Smart Cities: A Value Generation Research Agenda

Research-in-Progress

Introduction

The concept of smart cities conjures up images of cities which offer a very high quality of life, which are resilient and sustainable, which encourage entrepreneurial activity, are citizen centric and do this in a cost effective manner. The term smart city is a vast term but has been distilled into a number of characteristics such as the utilization of networked infrastructure to improve economic and political efficiency; an emphasis on business-led urban development; a strong focus on achieving social inclusion in public services; a stress on the crucial role of high-tech and creative industries in long-run urban growth; attention to the role of social and relational capital in urban development; and social and environmental sustainability (Hollands 2008: 308). The aspiration associated with this image is drawn with a backdrop of an ever increasing rise in the number of people living in urban areas, and therefore cities have to address issues such as an ageing population, human mobility, insecurity in food and energy, social tensions, and changing institutional and governance frameworks (UK Office for Science, 2014).

The reality thus far is different than that of the vision pictured above as many cities struggle with smart program implementation. At this point in time many pilots or living labs have been implemented but few have reached a sustainable level where they have transferred to self-sufficiency offering long term value. Cities themselves are well aware that the issues of transferring and scaling are not technical but rather they lie in their own ability. A recent survey of fifty cities worldwide identified that the main barriers to implementation as perceived by the cities, are: overcoming risk averse internal politics; funding and the ability to work with private partners; a highly regulated procurement environment not designed for fast take up; the lack of interoperability between city IT systems; and the lack of appropriate business models (Citymart, 2013). This disconnect is not something that has been taken up by the business and strategy academic community, perhaps to the newness of the topic. In August 2016, a web-of-science search of the Associated Business Schools top ranked journals (4 & 3) in strategic management, general management, small business venturing, marketing, and management and technology only produced eleven articles concerned with smart cities. A significant gap as the potential positive and negative impacts of smart city implementation will affect us all.

To shed light on where the issues are and to then suggest a research agenda, this working paper uses the business model framework to describe the perspective of service providers and to then compare this with the perspective of cities. This analysis has resulted in the identification of a number of tensions between the entities in the areas of measuring value and co-creation. Suggested research question with methodologies are then offered.

The business model construct

The business model is by definition a look at how a business works, i.e. a firm level of analysis. It describes the system of interdependent activities that are performed by the firm and by its partners and the mechanisms that link these activities to each other in order to create and capture value (Zott and Amit, 2010). Business models, as academic constructs, came to scholarly attention in the mid-nineties and have continued to gain momentum ever since. The business model construct has been a positive addition to both research and practice being used as both a description of the firm and as a tool for analysis. In its development, the concept has reached a point where it is now considered as an asset in itself, that is, as a source of competitive advantage (Baden-Fuller and Morgan, 2010; Doz and Kosonen, 201; Speith, 2014; Teece, 2010). Early definitions of business models were static in nature. For example the definition of Winter and Szulansk (2001) exemplify the use of the term as a recipe in the context of replication of a

business model. Similarly Magretta (2002), who as a consultant, addresses a practical audience, describes business models as stories that explain how enterprises works. In the second half of the 2000s there was more of a focus on open innovation and accessing resources externally from the firm's traditional boundaries (Chesbrough, 2007; Cohen & Winn, 2007; Hwang & Christensen, 2008; Spring Araujo, 2009; Teece, 2010; Zott & Amit, 2008). This was particularly enhanced by advancing digital technologies where it became easier to access resources external to the firm. Since 2010 the focus of business model research has been on the management of uncertainty (Amit and Zott, 2012; Battistella et al., 2012; Cavalcante et al., 2011; Dougherty and Dunne, 2011; McGrath, 2010; Romero & Molina, 2011). Here the authors converge on the notion that value generation is dependent on constant alertness and on the readiness to adapt to environmental changes. The premise is that entrepreneurs are facing high levels of uncertainty and may be wasting their time crafting elaborate business plans. The suggestion is that successful firms are those capable of improvisation (with intuition) being able to probe into the future via experimental products and strategic alliances. To gain an edge in the marketplace firms must commit to continuously re-examining its business model and make whatever changes are necessary

