How About Value Chain in Smart Cities? Addressing Urban Business Model Innovation to Circularity

Francesca Loia, Vincenzo Basile, Nancy Capobianco, and Roberto Vona

Abstract In the last years, the concept of "smart city" has been the subject of increasing attention in urban planning and governance due to the sustainability challenges and great technological advancements. Although the relevant literature highlights those smart cities can create a fertile environment to drive innovation from a technological, managerial and organizational, and policy point of view how smart cities function, in terms of their value chain and in light of sustainability and circularity is still an open question. Based on these considerations, this work aims to investigate how smart cities deliver value by combining environmental, societal, and financial priorities to re-imagine their core business models and shift the boundaries of urban competition in light of circular economy principles. To reach this goal, the tool Sustainable Business Model Innovation Canvas has been applied in the urban context with the aim to create and leverage an environmental and societal surplus in light of circularity in the smart city framework. Preliminary results shed light on new vistas on the future and new challenges of smart cities particularly relevant for facing the current complexity of the economy, social, and environmental changes.

Keywords Smart city · Sustainability · Circularity · Sustainable business model · Canvas · Innovation · Value chain

1 Introduction

The concept of a "smart city" has been the subject of increasing attention in urban planning and governance due to the sustainability challenges and great technological advancements [5, 12, 17, 25]. Cities and metropolitan areas account for about 60% of Gross Domestic Product, but they are also responsible for 70% of CO_2 emissions and more than 60% of resource use. As part of this transition towards sustainability, the development of smart cities includes creating circular cities with a focus on the well-being of the entire ecosystem.

F. Loia (✉) · V. Basile · N. Capobianco · R. Vona
Department of Economics, Management and Institutions, University of Naples 'Federico II', Naples, Italy
e-mail: francesca.loia@unina.it

© The Author(s), under exclusive license to Springer Nature Switzerland AG 2023

A. Visvizi et al. (eds.), *Research and Innovation Forum 2022*,
Springer Proceedings in Complexity, https://doi.org/10.1007/978-3-031-19560-0_19

Although the relevant literature highlights that smart cities can create a fertile environment to drive innovation, how smart cities function, in terms of their value chain, in order to support sustainability and circularity is still an open question. Based on these considerations, this work aims to investigate how smart cities deliver value by combining environmental, societal, and financial priorities to re-imagine their core business models and shift the boundaries of urban competition in favor of circular approaches. This paper, thus, tries to answer the following research question: "How do smart cities shape their business models for combining environmental, societal, and financial priorities in favor of circular approaches?". To reach this goal, the tool Sustainable Business Model Innovation Canvas has been applied in the urban context.

This paper is structured as follows: Sect. 2 frames smart cities as a driver of innovation for sustainability and circularity; Sect. 3 introduces the methodological approach based on an application of the Sustainable Business Model Innovation Canvas; Sect. 4 regards the results; Sect. 5 lists main implications and it also draws conclusions and directions for future research.

2 Literature Review

The concept of "smart city" has been deeply investigated in urban planning and governance [10, 17, 26, 27]. As broadly discusses by the consolidated literature, a smart city can be defined as a conceptual framework that combines key components such as technology (infrastructures of hardware and software), people (creativity, diversity, and education), and institutions (governance and policy) [17].

The ICT infrastructure is related to numerous emerging and streamline technologies, such as the Internet of Things (or IoT) and Big Data, together with cognitive computing, advanced analytics and business intelligence, 5G networks, anticipatory and context-aware computing and advanced distributed data warehouse platforms, which serve as enablers of sophisticated smart city services [9, 12, 14, 20, 28]. The technological evolution makes it possible to gather and analyse data across machines, enabling faster, more flexible, and more efficient processes to produce higher-quality urban services [12, 13, 15, 28].

