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Creating business models for smart cities: a practical framework

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ABSTRACT
Smart cities can use business models to evaluate what value they offer citizens by integrating ICT into their infrastructure and services. The article introduces the concept of the 'city business model' and proposes a practical framework for analysing it. The City Model Canvas (CMC)—based on the Business Model Canvas for firms—shows the elements that city councils should consider during the design, delivery and assessment of smart services, including the smart service's expected economic, environmental and social impacts. An example of how the CMC was used to design an ICT platform in Bristol shows its utility as a planning tool.

KEYWORDS Smart cities; urban governance; business models; public management; digital services

Introduction

Despite the hype around them, aspiring smart city governments need to show residents that they can create, deliver and sustain value for *them*, the residents (Díaz-Díaz, Muñoz, and Pérez-González 2017; Walravens 2012). This article frames this challenge as a problem in the business models of smart services. Like a firm's business model, which shows how a firm creates and delivers value for customers and how it captures profits, the concept of a city business model can help city governments articulate how they will produce and deliver *public* value through smart services (Letaifa 2015). Since there is currently no generally used method to understand smart city business models (Díaz-Díaz, Muñoz, and Pérez-González 2017; Walravens 2012), this article presents a framework for doing so.

This framework addresses the research problem of how city governments can take ownership of smart city projects to ensure that they create value for residents. The questions at the heart of this article are: what value do smart services actually create? How can local governments ensure that value is created and delivered? Finally, what are the costs and benefits of smart city services across economic, environmental and social dimensions? The article adapts the logic of the business model to a governance context so that city council managers can use it to address these issues. The article first presents the concept of the City Business Model and then a framework that city managers can use to create and deliver smart services: the City Model Canvas (CMC).

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What are smart cities and why do they need business models?

While the 'smart city' is not consistently defined in the literature (Angelidou 2015), Meijer and Rodríguez Bolívar (2016) have found in their literature review that most conceptualizations of the smart city include combinations of three elements: smart people, smart technology and smart collaboration. They conclude that the 'smartness' of a city is the extent to which a city can attract and mobilize human capital and enable collaboration through the use of ICT (Meijer and Rodríguez Bolívar 2016). This article relies on this conceptualization of the smart city and applies it to define 'smart services' as ICT-enabled public services that improve mobility, optimize resource consumption and facilitate collaboration. Examples of smart services are applications that integrate all modes of transport so that people can choose the fastest or cheapest way to reach their destination and applications that distribute traffic during rush hour or guide users to available parking spots; these improve mobility and reduce greenhouse gas emissions.

Despite the appeal of such services, there is currently no framework for city governments to integrate and assess these services into their current service provision models. This article's central argument is that while such smart services have the *potential* to deliver value to the city's residents, city governments cannot take for granted that they will in fact deliver value. This depends on how they are designed, implemented and governed; i.e. on the business models of smart services.

The city business model assumes that city governments are central players in smart cities. There is some debate around this issue, what many call 'smart governance'. Meijer and Rodríguez Bolívar's (2016) literature review shows that while some scholars see the governance of smart cities simply as the governance of a 'regular' city but with more reliance on technology (Batty et al. 2012), others go further, arguing that smart city governance requires innovative decision-making models, new government capacities, and collaborative networks (Cavenago, Trivellato, and Gascó-Hernández 2015; Gascó 2016; Schaffers et al. 2011). All agree, however, that local government capacities and decision-making are central to a city's 'smartness'. This article introduces the logic of business-models as a decision-making methodology and planning tool that can aid city governments in the complex decision-making processes about smart cities.

According to Chesbrough (2010), a business model articulates exactly what value a private firm creates for customers (i.e. the value proposition), defines the structure of the value chain required to produce and distribute the service or product, and helps the firm calculate the costs and potential profits of its activities so that it can remain profitable and sustainable (Teece 2010). Although public organizations and other non-profit seeking organizations do not operate with the same incentives and requirements as private firms, they can also benefit from developing a business model logic to articulate how they offer social and/or environmental value, to whom they offer it, and how they can sustain it over the long term (Seelos 2014; Seelos and Mair 2005). Since the exact value of smart services is still unclear, recent literature has shown interest in adapting the concept of business models to smart cities to articulate their value propositions (Kuk and Janssen 2011; Walravens 2015; Walravens and Ballon 2013).

In this article, we define the 'smart city business model' as *the way in which a city government organizes its services to create and deliver value for its citizens in a way that is economically viable, socially inclusive and environmentally sustainable*. Based on a brief overview of the main trends in urban governance and smart cities, this section

argues that city councils could benefit from developing city-specific business models to guide their service delivery.

The main justification for city-centred business models is perhaps the most obvious one: smart services should be financially viable and sustainable over the long term. The grey literature on smart cities shows that securing financing to develop smart services is one of the main current challenges for aspiring smart cities. Large infrastructure projects have high upfront costs, significant technological risks and a long-term payback horizon, which makes it difficult to attract investment (Rivada et al. 2016). City governments across the EU are facing pressure to reduce costs, making investment in smart services even more challenging and cities need to present a strong business case for smart services that would encourage capital investment (Siemens and Arup 2017). A central specification of the European Commission's current funding programmes for smart and sustainable services is that cities develop and test business models for smart services that are scalable and replicable across cities (European Commission 2017). This article addresses this policy call.