For the purposes of this paper we rely on the description of a business model offered by Johnson et al. (2008) who describe business models as having four interlocking elements that, taken together, create and deliver value. The first element is the customer value proposition. They correctly focus on a problem which needs to be solved when they focus on providing value to the customer by helping them get an important job done. The intent here is to be very specific of who the customer is, the customer problem being addressed and the solution being offered. The second element they call profit formula. While cities are not necessarily focused on profit, the concept is to create and capture value. This is a holistic concept but takes into account the cost of creation and the return on that effort, irrespective of how value is measured. It also refers to the method applied. For example, an annual fee or a charge per use may aggregate to the same margin but are completely different in their application. As with scholars advocating the resource based view we combine the last two elements, which Johnson and colleagues call key resources and key processes. Essentially these are a firm's resources and competencies. Again this is holistic concept covering direct and indirect abilities and connections. Importantly Johnson et al stress the richness of the business model concept is in the interactions between the three elements. In simple terms this means that a change in one element will have a knock on effect on one or both of the two elements. For example a change from an annual contract to a cost per use revenue stream will necessitate the firm learning new skills in business development, contracting and monitoring

Smart City as an IoT instance

Again, our image of smart cities is one of an environment where, through multiple sensors, city activities such as traffic, pollution and energy usage are being monitored; the data stored; analysed; and acted upon. This is in effect a classic IoT instance and is one that has been recognized by many in the past (e.g., Jin et al. 2014; Vlacheas et al. 2013; Zanella et al. 2014). IoT, as a value generation vehicle is based on a specific set of technical implementations which enable advantages from which value can be generated. Typically there are three components which enables this concept: (a) hardware—made up of sensors, actuators and embedded communication hardware (b) middleware—on demand storage and computing tools for data analytics and (c) presentation—novel and easy to understand visualization and interpretation tools which can be widely accessed on different platforms and which can be designed for different applications (Gubbi, et al. 2013).

Figure 1 is a simplified example of an IoT instance as a smart city service, the example being the management of air pollutants through influencing traffic volumes with congestion charges. On the left hand side are the basic elements of an IoT implementation and the right hand side represents typical examples for the air pollutants scenario. From a value generation perspective a given organization can reasonably only fit in a limited number of places along the IoT end-to-end spectrum. Such smart service provision is a classic ecosystem where an economic community is supported through mutual interaction (Moore 1993). From an academic point of view the smart service ecosystem fits into what is called service science in that there is: close interaction of supplier and customer; knowledge is created and exchanged; production and consumption are simultaneous; the combination of knowledge into useful systems; the exchange as processes and experience points; and the exploitation of ICT and transparency (Chesbrough and Spohrer 2006). In essence there are a multitude of organizational entities, with a variety of competencies, which are

interdependent which form this ecosystem. Increasingly cities look to procure services where elements are integrated by a primary service provider which further motivates the ecosystem to self-manage.

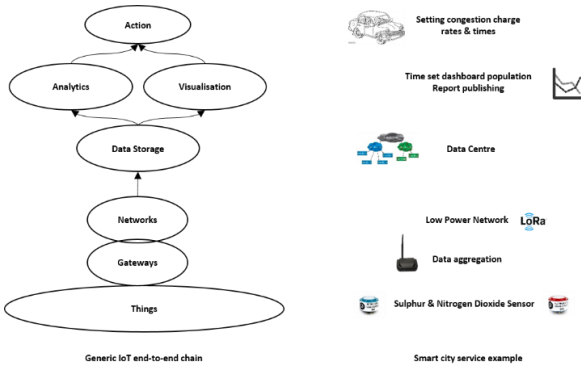

Figure 1. An example of a smart city service as an IoT instance.

A business model perspective of a smart service offering

It is important to note that the business model construct is used at an organizational level of analysis and is not intended to analyze ecosystems. For that reason we consider two generic organizational types: the primary service provider which is the focal point of the ecosystem; and a sub-system provider whose offering is directed towards the primary service provider. Table 1 describes the basic considerations for each business model element for the two organizational types. The service provider is presented as the interface between the customer (city authority) and the ecosystem. In large part the competencies required reflect the management of shared, but different, risk within the ecosystem and providing a value proposition that matches the city's needs.

Table 1. Service provision business model considerations

Business model element	Service provider	Sub-system provider
Customer value proposition	Addresses city problems of density, resource efficiency, environment, mobility and competitiveness.	Addresses specific technology or service knowledge gaps in a specific value proposition
Economic logic	Costs: reflective of the shared risk and investment of the ecosystem members.	Costs: Reflective of the organisation structure, internal competencies, access to know how & finance.
	Income: Revenue stream reflective of the value perception by the city.	Income: Revenue Stream reflective of the shared risk and investment of the ecosystem members
Competencies and Resources	Ability to manage the ecosystem, and to integrate the technology in order to produce a value proposition	Reflective of the firm's strategy with respect to competency development and access.