Smart cities have also emerged as a possible solution to sustainability problems deriving from rapid urbanization, climate change, and population growth [4, 24]. Environmentally oriented definitions, thanks to digital technologies based on platforms and applications which enable the analysis, monitoring, and optimization of urban physical systems (energy, water, waste, transportation, mobility, consumption, and others), can be used to improve the use of resources and decrease emissions. For the right monitoring of these assets, the key tool is the sensor network and the Internet of Things technologies, able to connect the data from sensors to the virtual context [1, 3]. In line with the concept of CE, defined by Pietro-Sandoval et al. [21], more attention is devoted to the implementation of circular principles to decouple

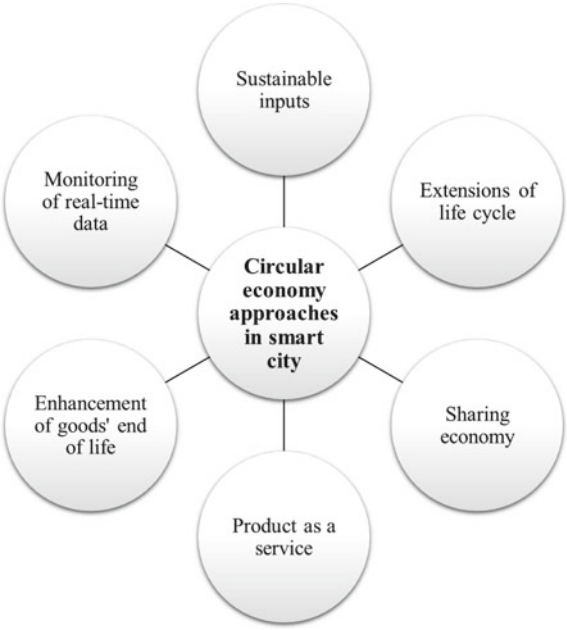

Fig. 1 Circular Economy approaches in smart city. *Source* Authors' elaboration

economic growth in cities from primary resource extraction through reuse, repair, and recycling [16].

In fact, CE principles can determine an urban revolution; they sustain the adoption of sustainable inputs (renewable sources, reuse, recycling), an extension of the useful life of assets and products, adoption of sharing economy initiatives, product as a service, enhancement of the end of life of goods (re-cycling, reuse, upcycling), and monitoring of real-time data through platforms (as shown in Fig. 1). In particular, recent debate has highlighted the need to explore the relation of smart, sustainable, and circular cities more systematically, focusing on practical applications—such as the Business Model tool—that could enable a deeper understanding of the considered domain [28].

3 Methodology

With the aim to describe how smart cities function, in terms of their value chain, for contributing to sustainability and circularity, the Business Models' (BMs) [19] have been investigated. Several business model frameworks have been proposed in the literature, as highlighted by [11]. However, rising environmental evolutions have led to the development of Business Model Innovation (BMI) which is defined as a novel way of creating, delivering, and capturing value, which is achieved through a change of one or multiple components in the business model [18].

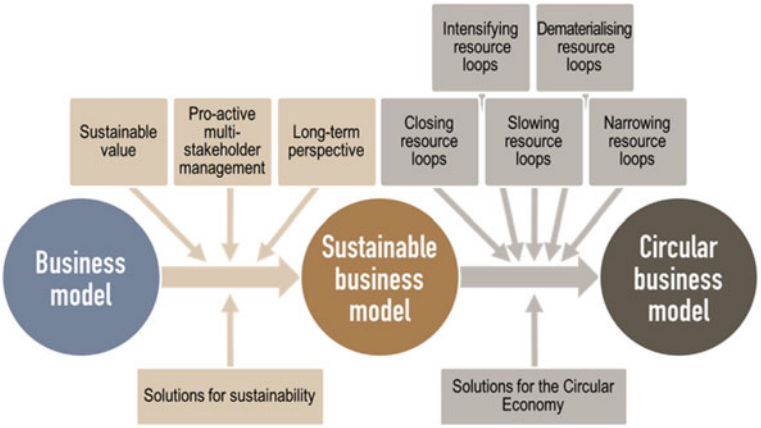

Fig. 2 Sustainable and circular business models. *Source* Geissdoerfer et al. [7]

As CE and sustainability have gained greater attention from governments, industry, and academia, a variety of BMI approaches have been proposed to suit the CE and sustainability principles [2, 7], as shown in Fig. 2. In this context, the alternative concept of the sustainable business model (SBM) has been broadly investigated due to its potential to bring a competitive advantage to organizations by boosting the conventional business models with the aim to meet the sustainable development while maintaining productivity and profitability [23]. Circular business models (CBM), similar to sustainable business models, aim to create, capture, and deliver value to improve resource efficiency by extending the lifespan of products and parts that thereby realizes environmental, social, and economic benefits [22].

