



Making Smart Cities “Smarter” Through ICT-Enabled Citizen Coproduction

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Abstract

In the context of smart cities, the role of non-state actors (e.g., citizens, private sector) in the policy design and provision of public services has been spreading out, aiming for a more open and collaborative government. Particularly, one of the key pillars of smart city initiatives is the concept of “citizen-centricity” which entails the shifting of smart city public services *for* citizens to smart public services *by* citizens (Bovaird and Loeffler 2012; Castelnovo 2019; Clarke 2018). In this context, the concept of citizen ICT-enabled coproduction is seen as an attractive alternative of regular delivery of public services. That means that citizens are

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given the opportunity to engage in the public services' value chain (Linders 2012; Bovaird 2007).

Despite the efforts of cities to lead the smart city initiatives towards a citizen-centric approach, direct engagement of citizens has not yet been achieved by most of the smart cities' initiatives (Cardullo and Kitchin 2019a). Therefore, this chapter aims at providing a thorough review of ICT-enabled citizen coproduction in order to highlight the potential and challenges of adopting such approach in the coproduction of citizen-centric smart cities.

Introduction

Citizens play a crucial role in smart cities as either direct or indirect recipients of the benefits of smart cities. At first, citizens were viewed as passive recipients of smart services, so the smart city was built on a techno-centric approach. Nevertheless, in order to overcome the criticisms and challenges of this approach, scholars and cities incorporated the concept of "citizen-centricity." Citizen-centricity concerns the prioritization of people's needs in the design and implementation processes of public services (Berntzen and Johannessen 2016; Lee and Lee 2014).

In order to achieve a citizen-centric approach, citizens are engaged as active contributors to cities instead of mere users. This approach is considered part of the nature of a city's "smartness" since citizens' resources, data, and information are crucial for the smart city objectives. As Berntzen and Johannessen (2016) argue, the "smartness" of cities depends on how governments will effectively promote active cooperation, collaboration, and interaction with citizens.

Yet, for most of the cities, the challenge remains on *how* to achieve the vision of citizen-centricity pursuing the switch from citizens' passive roles to active engagement (Cardullo and Kitchin 2019a). This challenge can be overcome by focusing on public service users who can contribute expertise, insight, and resources at various levels of public service delivery, including service planning, service delivery, and service monitoring.

In this context, the concept of citizen coproduction is seen as an attractive alternative of regular public services' delivery which encompasses a power redistribution, meaning that citizens are given the opportunity to engage in the public services' value chain (Bovaird 2007).

Citizens can engage in the coproduction of smart cities via traditional and more innovative mechanisms enabled by (new) ICTs. The implementation of technological advances has extended the applicability of the coproduction model in government service delivery, resulting in transformative changes, particularly at the city level (Cardullo and Kitchin 2019a; Townsend 2013). Nevertheless, the adoption of ICT to engage citizens as co-producers is not without controversies. For instance, the "digital divide" – referring to uneven access to or use of ICT – is a well-known ICT-innovations' obstacle for inclusiveness. Additionally, it is feared that other

advances, such as algorithmic manipulation may disempower citizens, causing an obstruction for the realization of democratic public values. This may be the product of the government replicating existing paradigms, shifting farther away from a citizen-centric approach (Cardullo and Kitchin 2019b; Castelnovo 2018; Osborne et al. 2016; Uppström and Lönn 2017).

The aim of this chapter, therefore, is to explore the potential of ICT-enabled coproduction in the smart city context by reviewing literature on coproduction, smart city, and e-government. This chapter presents an extensive review of all the relevant elements of ICT-enabled coproduction in order to highlight the potential and challenges of adopting such strategy.