The city's perspective

An obvious gap in academic research relates to our lack of understanding of the influencers and barriers to smart city implementation. While there is little or no academic work in this area there are a plethora of excellent consultancy reports which provide an understanding of their willingness to implement smart programs. Table 2 summarizes three such reports. From these reports it is clear that the perception of the cities is that implementation depends on sustainable business models; public procurement practice; easily working across city departments; relevant technical expertise; and good governance. It is also clear that perception of the cities that these characteristics are underdeveloped within city authorities. At this point in time most smart services are completely new for cities who have large bureaucratic legacy IT and organizational systems. They find it difficult to see the value they can capture as they do not have the appropriate metrics. As a new and novel system they are restricted by law in how they can co-create and most importantly they often do not have capability to govern a smart service implementation and operations.

Table 2. Cities perceptions of the barriers to implementing smart programs

City Wi-Fi Status Report* **(Wireless Broadband Alliance 2015)**	**Agile Cities (CityMart 2015)**	**Smart Cities (Centre for Cities 2015)**
A report based on input from San Jose, Singapore, New York, Dublin and Barcelona	findings from a survey and case study analysis of 50 cities from around the world	a review of smart city progress in the UK
▪ Lack of expertise ▪ Public expectations & user experience. ▪ Technologies choice. ▪ Insufficient market information. ▪ Cost of operations and maintenance. (OPEX) ▪ Lack of business model. ▪ Cost of network deployment. (CAPEX) * focused solely on Wi-Fi	▪ Procurement - not designed for quick uptake. ▪ Finance - private partnership are difficult; to get above a threshold when competing for finance. ▪ Data sharing - cities don't talk ▪ Business models - current data doesn't allow for a strong value case; city operators not aware of benefits; short term focus; technologies don't have credible business models to sustain them. ▪ People and Politics - Risk averse; resist implementation; attention elsewhere; requires multiple departments.	▪ Constrained demand from cities for smart initiatives. ▪ Business models for rolling out smart technologies are still underdeveloped. ▪ Cities lack technology-related skills and capacity. ▪ Cities find it difficult to work across departments and boundaries ▪ Cities have limited influence over some basic services. ▪ Concerns about data privacy, security and value. ▪ Increasing citizen take up and participation is difficult.

The potential tensions between smart service providers and city authorities

To illustrate the potential tensions that exist between service provision and city implementation we have tabulated the perspectives of services providers and cities in table 3. At a fundamental level the problem being addressed must be reflected in the service provider's customer value proposition and in a need of the city. The tensions in the system appear in the business model elements of economic logic and resources and competencies as the motivations and expectations of each entity differ.

Table 3. Service provider business model versus the city perspective

Business model element	Service provider	City perspective
Customer value proposition	Addresses city problems of density, resource efficiency, environment, mobility and competitiveness.	Addresses city problems of density, resource efficiency, environment, mobility and competitiveness.
Economic logic	Costs: reflective of the shared risk and investment of the ecosystem members. Income: Revenue stream reflective of the value perception by the city.	Measured by: • City competitiveness • Social • Spatial • Economic
Competencies and Resources	Ability to manage the ecosystem, and to integrate the technology in order to produce a value proposition	Requiring: • Governance • Expertise • Internal integration • Procurement policies • Funding mechanisms

Tension 1: measuring value

While the commercial orientated service provider has a concrete economic metric based on the revenue, costs and risk, city metrics have proven more vague and harder to define. While there is a growing literature base on public value at a governmental level (e.g. Benington and Moore, 2011), very little literature exists which focuses on cities and certainly not in the context of implementing smart programs. Notwithstanding this lack of empirical understanding we know that cities have a broader sense of value compared to that of commercially motivated service providers. Cities are competitive and wish to attract inward investment. City authorities are chartered to improve social good and improve quality of life. Cities, by definition, have to work within spatial constraints and must strive to do all this in a cost effective way.

The potential tension that arises may be between the differences each entity uses in measuring vale. The service provider must understand that the customer value proposition that they offer may address a legitimate city problem but the value they assume they generate is in all probability measured by a very different set of metrics. While cities have supported smart proof of concepts, as providers often pay the costs, scaling requires that the offering is measured favorably against a more complex set of value metrics.

Tension 2: co-creation

A potentially greater tension may exist in the realm of resources and competencies. For the foreseeable future smart initiatives have a high degree of novelty and their success will be based on a collaboration between the service providers and cities. The advent of IoT technology is offering a completely new set of services and infrastructure for exploitation, but they are very new. Along with this novelty, and associated competency development, is the complication that every city is different and therefore each smart implantation is contextual. This results in the need for service providers to co-create with cities, to proof their concepts and to ensure they are fit for the specific contextual purpose.