Besides its utility for analysing the financial challenges of smart services, the business model logic can help planners address current critiques about the social impact of smart cities that are directly related to the current underlying financial models for smart services. Large-scale ICT projects (e.g. data platforms and sensor technology) currently rely on private investment and expertise for their development and operation. While private finance models can be effective from a financial and technological perspective, there are concerns that the growing role of corporations in smart cities can result in an urban governance model that prioritizes large-business goals over social goals, thus inadvertently increasing social polarization and inequality (Grossi and Pianezzi 2017; Hollands 2015).

This argument fits into a wider debate about the corporatization of public services; while contracting-out and corporatizing services often improves flexibility, efficiency, customer responsiveness, and importantly, innovation, it also inherently creates possible conflicting interests between the corporate management and the political corps (Grossi and Pianezzi 2017; Grossi and Reichard 2008). Since, city-centred business models for smart services are centred on a public value proposition, incorporating such models would encourage city councils to analyse the impact of the service's organization and deployment from a public service perspective first.

Three additional trends identified in the urban governance and public management literature support the need for smart city business models.

The first trend relates to the networked nature of public service provision today. There is widespread agreement in the public management literature that city councils are no longer the only actors providing public services (Anttiroiko, Valkama, and Bailey 2014; Osborne 2010). Even within local government, there are several organizations, departments and even different hierarchical levels of government simultaneously making decisions about what goes on in a city. Outside local government, other actors involved in service provision include charities, who often provide services that local government does not, and often also private companies, who may operate some services, such as transport. The increased complexity of the challenges that cities face and the plurality of stakeholders coexisting in cities have led to calls for more collaboration between actors to achieve their goals (Crosby, Hart, and Torfing 2017; Sullivan, Williams, and Jeffares 2012). Service providers, service users and their communities often co-produce and co-create services together, i.e. providers and users

interact to initiate, design and shape public services (Pestoff 2006; Voorberg, Bekkers, and Tummers 2015). As already mentioned, private firms and state-owned corporations sometimes act as service providers, especially when they involve ICT (Hollands 2015). In this context, city councils must know: who should operate the service? Who can access that service? Who will profit from it? Who will regulate it? Using a business model framework would help city councils – or any other public organization in charge of smart city projects – locate themselves in this 'value creation network' of public service delivery and define their responsibilities in it. It can help city governments identify and manage the plurality of stakeholders holistically by mapping stakeholders and their role in smart services.

The second trend affecting urban governance is increased concern for environmental sustainability (Haughton and Hunter 2004). The environmental argument in favour of smart cities is that ICT applications encourage more efficient resource consumption, e.g. by improving buildings' energy efficiency with sensors or increasing the efficiency of transport through real-time data analysis (Meyer 2013). As Zeemering (2018) has shown, however, local governments still lack clear frameworks for integrating sustainability concerns into their regular decision-making processes. City business models can help city governments embed environmental goals into their strategic plan for smart services.

Finally, a holistic business model can help city councils answer calls for innovation in the public sector (Collm and Schedler 2014; De Vries, Bekkers, and Tummers 2016). Integrating ICTs more organically into public services necessarily requires innovation in government and in the public administration; it requires rethinking how governments interact with citizens, what actors will work with government, and what new resources will be needed (Korteland and Bekkers 2008; Mergel 2018). Using business models enables organizations to visualize how changes in one or more elements would open new business opportunities and bring about new ways of creating and delivering value (Teece 2010).

Despite these justifications, it is important to acknowledge that the idea of applying business models to public organizations is not entirely unproblematic. As Oulasvirta and Anttiroiko (2017) have shown, business management models and tools that are inserted into public sector practices without being modified to the realities of local governments will not work well. We can point to two pitfalls of applying a business model logic in government:

One risk is that the business model logic will be misinterpreted as a profit-driven or cost-driven logic. This mentality can emphasize efficiency and savings, and thus, lead to the privatization of urban services (Hollands 2015), with the associated pitfalls discussed earlier, and to the unequal treatment of citizens as customers, where those who can pay more are served better. Another risk is that fostering a business model mentality in government will lead to other business-like practices that can be detrimental for the public when they are pursued without consideration of social inclusion goals or environmental sustainability. Hollands (2015), for example, critiques the growing competition for cities to attract talent, business and tourism at the cost of displacing local communities.

To mitigate these risks, the business model logic should be adapted to a governance context if it is to offer a way to address the challenges of transforming cities into sustainable and inclusive spaces. Already more than 50 per cent of the world population lives in cities and urbanization is projected to increase in the following decade,

while environmental and social pressures also intensify (Meijer and Rodríguez Bolívar 2016). It is naïve to assume that current service models will meet these needs without public service innovation. That said, the 'city business model' logic must emphasize that value is not necessarily cost-centred but also environmental and social in order to avoid the pitfalls of privatization in the search for new models. In this sense, the smart city business model is not meant – as may appear at first sight – as a managerialist tool borrowed from the private sector and directly applied to the public sector. On the contrary, the concept is born from an understanding that public organizations face a unique challenge: governing the transformation of cities to meet future challenges without sacrificing public value.

In sum, city council managers can benefit from applying a business model logic to the development of smart services to coordinate the plurality of stakeholders involved, to assess the social and environmental impacts of smart services as well as their economic viability, and to ensure that decisions about smart city projects are centred on a value proposition for residents.

Analysing business models: current tools

Based on the previous argumentation, this article's aim is to present a holistic decision-making framework that city governments can use with their stakeholders to develop city business models for their smart services.

In the context of smart cities, the literature offers at least two frameworks for analysing business models that have adapted the tool to a governance context. Walravens (2012, 2015) proposes a framework for smart city services that analyses the network of actors involved in creating public value through smart services. When applied to a smart city service, the model lets us assess who governs the network of actors involved in smart services and whether public value is actually offered to citizens. This approach to business models explicitly recognizes that smart services are often organized by a value creation network, in which public entities collaborate with firms, non-profit organizations, civic associations and private citizen groups. This is especially useful to assess services that rely on extensive ICT use and often rely on private firms' expertise (Paskaleva 2009).