The remainder of the chapter is structured as follows. Section “[ICT-Enabled Coproduction](#)” introduces the concept of citizen (ICT-enabled) coproduction. Section “[Characteristics of ICT-Enabled Coproduction](#)” presents the different aspects that characterized ICT-enabled coproduction. Section “[The Process of ICT-Enabled Coproduction](#)” discusses the main elements of the process of coproduction related to the smart city literature. Section “[Potential Outcomes of ICT-Enabled Coproduction Through the Lenses of Public Values](#)” introduces a brief Review about the potential of ICT-enabled coproduction to enhance or obstruct the realization of public values. Section “[ICT-Enabled Coproduction Initiatives](#)” introduces two examples of the implementation of citizen ICT-enabled coproduction in the context of smart city initiatives in order to illustrate some elements discussed in the previous sections. Finally, section “[Concluding Remarks](#)” briefly poses the conclusion of the chapter and suggests avenues for future research.

ICT-Enabled Coproduction

The interest in public services coproduction — collaboration between government, citizens, and non-state actors in delivering smart public services — has been increasing on both the academic and professional level. This growing attention is mainly, but not exclusively, attributed to the continuing effects of the global financial crisis, a shortage of government resources, and the decline of trust in the public sector.

Coproduction initiatives are therefore presented as an innovative alternative to deliver more democratic and better smart public services (De Vries et al. 2016). Coproduction, as a way to engage citizens, is also known as one of the main components to account for smartness in cities.

Smart city initiatives, therefore, are expected to enable the engagement of citizens as it has the potential “to develop citizens’ sense of ownership of their city, enhance the local authority’s awareness of their needs, and ultimately reshape the citizen-government relationship” (Nam and Pardo 2011). The ultimate objective is the co-coproduction of sustainable environments to achieve better quality of life (Ganapati and Reddick 2018).

The Concept of Coproduction

The concept of coproduction is seen as part of the New Public Governance paradigm which acknowledges the provision of public services as a more pluralistic model focused on networks and inter-organizational relationships (Bovaird and Loeffler 2012; Bracci et al. 2016). However, its definition is still a subject of concern in the public management research agenda due to its wide-ranging applicability and its somehow unclear distinction with related topics, such as collaborative governance, co-creation, civic engagement, citizens' participation, and so on (e.g., Bracci et al. 2016; Voorberg et al. 2014). Nevertheless, progress on the definition of coproduction was made in the last years (Brandsen and Honingh 2016; Nabatchi et al. 2017). In this chapter, the ground of understanding of the coproduction concept lies in the definition of Brandsen and Honingh (2016, p. 431):

Coproduction is a relationship between the employees of an organization and (groups of) individual citizens. It requires direct and active inputs from these citizens to the work of the organization. The professional is a paid employee of the organization, whereas the citizen receives compensation below market value or no compensation at all.

In addition, Nabatchi (Nabatchi et al. 2017) suggests some further clarifications on the definition of the coproducing actors. First, the *state* actors or “regular coproducers” are the professionals serving directly (e.g., government employees) or indirectly (e.g., employees of a nongovernmental organization, like a private company) in the government. Second, the lay actors or “citizen coproducers” are members of the community that voluntarily serve as citizens, clients, and/or customers. Therefore, coproduction involves the activities that public servants (in any sector) and services users/members of the community contribute to design, implement, and/or deliver public services (Pestoff et al. 2012), where all coproducing actors “make substantial resources contributions” (Bovaird 2007), co-creating public value, and/or private value (Alford 2009).

The Adoption of ICT to Coproduce

The ability and possibilities to perform coproduction activities have increased due to the new solutions brought by technological advances. Specifically, ICT-enabled coproduction comprises the coproducing activities that take place using varied ICTs, from web-based platforms and mobile applications to sensors and artificial intelligence (Clark et al. 2013; Fugini and Teimourikia 2016; Lember et al. 2019; Linders 2012). Moreover, ICT can indirectly affect coproduction by providing real-time access and exchange of information. At the same time, the adoption of new technological advances give government more opportunities citizens as coproducers in a transparent and open environment that provides feedback into governance (Nam and Pardo 2011).