In the smart city context, designing business models is essential to systematically assess the most relevant aspects of investment propositions stimulating and fostering communication and engagement of relevant stakeholders who could potentially liaise the replication on large-scale of smart cities solutions. Some studies on sustainable business models for smart city have been carried out by applying the tool of Business Model Canvas [6, 8], however further research efforts are needed for following the principles of the CE.

4 Results and Discussion

In order to answer to the research question, Sustainable Business Model for smart city in light of CE practices has been proposed [22] (Fig. 3).

In the case of the SBM, the ***key partners*** include all the target users, involved in the network of the smart city ecosystem, for which the value in terms of CE is created and whose needs are addressed through a smart city project. Network can

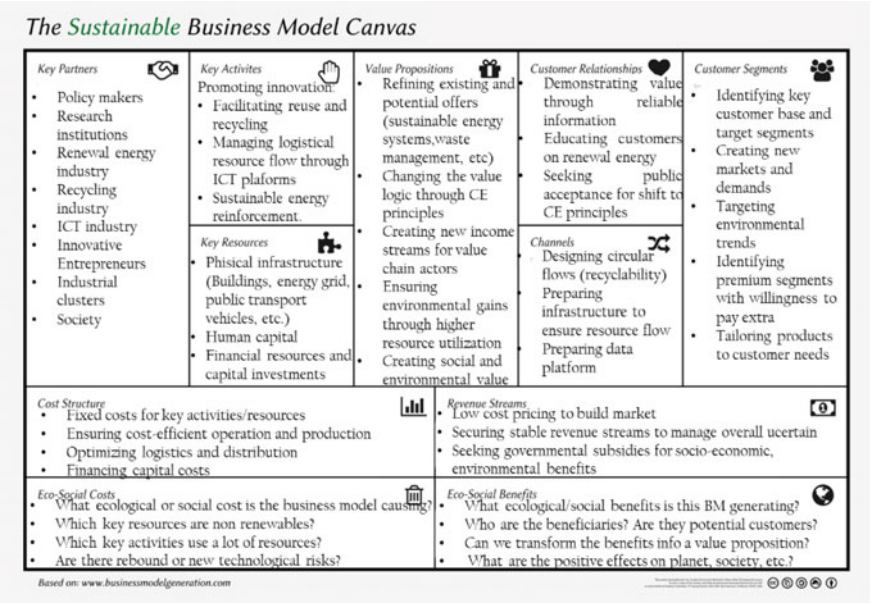

Fig. 3 Sustainable Business Model for smart city in light of circularity. *Source* Authors' elaboration from Giourka et al. [8], Reim et al. [22] and Basile et al. [2]

include community, business and research organizations, decision-making bodies (government), and nonprofit organizations [8, 22].

The ***key activities*** regard the management and delivery of activities by actors involved in the smart city context. The focus is mainly on activities essential to transition to CE aimed at promoting more innovation based on the reuse and recycling approach, resource flow through ICT platforms, and sustainable energy reinforcement.

The ***key resources*** refer to physical assets (which include buildings, energy grid, public transportation vehicles and systems, wireless networks, waste management systems, etc.), human assets (which can consist of the political will toward circularity within smart cities, the creation of a culture of innovation and sustainability between citizens), intellectual assets (which include patents and legal, regulatory frameworks aimed to support circularity and sustainability initiatives), and financial assets (which include access to capital and subsidies and tax incentives to realize smart solutions) [8, 22].

The ***value proposition*** consists of smart city initiatives in terms of CE principles that address the critical need to rapidly reduce emissions and curb climate change. From the perspective of citizens, smart city projects can reduce energy bills and improve air quality. Different value propositions can be derived from the various areas of smart cities, such as mobility, safety, health, energy, water, waste, economic development, housing, and community engagement [8, 22].

The ***customer relationship*** regards relationships that should be established for enabling continuous co-creation practices between actors involved in the smart city ecosystem aimed at reaching sustainable development and circularity [8, 22].

The ***channels*** regard both physical (design of circular flows, availability of infrastructure) and technological asset (the digital infrastructure required for enabling the smart city applications).