The second recent framework for developing smart city business models, proposed by Díaz-Díaz, Muñoz, and Pérez-González (2017), is an extended application of the Business Model Canvas. The Business Model Canvas (BMC) is the most commonly used framework in the business literature for analysing firms' business models.

Created by Osterwalder and Pigneur (2010), the BMC is a visual chart used for representing a firm's logic and its way of organizing its operations for creating, delivering, and capturing value. The BMC consists of a template with nine building blocks (see Figure 1). The canvas has become popular because of its versatility: the tool can be used to brainstorm and design a new business, to continually assess business viability, and to analyse how the business is organized. Its structure also allows firms to develop innovative business models by reorganizing or reimagining the contents of any one of its nine blocks to unveil a new market or business opportunity.

Díaz-Díaz, Muñoz, and Pérez-González's model (2017) propose a Business Model Evaluation Tool for smart city business models that adapts the BMC to smart cities by adding a socio-environmental dimension to the economic evaluation of business models. This important addition recognizes that city councils' accountability is not

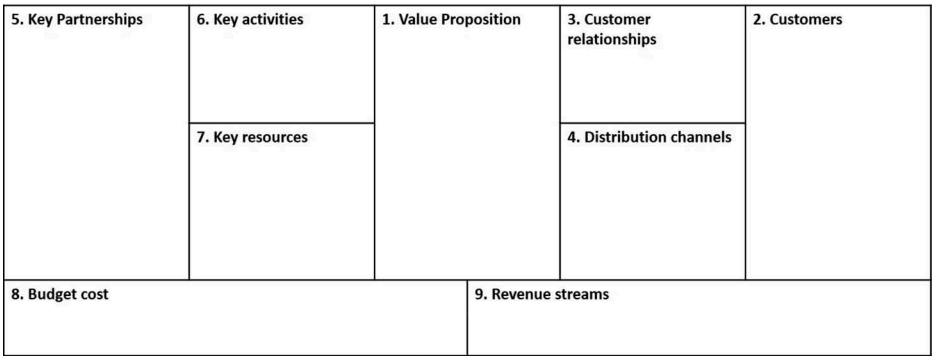

Figure 1. The Business Model Canvas (BMC).

purely limited to economic sustainability (Hollands 2015). This work also recognizes the practicality of the BMC as a framework that allows organizations to work with all the different components of the underlying business model in one single framework. As Trimi and Berbegal-Mirabent (2012) argue, this not only allows the different stakeholders to have a common starting point for discussions and decisions; it also encourages these stakeholders to consider all the elements as a whole, rather than individually, and to see how they all relate to each other.

These two proposals for developing business models for smart cities are practical and useful for city council managers. However, each has certain limitations for smart cities. Walravens (2012, 2015) provides a model for cities to assess whether their services are actually providing public value but the model is complex and offers limited guidance on the specific elements that need to be considered in designing a public service, the way the BMC does for firms. Walraven's (2012, 2015) model is therefore, better to assess a smart service once it has been already implemented. Díaz-Díaz, Muñoz, and Pérez-González (2017), on the other hand, do provide a more holistic framework for designing and implementing a business model for city services but do not go far enough in adapting the elements of the BMC to a public service context. Except for the environmental and social impact elements, the upper section of the BMC was not adapted to a public sector context. For example, it is debatable whether city councils have 'customers'. Of course, Díaz-Díaz, Muñoz, and Pérez-González (2017) focus on citizens in the actual application of their framework but the main premises of the framework should be further adapted to the public sector context to have a real added value for city councils.

The next section introduces a new framework for smart city business models that builds on this previous work but adapts it further to design, implement, and assess public services in smart cities.

The City Model Canvas

The City Model Canvas (CMC) is a framework that city councils can use to articulate how they expect to create and deliver value in an economically, environmentally, and socially sustainable way through smart services. They can also use the framework to assess existing models and innovate within them. The CMC is an adaptation of the

<table>
<tr><td colspan="5">1. Mission statement What is the ultimate goal that the city seeks to achieve?</td></tr>
<tr><td rowspan="2">6. Key Partnerships

Who can help the city deliver the proposed value to the beneficiaries? Who can access key resources that the city council does not have?</td><td>7. Key activities

What must the city council do to create and deliver the proposed value?</td><td rowspan="2">2. Value Proposition

What specific benefits are created and what specific problems does the proposed service solve or alleviate?</td><td>4. Buy-in & support

Whose buy-in is needed in order to deploy the service (legal, policy, procurement, etc.)?</td><td rowspan="2">3. Beneficiaries

Who will directly benefit from the proposed services?</td></tr>
<tr><td>8. Key infrastructure and resources & key regulatory framework

What key resources does the city council have to create and deliver the value? What infrastructure does it need? What is the key regulatory framework required?</td><td>5. Deployment

How will the city solve the problems of the Value proposition specifically?</td></tr>
<tr><td colspan="2">9. Budget cost structure

What costs will the creation and delivery of the proposed services entail?</td><td colspan="3">10. Revenue streams

What sources of revenue for the city do the proposed services provide? What other sources of revenue does the city have?</td></tr>
<tr><td colspan="2">11. Environmental costs

What negative environmental impacts can the proposed services cause?</td><td colspan="3">12. Environmental benefits

What environmental benefits will the proposed services deliver?</td></tr>
<tr><td colspan="2">13. Social risks

What are some of the potential social risks that the proposed service entails? Who is most vulnerable as a result?</td><td colspan="3">14. Social benefits

What social benefits will the proposed services bring about? For whom will these benefits materialize?</td></tr>
</table>

Figure 2. The City Model Canvas (CMC).