However, as stated in the city reports, at this point in time cities typically lack technical expertise and governance mechanisms. The resulting behavioral effects would be, at the very least, risk averse and reluctance to engage. More significantly, if such reluctance leads to cities not developing competencies and handing control to service providers, full smart city implementation will only be prolonged.

Research questions and methodology.

The inspiration for the format of this section comes from Veit et al. (2014) who defined a research agenda for business model research in business and information systems engineering. Based on our arguments above we propose the following research agenda (Table 4) to address the identified tensions which can be categorized as:

- Differences in the perception of value. Economic metrics for service providers and social, economic and environmental metrics for cities.
- Differences in attitudes to coordination and governance.
- Lack of competency alignment. Service providers and city authorities have different starting points, different dominant logics, which affect their approach and ability to co-create.

In this research agenda vision a number of methodological aspects are seen as critical. First, in researching any topic there is much more value to be gained by engaging those involved in the topic. To us it is very important to partner with cities and service providers and to provide practical value in return. This means an engagement where cities are informing the research and the research is directed at city problems. Secondly, we see research success achieved by living as close to smart programs as possible. Case studies by interview are appropriate for retrospectively analysis – learning from past successes and mistakes, while longitudinal studies are appropriate for future orientated research. Thirdly an obligation that comes with partnership with stakeholders in future orientated research is feedback or intervention. Our intent is to follow design thinking principles where empathy and problem definition are achieved during city partner and service provider engagement. Intervention through experimentation will equate to prototyping within the design thinking principles.

We acknowledge that other variables affect smart city success. These include variables such as city size and available city assets but due to the space constraints of a research in progress we leave these considerations for another day.

Table 4. Research agenda for smart city value generation and capture

BM element	Research questions	Theories	Exemplary research methods
General	▪ What is an appropriate smart city / IoT governance framework (including strategy alignment, risk & resource management, implementation and measurement)? ▪ What are sustainable smart program business model designs?	▪ Organisational governance ▪ Decision making ▪ RBV ▪ Complexity ▪ Real options	▪ Longitudinal studies ▪ Case studies ▪ Design thinking
Value proposition	▪ How should value for city authorities, enterprise service providers (& sub-system provider) & citizens be measured? ▪ How can stakeholders engage in defining a collective value?	▪ Motivation ▪ Engagement	▪ Case studies by interview ▪ Design thinking
Economic logic	▪ What mosaic of value sharing models are appropriate for smart cities?	▪ Knowledge and resource sharing	▪ Desk review and case studies ▪ Statistical
Capabilities	▪ How can complex ecosystems be coordination w.r.t. value proposition, alliance, power, etc. with the city authority at the centre? ▪ What are the significant dynamic capabilities of cities with respect to smart program implementation?	▪ Alliance ▪ Fixed & soft power ▪ RBV ▪ Dynamic capability ▪ Dominant logic	▪ Longitudinal studies ▪ Case studies ▪ Design thinking

References

Amit, R. and Zott, C., 2001. "Value Creation in E-Business," *Strategic Management* Journal (22: 6/7), pp. 493-520.

Amit, R. and Zott, C., 2012. "Creating value through business model innovation," *MIT Sloan Management Review* (53:3), p. 41.

Atzori, L., Iera, A. and Morabito, G., 2010. "The internet of things: A survey," *Computer networks* (54:15), pp.2787-2805.

Baden-Fuller, C. and Morgan, M. S., 2010. "Business Models as Models," *Long Range Planning* (43:2/3), pp. 156-171.

Barney, J, 1991. "Firm Resources and Sustained Competitive Advantage," *Journal of* Management **(**17:1), pp. 99-120

Battistella, C., Biotto, G. and De Toni, A.F., 2012. "From design driven innovation to meaning strategy," *Management Decision* (50:4), pp.718-743.

Benington, John. 2011. "From Private Choice to Public Value?" In *Public Value: Theory and Practice,* edited by John Benington and Mark Moore, pp. 31–49. Basingstoke, UK: Palgrave Macmillan.

Cavalcante, S., Kesting, P. and Ulhøi, J., 2011. "Business model dynamics and innovation:(re) establishing the missing linkages," *Management Decision* (49:8), pp.1327-134.

Centre for Cities, 2014. "Smart Cities," *Self-Published*

Chesbrough, H.W., 2007. "Why companies should have open business models," *MIT Sloan management review* (48:2), p.22.