The ***customers*** regard the high potential and need to work on creating new markets. It is important to carefully consider customer needs and market requirements and to adapt products and services to the potential customers in smart city.

The ***cost structure*** is related to the key resources and activities required to implement smart city solutions such as fixed costs, i.e., salaries, rents, IoT sensor installation process and services, network/grid infrastructure, technology installations, land, or costs that vary based on incentives or rewards provided to end-users. The SC-BMC helps to identify public and private funding and to facilitate collaboration between multiple actors. Economies of scale can also provide a cost advantage in the case of large-scale implementation of solutions, causing the average cost of investment to decrease as output increases (e.g., sensors recognizing free parking spaces).

CE initiatives in the smart city can offer many opportunities for new ***revenue streams*** for companies. Seeking and obtaining government grants is an important activity to increase the revenue stream. However, companies must demonstrate that CE-related products and services are profitable. Upgrading infrastructure, and technologies and opening up public city data can create new value chains and opportunities in a sustainable way. For example, revenues for private actors can come from user fees (i.e., end users pay for units of energy from renewable sources), or from loans/rents/leases (i.e., granting an investor trade excess energy produced by the PV systems on buildings for a fixed period in return for a fee).

Ecosocial costs refer to the urban operations which have the potential to impact on the environment. In this case, ecosocial costs may be related to bio-physical measures such as CO_2 e emissions, ecosystem impacts, natural resource depletion, human health, political perspectives, non-developmental areas, and pollution.

Ecosocial benefits, on the other hand, allow for better understanding where the organisation's biggest environmental impacts lie within the BM and provide insights for where the organization may focus on creating environmentally-oriented innovations.

5 Conclusions

Nowadays, cities need to provide for the majority of the world's citizens while rapidly decreasing environmental impact and taking up the challenge of circularity.

This work aims to, by applying the managerial tool of the Sustainable Business Model, highlight the smart city potentialities related to circular economy practices. As a result, the value proposition that emerged consists of smart city initiatives based on circular economy principles which respond to the need of improving resource

efficiency, reducing emissions, and containing climate change for realizing environmental, social, and economic benefits. Smart cities, therefore, have the opportunity to drive circular economies by encouraging the use of renewable energy, energy saving, sustainable consumption and production, sustainable transportation, conservation of natural resources, and sustainable waste management [21]. Such policies—useful for building resilience in the urban context—are also promoted by Sustainable Development Goal 11 of the 2030 Agenda.

However, the work provides initial understandings that pave the way for additional studies for a deeper understanding of the issue. In this sense, the partial nature of the research does not allow us to generalize, although the insights from this preliminary exploratory study may offer a useful stimulus for future qualitative studies.

References

1. Arasteh, H., Hosseinnezhad, V., Loia, V., Tommasetti, A., Troisi, O., Shafie-khah, M., Siano, P.: Iot-based smart cities: a survey. In: 2016 IEEE 16th International Conference on Environment and Electrical Engineering (EEEIC), pp. 1–6. IEEE (2016)
2. Basile, V., Capobianco, N., Vona, R.: The usefulness of sustainable business models: analysis from oil and gas industry. Corp. Soc. Responsib. Environ. Manag. **28**(6), 1801–1821 (2021)
3. Chui, K.T., Lytras, M.D., Visvizi, A.: Energy sustainability in smart cities: artificial intelligence, smart monitoring, and optimization of energy consumption. Energies **11**(11), 2869 (2018)
4. Ciasullo, M.V., Troisi, O., Grimaldi, M., Leone, D.: Multi-level governance for sustainable innovation in smart communities: an ecosystems approach. Int. Entrep. Manag. J. **16**(4), 1167–1195 (2020)
5. Dameri, R.P.: Smart city definition, goals and performance. In: Smart City Implementation, pp. 1–22. Springer, Cham (2017)
6. Díaz-Díaz, R., Muñoz, L., Pérez-González, D.: Business model analysis of public services operating in the smart city ecosystem: The case of SmartSantander. Futur. Gener. Comput. Syst. **76**, 198–214 (2017)
7. Geissdoerfer, M., Vladimirova, D., Evans, S.: Sustainable business model innovation: a review. J. Clean. Prod. **198**, 401–416 (2018)
8. Giourka, P., Sanders, M.W., Angelakoglou, K., Pramangioulis, D., Nikolopoulos, N., Rakopoulos, D., Tzovaras, D.: The smart city business model canvas—a smart city business modeling framework and practical tool. Energies **12**(24), 4798 (2019)
9. Kashef, M., Visvizi, A., Troisi, O.: Smart city as a smart service system: human-computer interaction and smart city surveillance systems. Comput. Hum. Behav. **124**, 106923 (2021)
10. Komninos, N., Schaffers, H., Pallot, M.: Developing a policy roadmap for smart cities and the future internet. In: eChallenges e-2011 Conference Proceedings, IIMC International Information Management Corporation, pp. 1–8. IMC International Information Management Corporation (2011)
11. Krumeich, J., Burkhart, T., Werth, D., Loos, P.: Towards a component-based description of business models: a state-of-the-art analysis (2012)
12. Lytras, M.D., Visvizi, A.: Who uses smart city services and what to make of it: toward interdisciplinary smart cities research. Sustainability **10**(6), 1998 (2018)
13. Lytras, M.D., Visvizi, A., Sarirete, A.: Clustering smart city services: perceptions, expectations, responses. Sustainability **11**(6), 1669 (2019)
14. Lytras, M.D., Visvizi, A., Jussila, J.: Social media mining for smart cities and smart villages research. Soft. Comput. **24**(15), 10983–10987 (2020)