Business Model Canvas (BMC); it replaces several of the elements of the BMC with elements that are relevant to a public service context.

The City Model Canvas also borrows from the BMC for mission-driven organizations (Osterwalder and Blank 2016) (see Appendix 1) and from the 'triple layered' BMC (Joyce and Paquin 2016) (see Appendix 2). The former adapts the traditional BMC to organizations whose primary aim is not to maximize profit but to achieve a particular mission by re-labelling some of the key elements in such a way that its logic reflects that of a mission-driven organization (such as a government or non-profit organization) (Osterwalder and Pigneur 2010; Blank 2016). The triple layered business model canvas is a framework for private firms that assesses a traditional BMC alongside a second canvas centred on environmental value and a third canvas focused on social value (Joyce and Paquin 2016). The CMC introduced in this article integrates the concept of the three types of value and refers to it as the 'triple bottom line'.

The City Model Canvas (see Figure 2) adapts and rearranges the elements of these three frameworks to represent the role and the goals of a city council.

Elements of the City Model Canvas

The CMC consists of fourteen individual elements that describe a city's business model. These are organized into four main parts. Parts I-III are based on the mission-model canvas (Osterwalder and Blank 2016), while part IV integrates concepts from Joyce and Paquin (2016) triple-layered model. The fourteen

elements of the CMC are summarized below based on Osterwalder and Pigneur (2010) original description of how to use the Business Model Canvas and the adapted models introduced above.

The first part of the canvas starts with the mission statement, a short declaration of the overall aim that the city wants to reach through its smart service. Next comes the canvas' central element: the value proposition. This states what benefits are created and which problems will be solved by the organization through smart services. In the CMC, the value proposition usually encompasses improved quality of life in an urban environment that is economically prosperous, environmentally responsible and socially inclusive. A clear value proposition will help city council managers focus their key activities on the delivery of that value. This is important to ensure that smart services are actually designed to alleviate a particular need of the population.

The second part of the business model includes the elements that are associated with *delivering* value to the public. This includes an identification of the direct beneficiaries of smart services, an identification of whose support (buy-in) must be obtained for a project's successful implementation (i.e. stakeholders with veto power), and a plan for how the services will be delivered or accessed (deployment).

The third part of the model includes all elements that are associated with *creating* that value: key partnerships refer to the stakeholders whose support is essential. Key activities are the steps and actions the city council must execute to ensure the model's effectiveness. Key resources and key infrastructure are not only the financial and physical assets the city needs to implement its projects (e.g. a 4G or 5G wireless network and the energy grid), but also political and strategic resources, such as the regulatory frameworks, required to deploy smart services.

The fourth part of the CMC is the 'triple bottom line', adapted from work by Joyce and Paquin (2016). It consists of an assessment of the economic, environmental and social costs and benefits of the proposed smart service. The first bottom line shows the economic viability of the actions. It compares expected costs and revenues and forces the city council to consider how it will finance services. The second 'bottom line' is the environmental balance of the planned interventions. It compares the potential environmental benefits and costs of the project. The third bottom line, social sustainability, compares social benefits and social impacts (the negative costs that the project can have on residents and communities, such as excluding particular groups from services or increasing living costs in some areas). Any trade-offs between these three 'bottom lines' would become apparent in the discussion of the CMC (e.g. a smart service may have a high environmental benefit but also a high social cost) and can be negotiated with stakeholders before implementing decisions.

In sum, the CMC is a holistic decision-making framework that city councils can use to articulate how they can create and deliver public value through smart services. It organizes all the different elements of the business model in one graphic that can be used to visualize existing business models and design new ones. Importantly, the CMC encourages city councils to consider not only the economic viability of their business models, but also their environmental and social impact.

To illustrate an application of the City Model Canvas, we applied it to the case a new ICT city platform that Bristol's City Council is currently developing.

The CMC at work: an illustrative case

We present the case of Bristol's city platform as an illustrative case of how the business model logic and the CMC can be used for a smart city strategy. According to Yin (2018), an illustrative case is a descriptive method that allows us to examine unfamiliar concepts closely. The method was, therefore, appropriate to 1) show how city managers can apply the tool, and 2) collect practical insights from its application to develop the framework further and guide practitioners.

Bristol: a leading smart city

Bristol was selected as an appropriate context to apply the CMC because of its current smart city strategy. Bristol recently rose to the top of the UK Smart Cities Index (commissioned by Huawei UK and conducted by Navigant Consulting) (Temperton 2015). Bristol is also one of three lead cities (called Smart City 'Lighthouses') participating in the European Union's Horizon2020 Project REPLICATE,[1] which is a large-scale project to deploy smart services with the goals of optimizing energy consumption, improving mobility, improving ICT connectivity, *and developing smart city business models*. One of Bristol's largest smart city projects is the design and creation of an 'ICT city platform'. Since the City Council was beginning the planning stage of this project, it offered an ideal an opportunity to apply the CMC.

