the interaction of these components, then, mutually valuable outcomes are generated (ibid.) in the form of tangible and intangible benefits.

This view is also aligned with the perspective according to which cities are historic and social spaces, and as a result, research seeking to understand political and social reality always concerns the 'the actually existing smart city' (Shelton, Zook, and Wiig 2015). Unique environments, then, may leverage the hybrid knowledge of their experts to identify their own goals. In the case of the Dublin Docklands, in terms of smart and sustainable development, stakeholders broaden the definition of smart city goals and envision a vibrant urban life in the area emerging from a well-functioning innovation economy. The spatiality of knowledge has been widely discussed, such as in the case of Silicon Valley (Katz and Wagner, 2014) and the discussion surrounding the Silicon Docks is no different; concept and locale are treated by interview participants as intertwined. Connecting space as a central notion with social experience and human cognition and perception is well established in Geography, Philosophy, and increasingly in Information Systems. It is from the interrelatedness of these components that we learn to treat urban environments as unique phenomena. Idea and space, data and experience have to be thus treated as inseparable from their emergent context.

Finally, our data has shown that, based on their experiences, stakeholders have a more fine-grained perspective on smart cities, than the literature may suggest. Our participants have shared guiding principles in mind in terms of forming collaborations to lead and execute smart initiatives, with regards to urban renewal, way of thinking in the information age and finally, the values of smart initiatives. The emphasis on principles indicates that the social and cultural dimension is a determining factor in pursuing smart city goals. Early insights, then, call our attention to a more meaningful treatment of the smart city dimensions. Enabling factors for smart cities are influenced by unique principles that underpin engagement patterns, information processing and the concepts of urban space.

The first phase of the research is planned to last until the end of September 2016. Following this, a stakeholder meeting is planned, where the participants critically review and reflect on the sum of their collated descriptions of the smart future of the Silicon Docks and allow us to expand on our preliminary findings. As the interviewees point out, the lived reality of smart cities call for a better understanding of the interconnected and process-based nature of the factors to understand new ways of value creation. Once analyzed as purely technological environments the study of smart cities has come to a crossroad. Understanding smart urban contexts as unique socio-technical environments encompassing multiple interconnected components, we argue, we may find a way to more meaningful value creation.

Appendix 1

Core Concepts	INFRASTRUCTURE			GOAL						APPROACH				PRINCIPLES									
	skills exchange	connected thinking (Non-siloed info.)	spatial issues	multi-operator telecommunications	branding	vision	demonstration, showcase	demonstrate long-term thinking	overall definition of the area & identification of assets	storytelling as success	employer location of choice	boost innovation	coopetition	stakeholder engagement	local authority as enabler	leadership	citizen centric approach to strategy	citizen-engagement throughout the design process	creative finance	transparency	technology as secondary/enabler	learning as outcome	
1				x									x	x									
2	x	x	x		x			x	x		x		x	x				x					x
3		x	x		x	x				x	x	x	x		x	x	x						x
4			x		x	x			x				x										
5		x	x																			x	x
6			x					x					x			x	x		x	x	x	x	x
7			x		x			x				x	x		x	x	x	x					x
8		x	x		x		x		x		x					x	x				x	x	x
9	x	x	x		x		x			x			x		x		x		x				x
10	x	x		x		x	x			x			x			x	x					x	
	3	6	8	2	2	6	2	2	3	3	3	3	2	8	2	3	5	6	2	2	4	4	7

Appendix 1. Smart City Enabling Factors in the Dublin Docklands

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