Chesbrough, H. and Spohrer, J., 2006. "A research manifesto for services science," *Communications of the ACM* (49:7), pp.35-40.

Citymart, 2013. "Agile Cities," *Self-Published*

Cohen, B. and Winn, M.I., 2007. "Market imperfections, opportunity and sustainable entrepreneurship," *Journal of Business Venturing* (22:1), pp. 29-49.

Dougherty, D. and Dunne, D.D., 2011. "Organizing ecologies of complex innovation," *Organization* Science (22:5), pp. 1214-1223.

Gubbi, J., Buyya, R., Marusic, S. and Palaniswami, M., 2013. "Internet of Things (IoT): A vision, architectural elements, and future directions," *Future Generation Computer Systems* (29:7), pp. 1645-1660.

Hwang, J. and Christensen, C.M., 2008. "Disruptive innovation in health care delivery: a framework for business-model innovation," *Health Affairs* (27:5), pp. 1329-1335.

Jin, J., Gubbi, J., Marusic, S. and Palaniswami, M., 2014. "An information framework for creating a smart city through internet of things," *Internet of Things Journal, IEEE* (1:2), pp. 112-121.

Johnson, M. W., C. M. Christensen and Kagermann, H., 2008. "Reinventing your Business Model," *Harvard Business Review* (86:12), PP. 55-68.

Magretta, J., 2002. "Why Business Models Matter," *Harvard Business Review* (80:5), pp. 86- 92.

McGrath, R. G., 2010. "Business Models: A Discovery Driven Approach," *Long Range Planning* (43:2/3), pp. 247-261.

Miorandi, D., Sicari, S., De Pellegrini, F. and Chlamtac, I., 2012. "Internet of things: Vision, applications and research challenges," *Ad Hoc Networks* (10:7), pp. 1497-1516.

Moore, J.F., 1993. "Predators and prey: a new ecology of competition," *Harvard business review* (71:3), pp. 75-83.

Morris, M., Schindehutte, M. and Allen, J., 2005. "The entrepreneur's business model: toward a unified perspective," *Journal of business research* (58:6), pp. 726-735.

Penrose, E. T., 1959. "The Theory of Growth of the Firm, Basil Blackwell, London 1993. The Cornerstones of Competitive Advantage: A Resource-Based View," *Strategic Management Journal* (14:3), pp. 179-191.

Romero, D. and Molina, A., 2011. "Collaborative networked organisations and customer communities: value co-creation and co-innovation in the networking era," *Production Planning & Control* (22:5-6), pp. 447-472

Spieth, P., Schneckenberg, D. and Ricart, J.E., 2014, "Business Model Innovation – State of the Art and Future Challenges for the Field", *RandD Management* (44:3), pp. 237-247.

Spring, M. and Araujo, L., 2009. "Service, services and products: rethinking operations strategy," *International Journal of Operations & Production Management* (29:5), pp. 444-467.

Teece, D.J., 2010. "Business models, business strategy and innovation," *Long range planning* (43:2), pp. 172-194.

Veit, D.; Clemons, E.; Benlian, A.; Buxmann, P.; Hess, T.; Kundisch, D.; Leimeister, J. M.; Loos, P. & Spann, M., 2014. "Business Models - An Information Systems Research Agenda, in *Business & Information Systems Engineering - Research Notes,* pp. 45-53

Vlacheas, P., Giaffreda, R., Stavroulaki, V., Kelaidonis, D., Foteinos, V., Poulios, G., Demestichas, P., Somov, A., Biswas, A.R. and Moessner, K., 2013. "Enabling smart cities through a cognitive management framework for the internet of things," *Communications Magazine, IEEE* (51:6), pp. 102-111.

Wireless Broadband Alliance, 2015, "City Wi-Fi Status Report," *Self-Published.*

Zanella, A., Bui, N., Castellani, A., Vangelista, L. and Zorzi, M., 2014. "Internet of things for smart cities," *Internet of Things Journal, IEEE* (1:1), pp. 22-32.

Zott, C. and Amit, R., 2008. "The fit between product market strategy and business model: implications for firm performance," *Strategic management journal* (29:1), pp. 1-26.

Zott, C., Amit, R. and Massa, L., 2011. "The Business Model: Recent Developments and Future Research," *Journal of Management* (37:4), pp. 1019-104.

Doz, Y. L. and Kosonen, M., 2010. "Embedding Strategic Agility: A leadership Agenda for Accelerating Business Model Renewal," *Long Range Planning* (43:2/3), pp. 370-382.