The City Council's mission for the ICT platform is to integrate and develop a platform that can enhance service delivery, collaboration and innovation in the city. The ICT platform is designed to collect and store data from other applications in the city, such as traffic sensors and energy demand sensors, and to analyse in real time movement and conditions in the city with the aim of optimizing mobility and energy efficiency. The City Council also aims at making the platform accessible to private businesses and associations (through special contracts and agreements that ensure data protection) so that they can use to platform to collaborate and innovate. They can coordinate operations and transactions across multiple applications and service providers, such as between bus companies to optimize routes and time plans, and to create new public and commercial services, such as programs for users to visualize and manage their energy consumption. The City Council expects that the direct benefits for residents will include improved mobility through reduced congestion at peak traffic hours, improved quality of public transport options, and greater energy efficiency that will help the City Council tackle fuel poverty in Bristol's poorest neighbourhoods. Expected indirect benefits for residents are environmental, such as improved air quality from better mobility and a lower carbon footprint in the medium- to long-term, and economical, through new commercial services enabled through the platform.

The ICT platform in Bristol was commissioned by the City Council, under the Mayor's leadership with financial support from the European Commission through the REPLICATE project. The platform's design and development are overseen by the City Council's City Innovation Team. The ICT platform is still in an early planning and design phase. The team applied the CMC to explore the value proposition of the ICT platform and to explore options to make the platform financially viable and socially and environmentally sustainable and ideally, to establish the foundation for a business case for the ICT platform.

Illustrative case study method

For this study, Bristol City Council applied the CMC through three workshops with a group of stakeholders of the smart city platform. Complimentary insight into the application of the CMC was gathered through five semi-structured interviews with the members of City Council's City Innovation Team who are overseeing this particular project through the EU-funded project REPLICATE.[2]

The purpose of the three workshops was specifically to create a City Model Canvas for Bristol's ICT platform. The first two workshops were held in April 2017 and October 2017 respectively and were attended uniquely by the five members of Bristol's City Innovation Team who are working on smart city initiatives. The goals of both workshops were to familiarize the team with the framework and to brainstorm input for it. Since the members of the City Innovation Team are currently the main decision makers about the day-to-day oversight of the ICT platform, they are the ones who will use the CMC and also the ones who can provide insight into its utility.

The aim of the third workshop, which took place in January 2018 in Bristol, was to complete a formal version of the CMC that would be used as the basis for the implementation of the ICT platform. This workshop was again organized and attended by the five members of the City Innovation Team who are working on smart services. Additionally, the following stakeholders of the ICT project were present to ensure that their input would flow into the CMC:

- Head of the Operations Centre in Bristol, who provided input into the requirements such a centre has from the ICT platform
- Director of the Head of Research Group for smart cities at University of Bristol, which is a main partner in developing the ICT platform
- Head of Knowle West Media Centre (KWMC), an arts charity based in Bristol that supports individuals and communities to get the most out of digital technologies and the arts and who brought input from those communities
- Seven members of the City Council ICT group, who are responsible for the technical development of the ICT platform
- Two information system architects for ICT digital, an advisory ICT group working within the city council on smart city projects

The aim of the third workshop was for stakeholders to agree on a final version of the CMC for the ICT platform. The workshop was moderated by the lead project manager for the smart city strategy in the City Innovation Team and was divided into three sessions. Two of the researchers observed without participating at all. During the first session, the moderator presented the CMC, explaining its elements on a screen. Participants were also given two copies of an empty CMC to take notes. After the presentation, participants asked clarification questions for 45 minutes. In the second session, participants started completing the CMC for the ICT platform. First, they had 20 minutes to work individually on their own copy of the CMC. Afterwards, all participants took turns providing input that was directly filled into the CMC projected on the wall. The moderator asked for input moving along the canvas systematically, element by element, starting with the mission statement and ending with the triple bottom line. At this point, participants were only asked to give their suggestions without discussing them. This exercise lasted approximately 1,5 hours. All participants

were able to provide input into every element more than once. After a lunch break, there was a third and final session. First, participants had one hour to discuss each other's contributions to the CMC from the previous session without the expectation of agreement. After another short break, participants continued to discuss the CMC but now with the explicit goal of reaching an agreement. The moderator guided the discussion systematically using the CMC and adding or removing elements as participants agreed on changes. The CMC was considered finished when there was consensus among all participants about the contents. Consensus was reached when every participant said they were satisfied with the CMC when asked directly. The goal of reaching consensus meant that the final round lasted approximately two hours.

One member of the innovation team took minutes of the whole workshop. The minutes were, however, not analysed formally because they reflected a brainstorming process, in which opinions and positions changed throughout the duration of the workshop, and because the conclusion of the discussions was reflected in the final version of the CMC. Any reflections about the process of completing the CMC were discussed during five follow-up interviews with the City Council Innovation Team members who are working on the ICT platform.

The researchers conducted these five interviews in the weeks after the final workshop. The interviewees, who we may only identify by their role, were: the lead programme manager for REPLICATE, three project managers for smart city pilot projects, and the project manager for business models and scaling up. These team members' are the primary responsible managers for planning, implementing and assessing the ICT city platform, along with other smart city pilot projects in the areas of mobility and energy efficiency. They are also responsible for developing business models to replicate and scale pilot projects in a second phase. The interviews were conducted and recorded by the same researcher over video conference; each interview lasted between 60 and 90 minutes.

The interviews were conducted between February and April 2018. The purpose of the interviews was to understand how the city managers used the CMC and what they perceived as its strengths and limitations from a city management perspective. Interview partners were first asked to explain their role in the City Council and their involvement with the smart city strategy. Following this introduction, everybody was asked the following questions: 1) can you explain how the CMC was used in this case? 2) Based on this experience, what were the main benefits or advantages of using the CMC? 3) Based on this experience, what were the main drawbacks or limitations of the CMC? 4) Did you identify any trade-offs between the three 'bottom lines' of economic viability, environmental sustainability and social inclusion? 5) Are there any additional insights or comments about the CMC you would like to add?