15. Lytras, M.D., Visvizi, A., Chopdar, P.K., Sarirete, A., Alhalabi, W.: Information management in smart cities: turning end users' views into multi-item scale development, validation, and policy-making recommendations. Int. J. Inf. Manage. **56**, 102146 (2021)
16. MacArthur, E.: Towards the circular economy. J. Ind. Ecol. **2**(1), 23–44 (2013)
17. Nam, T., Pardo, T.A.: Conceptualizing smart city with dimensions of technology, people, and institutions. In: Proceedings of the 12th Annual International Digital Government Research Conference: Digital Government Innovation in Challenging Times, pp. 282–291 (2011)
18. Osterwalder, A., Pigneur, Y.: Business Model Generation: a Handbook for Visionaries, Game Changers, and Challengers, Vol. 1. Wiley (2010)
19. Osterwalder, A., Pigneur, Y., Tucci, C.L.: Clarifying business models: origins, present, and future of the concept. Commun. Assoc. Inf. Syst. **16**(1), 1 (2005)
20. Polese, F., Troisi, O., Grimaldi, M., Loia, F.: Reinterpreting governance in smart cities: an ecosystem-based view. In: Smart Cities and the un SDGs, pp. 71–89. Elsevier (2021)
21. Prieto-Sandoval, V., Jaca, C., Ormazabal, M.: Towards a consensus on the circular economy. J. Clean. Prod. **179**, 605–615 (2018)
22. Reim, W., Parida, V., Sjödin, D.R.: Circular business models for the bio-economy: a review and new directions for future research. Sustainability **11**(9), 2558 (2019)
23. Schaltegger, S., Lüdeke-Freund, F., Hansen, E.G.: Business models for sustainability: a co-evolutionary analysis of sustainable entrepreneurship, innovation, and transformation. Organ. Environ. **29**(3), 264–289 (2016)
24. Toli, A.M., Murtagh, N.: The concept of sustainability in smart city definitions. Front. Built Environ. **6**, 77 (2020)
25. Troisi, O., Fenza, G., Grimaldi, M., Loia, F.: Covid-19 sentiments in smart cities: the role of technology anxiety before and during the pandemic. Comput. Hum. Behav. **126**, 106986 (2022)
26. Visvizi, A., Lytras, M.D.: Rescaling and refocusing smart cities research: From mega cities to smart villages. J. Sci. Technol. Policy Manag. (2018)
27. Visvizi, A., Lytras, M.D.: Sustainable smart cities and smart villages research: rethinking security, safety, well-being, and happiness. Sustainability **12**(1), 215 (2019)
28. Visvizi, A., Lytras, M.D., Damiani, E., Mathkour, H.: Policy making for smart cities: Innovation and social inclusive economic growth for sustainability. J. Sci. Technol. Policy Manag. (2018).