The adoption of ICT in coproduction processes can also transform coproduction by scaling up the collection of citizens’ data (e.g., gamification strategies). Even technologies can substitute coproduction with fully (or partly) automated processes (e.g., predictive policing). In this vein, different technologies are strongly shaping coproduction processes: for instance, communication (e.g., mobile applications, wireless communications, online platforms), sensing (e.g., smart devices), actuation (e.g., 3D printing and robots), and processing technologies (e.g., Big Data analytics and AI) (Aceto et al. 2018; Lember et al. 2019). Yet, the wide array of technologies adopted for coproducing public services achieve different outcomes and present varying limitations (see section “[Potential Outcomes of ICT-Enabled Coproduction Through the Lenses of Public Values](#)”).

Characteristics of ICT-Enabled Coproduction

To further delineate our understanding of ICT-enabled coproduction, this section is drawn on the typology of smart city services developed by Lee and Lee (2014) and built around coproduction literature. As shown in Table 1, there are different main dimensions that define citizen-centric smart city services. These dimensions have been adapted in line with our understanding of coproduction enabled by digital technologies.

The first dimension is the type of approach, either top-down or bottom-up. With the inclusion of technologies in the coproduction process, the type of approach is even more relevant since citizens have more possibilities to not only engage but to lead the coproducing activities (e.g., Living Labs). Depending on who is going to play the initiator’s role, the coproduction initiative can be clustered into the two approaches.

The *top-down* approach refers to the (“traditional”) coproduction process led by the government or regular producers. For instance, *Apps from Antwerp* was an initiative launched by the city of Antwerp in 2016 and 2017 (Belgium) to encourage residents, students, companies, and visitors to develop mobile applications for a better city. The aim is to stimulate creativity and innovation while making things better for and in Antwerpen (Stad Antwerpen 2019).

On the other hand, the *bottom-up approach* highlights the “citizen power” since these initiatives are started by actors from outside government. Take the case of *Rodalía.info*, a real-time public transport information platform using data provided by service users regarding the local train services in Barcelona (Spain) (see www.rodalia.info). In addition, the collaboration may involve other actors, such as research bodies and NGOs to improve a public service or to create a new one (Skaržauskienė and Mačiulienė 2017) such as in the case of *CurieuzeNeuzen*, a citizen science project initiated by Flemish universities, and the Flemish regional government in 2018. In this project, 20.000 citizens were selected to measure the air quality near their own house. The aim was to acquire a detailed map of air quality in Flanders (see www.curieuzeneuzen.be).

Table 1 Dimensions of ICT-enabled coproduction of smart public services

Dimension	Definition	Categories
Approach	<i>Who initiated the coproduced service</i>	Top down
		Bottom-up
Level	<i>Number and type of actors involved</i>	Individual
		Collective
		Group
Service cycle	<i>Stage of the service delivery</i>	Design/Planning
		Execution/Implementation
		Monitoring/Evaluation
Provider vs. beneficiary	<i>Distribution of power and responsibility</i>	Citizen sourcing
		Government as a platform
Mode of technology	<i>How ICT changes the shape of services</i>	Informative
		Transformative
Delivery mode	<i>How services are being coproduced</i>	Interactive
Service authority	<i>Level of citizens' autonomy for coproducing the service</i>	Voluntary
ICT pillar	<i>Functionalities of the implemented ICT</i>	Communication
		Processing
		Actuation
		Sensing

Furthermore, as the definition of coproduction by Brandsen and Honingh (2016, p. 431) states, “[c]oproduction is a relationship between the employees of an organization and (groups of) individual citizens,” the involvement of citizens in the coproduction of public services can be individual, in group or collective. On the individual level of coproduction, a citizen collaborates directly with a regular producer, leading mainly to personal benefits. On the group level, one or more regular producers collaborate with a specific cluster of citizens (e.g., residents of a neighborhood). In this case, the main benefits can be either personal or societal. Finally, the collective level of coproduction entails the involvement of one or more regular producers within an organization or across multiple organizations (e.g., municipal council) and several citizens. The main difference between the collective and group level is that collective coproduction specifically aims for the provision of social benefits for an entire community.