The recordings were transcribed and hand-coded line-by-line by a single person to ensure consistency (Saldaña 2015). A second researcher, who was not involved in the interviews or first coding, revised the codes found by the first researcher to improve consistency; this did not result in any additional codes. Since this is an illustrative case whose purpose was to show how the CMC can be used and what insights can be derived from its application, the coding was limited to identifying the advantages and limitations of the CMC, allowing room for any unexpected insights.

For this case study, the researchers did not interview either politicians in Bristol or other stakeholders because the purpose was to explore whether the CMC is useful as a planning tool for city council managers specifically. Other stakeholder's input is

included in the CMC but we did not interview these stakeholders because the purpose here is only to illustrate how the framework can be used by city council managers. Additional interviews were beyond the scope of this article. However, future studies about the CMC and about specific business models for smart city projects should certainly explore other stakeholders' views for a more complete picture.

The next section presents an analysis of the insights derived from the interviews.

Bristol's CMC for an ICT platform

This section presents the full City Model Canvas that Bristol's City Innovation Team created for the ICT platform. The section shows how the CMC can be applied in practice for a smart city project, how it was useful for Bristol's city council managers and where they had difficulties with it.

The CMC resulting from the exercise is presented as Figure 3.

Without describing every other element of the canvas, three elements of Bristol's CMC are worth emphasizing.

The canvas' central element is the value proposition. Because the ICT platform is still in the planning stage, the value propositions are the result of the city managers' and the stakeholders' expectations. They included: improving traffic conditions through real time data that power user apps, such as parking spot information and bus route optimization; improving resource consumption by enabling electricity monitoring in government buildings; and enabling new commercial and public services that can work together on the open and transparent data platform. These were the result of previous analysis the City Innovation Team had conducted on Bristol's current needs in mobility and resource efficiency and of the discussions with stakeholders during the third workshop. In the planning stage, this is valuable to ensure that all other activities are focused on refining and realizing these value propositions. Based on this work, Bristol will develop a pilot project to test the ICT platform on a small scale.

Mission statement *To integrate and develop city ICT platforms in Bristol to enhance service delivery, collaboration and innovation.*

Key Partnerships
- Bristol Operations Centre
- Transport operators
- TravelWest
- University of Bristol
- Bristol Is Open
- Small to medium sized enterprises (partners and suppliers)
- Large companies (partners and suppliers)
- NGOs and community groups
- KWMC and Our Digital City Programme
- UKRCIC project
- REPLICATE project
- SPHERE project
- BCC digital services team

Key activities
- Agree scope and resources
- Develop / confirm strategic partnerships and signed memorandum of understanding for research, development and commercialisation
- Map city council requirements and in-scope assets.
- Map city / partner (operators) requirements and in-scope assets and platforms
- Create a persuasive case for partner / private operators to engage and integrate platforms, and secure commitment
- Decide upon a standard data model with partners through data sharing templates and methods
- prototype example smart services that leverage cross-city application services

Key infrastructure and resources
- The Bristol Operations Centre
- BNET fibre network
- Bristol Is Open test-bed network
- REPLICATE project scale-up resource and learning.
- UKCRIC project resources and partnerships
- Bristol Open Data Platform
- KWMC: The Factory: community sensor and digital manufacturing centre

Value Proposition
1. To offer secure and trusted data storage, real time data and holistic analytics across platforms about the functioning of services, movement and conditions in the city in order to support optimisation of network efficiencies, resource allocation, and decision-making
2. To offer secure and trusted real-time control and monitoring of IoT networks across platforms
3. To enable creation of new public and commercial services
4. To enable service innovation and collaboration through open and shared data
5. To enable the servicing of transactions across multiple application and data providers
6. Provide transparent and trusted contracting between stakeholders

Buy-in & support
- The Mayor and senior management
- Bristol City Council
- Private sector operators and suppliers
- Community Anchor Organisations and Voluntary sector

Deployment
- The service will delivered through the Bristol Operations Centre in partnership with a number of strategic partners
- Access to open data will be through the Bristol Open Data Platform
- Access to shared data will be via agreements with partners

Beneficiaries
- Bristol City Council through helping to meet strategic city objectives and service transformation
- Bristol Operations Centre through enhanced value proposition
- Citizens through more efficient and effective city networks (e.g. transport, safety)
- Partners and suppliers through contracts, use cases and marketing opportunities
- Bristol Operations Centre customers
- Universities through greater research collaboration
- Visitors and businesses through better city information

Budget costs
- Capex costs: Development budget (contribution from REPLICATE), Bristol Operations Centre phase 2 and development partners
- Opex costs: Ongoing user management and training, functional updates, maintenance and debugging, emergency repairs / fixes, ongoing security updates; met through operational budget once launched
- Ongoing developmental work with stakeholders

Revenue streams
- Direct: Supporting Council savings through service redesign and better prioritisation of resources, enabling competitive business growth (e.g. tele-care)
- Indirect: Increased economic growth (growth in business rates), public sector savings, increase in tourism / spend because of better managed networks

Environmental costs
- None currently envisaged. Possibility of increasing efficiency of networks (e.g. transport) leads to unexpected consequences such as increase in air pollution from more vehicles
- CO_2 footprint of all the servers and electricity

Environmental benefits
- Less congestion and carbon emissions through better transport and energy network management
- Increase in air quality through better flowing traffic

Social risks
- Robust people, process and technological safe-guards need to be in place to ensure privacy of individual citizens is adhered too and the security of the system is maintained
- Sufficient testing and ongoing checks to ensure that new algorithms and analytics do not reinforce societal biases that could widen inequality
- Citizens reject ICT and Smart City solutions as invasive and exploitative – lack of trust

Social benefits
- City services will be more efficient and effective enhancing the livability and productivity of the city
- Citizens will be able to participate in the development of their city services and needs met. Democratic processes and decision making enhanced
- The city will be safer and more resilient through the enablement of better and more agile decision making
- More control of infrastructure and access to hyper local information for local communities

Figure 3. CMC for Bristol's ICT platform.

Second, the exercise showed that one of the primary uses of the CMC is stakeholder and beneficiary identification. Most of the discussions during the three workshops were focused on identifying key partners, key veto players and key beneficiaries for the ICT platform and in discussing what the council's role was in coordinating those stakeholders (key activities). Among the key activities identified are: map the City Council's requirements and resources, map partners' requirements and assets and secure their commitments, confirm strategic partnerships and create a persuasive case for them to engage and integrate their platforms. One difficulty here was to identify who was primarily a key partner and who was primarily a key beneficiary in cases when they could be both participant and beneficiary, such as the University of Bristol (see Figure 3). Another difficulty was distinguishing direct beneficiaries from indirect ones. Bristol's CMC shows that all citizens will benefit from more efficient and effective city networks, for example for transport. One problem with this conclusion is that it could overestimate the benefits of the ICT platform. While all citizens might benefit from better coordinated services, such as transport, it is important to say who will benefit directly (e.g. bus users who will now have access to more routes and coordinated timetable) and who will benefit indirectly (e.g. solo car drivers who will see reductions in traffic congestion). Otherwise, city council managers might overestimate the benefits or costs of a smart service.

Finally, the CMC showed the importance and the difficulty of considering the potential environmental and social impacts of the ICT platform. Benefits mentioned by stakeholders were an improved environmental footprint for the city from optimized transport and energy use, better control of infrastructure through data analysis, and more efficiency in public service provision. Among the negative environmental impacts, stakeholders mentioned the CO_2 emissions from the platform's servers, its electricity consumption, and the possible unintended consequence that even more cars will come into circulation when traffic conditions in the city improve (i.e. a rebound effect). Social risks included the need for thorough data protection policy to ensure citizen data privacy and the need to test the system often to ensure that it does not reinforce social biases intrinsic to the system. However, participants were unable to come up with specific criteria for measuring these risks and benefits were developed during this workshop, partly due to time constrains and partly due to lack of indicators for measuring such impacts. This can be a second step in working on the CMC so that the criteria can be used post-implementation to assess the project's impact.

The next section discusses the strengths and limitations of the CMC as perceived by the city council managers from the City Innovation Team who worked on it during all three workshops.

Discussion: strengths and limitations of the City Model Canvas

The interviews with the City Innovation Team that used the CMC reveal the framework's strengths and limitations in its particular application to a new ICT platform in Bristol.

Strengths of the CMC

The interviews with members of Bristol City Council point to three main strengths of the CMC: 1) stakeholder identification, 2) holistic planning, and 3) triple-bottom line thinking. This section will discuss these strengths based on the information collected during the workshops and the interviews with Bristol City Council's City Innovation Team.

Holistic planning

The application of the CMC in Bristol suggested that the framework's clearest advantage is that it helped the City Innovation Team organize all important elements of a smart city service on a single page. The interviewees agreed that it can be difficult to consider the many aspects of a complex public service simultaneously. The canvas method provided a kind of checklist and guideline for city council managers to regularly return to and review whether important elements have been considered, or whether something has been left out. Once the project's different elements had been mapped, the ensuing discussions were about how they fitted together. All of the interviewees mentioned that this was useful during the project's design phase because it structured their thinking about what they hoped to achieve with this technology, how they would deploy it, and what they needed to do to achieve that (such as securing partnerships and resources).

During the workshops organized, the concept of the value proposition was also emphasized repeatedly as a way to ensure that the integrated city platform would in effect add value to the urban ecosystem and to the identified beneficiaries. The interviewees highlighted that this structured discussion was especially important for the ICT platform, which is unprecedented in the city and for which there is no clear roadmap in place. As Meijer and Rodríguez Bolívar (2016, 392) have written, city council managers must understand that technology will not improve a city's urban ecosystem unless the process of introducing it is focused on adding public value. The CMC contributed to that focus.

Stakeholder identification

the second important strength of the CMC, according to the interviewees, was its utility as a stakeholder identification tool. The City Innovation Team used the framework to identify the key partners, key beneficiaries and key supporters systematically. The interviews revealed that this is an important advantage because smart services usually involve a plurality of stakeholders with different conceptualizations of the risks and benefits expected from the project; it is important to approach them *before* a project is implemented to ensure that the end result will be generally acceptable. Another benefit of mapping stakeholders with the CMC is that one of the City Innovation Team's main responsibilities is to coordinate all stakeholders' contributions to the process; a strategy for doing so and specific key activities were based on the resulting CMC.

An interesting insight from the exercise is that Bristol's CMC shows that occasionally, the same stakeholders could be placed in more than one of the canvas' boxes. The University of Bristol, for example, shows up as both a key partner and a key beneficiary of the ICT platform development in Bristol; while it is a key collaborator in developing the platform, it will also benefit itself from the future applications and collaborations that the platform will enable. This shows that as a planning tool, the CMC can be used to show stakeholders how collaborating on one dimension of a smart service can eventually yield benefits for them in another dimension.

Triple-bottom line

interviewees emphasized the triple-bottom line as a strength of the CMC. Having to evaluate this element as a systematic step in the design of smart services compels city council managers to consider the costs as carefully as the benefits of smart services. Moreover, the interviewees from the City Innovation Team explained that other stakeholders' expectations of the benefits and risks of smart services are not uniform

and can compete with each other; the triple-bottom line gave them an opportunity to discuss these expectations with various stakeholders. This is important in light of recent critiques of smart cities, as mentioned in an earlier section.

Assessing the triple-bottom line in smart city business models will also enable city council managers to see how the smart city strategy contributes not only to economic growth but to other public values as well. The CMC presented here incorporates social and environmental value but future adaptations of the CMC could include other public values. This addresses the question Hollands (2015, 62) raises in his critique of smart cities: 'who stands to gain and lose in the race towards such an urban future?'A triple-bottom line assessment calls upon city council managers to engage with this question.

Limitations of the CMC

The application of the CMC in Bristol also revealed some of its limitations. These observations define the scope of the CMC's utility for smart services and can be the basis for future work on smart city business models.

Presenting a viable business case

according to the interviews, the main challenge in the case of Bristol's ICT platform was translating the initial mapping from the CMC to a concrete business case for the platform. While the CMC is a high-level planning tool rather than a detailed business planning method, the city council and the researchers expected that the CMC results would provide a clear basis for a full business case. This was not the case. Despite having assessed the costs and revenues, it remained unclear how a financially viable business case could be developed partly because of the difficulty of accounting for savings in other departments, e.g. transport or health. Bristol's experience with the CMC suggests that the framework is mainly useful as a planning tool; it gave the City Innovation Team a starting point and a roadmap for the project's design, but further work is required to develop a viable business case for its implementation.

Accounting for savings opportunities

Another limitation of the CMC that came up in the case of Bristol was that the cost-benefit element of the CMC accounts for direct revenue streams and direct costs. The City Council, however, also valued the long-term savings the ICT platform would enable (for example, by making traffic more efficient) as well as direct revenue. City council managers explored the potential business case and potential savings during the CMC workshop with stakeholders. In the discussion on savings, possible costs and possible revenues, they relied on stakeholders technical expertise and their available models to project them that had been prepared for the workshop. In the CMC workshops it was unclear how to translate these savings opportunities directly into a viable business model. This is likely to be the case for many city councils, who face pressures to be fiscally sustainable. The interviewees mentioned that for them, the justification for many smart services in coming years will be based on how these unlock long-term savings opportunities. Future applications of the CMC should acknowledge this.

In sum, the exercise in Bristol suggests that the CMC is a useful planning tool in the design stage but must be complemented with additional work to produce viable business cases for city councils.

Conclusions

This article has argued that city councils can use a business model logic to design and implement smart city services and has shown specifically how a framework for designing city business models can be applied to the planning phase of an integrated ICT city platform. The City Model Canvas offers a framework and methodology for articulating a city business model's various elements and to identify whether planned smart services might have unintended environmental and social consequences. The illustrative case study of the CMC in Bristol City Council showed that the CMC is primarily a practical planning tool for city councils and other stakeholders. It is meant to enhance the public decision-making process behind smart services. One limitation of this illustrative case study and how it was structured is that it only explored how the CMC business model logic can be used specifically by city council managers; it did not include conversations with either politicians or other stakeholders. Future research should explore its utility in higher-level decision making processes that involve politicians and politically-appointed executives as well as other stakeholders, such as citizen groups and private companies involved in smart city development.

Future research can also use the CMC to evaluate smart city projects at regular intervals after their initial implementation to assess the following governance concerns: 1) has the project delivered the expected value to citizens? 2) What is the overall balance of the triple bottom line? Are there trade-offs to acknowledge between these three goals? 3) What is the balance of stakeholders involved *x* years into the project – is the project reaching key beneficiaries? Have all key partners been engaged in the project? Such future research will be comparable and systematic if it relies on a common integral model, such as the CMC. We welcome future work that improves upon the City Model Canvas methodology.

Notes

1. The other participating Lighthouse cities are Florence (Italy) and San Sebastian (Spain).
2. The researchers were also involved in this project with the role of developing new business models for smart cities. Since this article does not aim at answering a traditional research question but to describe how the CMC tool can be used, interviewer bias was not a strong concern.

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Appendices

Appendix 1. The business model canvas for mission-driven organizations

<table>
<tr><td rowspan="2">5. Key Partnerships</td><td>6. Key activities</td><td rowspan="2">1. Value Proposition</td><td>3. Buy-in & support</td><td rowspan="2">2. Beneficiaries</td></tr>
<tr><td>7. Key resources</td><td>4. Deployment</td></tr>
<tr><td colspan="3">8. Mission Budget (or costs)</td><td colspan="2">9. Mission Achievement (or fulfilment or impact) Factors (or criteria)</td></tr>
</table>

Source: Osterwalder and Blank (2016).

Appendix 2. Triple layered Business Model Canvas

First layer: Economic business model canvas

Key partners	Key activities	Value proposition	Customer relationships	Customer Segments
	Key resources		Channels	
Cost structure		Revenue streams		

Second layer: Environmental life cycle business model canvas

Supplies and outsourcing	Production	Functional value	End-of-life	Use Phase
	Materials		Distribution	
Environmental impacts		Environmental benefits		

Third layer: Social stakeholder business model canvas

Local communities	Governance	Social value	Societal culture	End-user
	Employees		Scale outreach	
Social impacts		Social benefits		

Source: Joyce and Paquin (2016).