Citizens can engage in the coproduction of different stages of the smart service management. Based on Bovaird and Loeffler (2012), on the one hand, the concept of coproduction reflects the activities of co-planning, co-prioritization, co-managing, co-delivery, and co-assessment. On the other hand, Nabatchi et al. (Nabatchi et al. 2017) refers to four phases of the service cycle: co-commissioning, co-designing, co-delivery, and co-assessment. In this chapter, however, we will further discuss the typology developed by Linders (2012) who specifically discusses citizen

coproduction in a digital setting. While her study is focused on the use of social media, the classification can be applied to other types of technologies.

First, Linders (2012) divides the stages of the service delivery into three clusters: design, day-to-day execution, and monitoring. The *design* phase involves both the planning and design of public services and is characterized by strategic decision-making. The *execution* phase includes the day-to-day activities while the *monitoring* phase covers an assessment process that entails the identification and correction of issues and the evaluation of the efficacy of the service with the aim to generate opportunities for improvement.

Second, Linders (2012) classifies the type of coproduction based on the provider versus beneficiary dimension, resulting in “Citizen-Sourcing,” “Government as platform,” and “Do It Yourself Government.” The latter, nevertheless, would not be considered as coproduction based on the abovementioned conceptualization (see section “[ICT-Enabled Coproduction](#)”) which indicates that coproduction entails at least the involvement of both citizens and regular producers.

Citizen sourcing can provide more functional services in the smart city by offering the “wisdom of the crowd” in order to deliver more citizen-centric services. Moreover, it can overcome some limitations concerning time and space through what is called “situated engagement.” Citizen sourcing is also expected to improve the relationships and communications between citizens and government by the share of knowledge (Wu 2017). Yet, to really exploit the advantages of involving citizens in the design, execution, and monitoring of public services, regular producers should allow a redistribution of power among the coproducing actors. For citizen sourcing efforts, this could mean citizens contributing not only with ideas and feedback, but also with other kind of resources such as time and behavior (Fledderus et al. 2015). In addition, citizen sourcing initiatives entail more complex processes and integrated information, and, therefore, poses challenges beyond technological aspects such as data risks and changes in governance processes (You et al. 2016).

Another type of ICT-enabled coproduction is known as *Government as Platform* (GaaP) wherein the government encourages people to actively engage in the co-design, co-execution, and co-evaluation of public services. GaaP illustrates the potential collaboration between citizens and regular producers in which governments are the source of information. That means that regular producers provide citizens with data to allow informed decisions and to increase citizens’ trust and legitimacy. As shown in Table 2, the way governments implement Citizen Sourcing and GaaP coproduction approaches will also depend on the public service’s stage (Linders 2012).

Other dimensions of smart public services relate to the mode of delivery of the coproduced public services and the authority. First, while Lee and Lee (2014) propose two modes, *passive* and *interactive*, only the latter concerns coproduction. However, with the inclusion of ICT in the coproduction process, the direct interaction is not necessarily face-to-face but remains interactive, being one of the valuable contributions of digital technologies. Second, to be considered coproduction, the involvement of citizens must be voluntary. Therefore, the “mandatory” characteristic

Table 2 Examples of ICT-enabled coproduction

	Citizen sourcing	Government as a platform
Design	Consultation and ideation <i>Examples:</i> eRulemaking, IdeaScale, eDemocracy	Informing and nudging <i>Examples:</i> Crime mapping, data mining
Execution	Crowdsourcing/co-delivery <i>Examples:</i> CrisisCommons, Challenge.gov , PeerToPatent, government-run wikis	Ecosystem embedding <i>Examples:</i> GPS, Gov open sourcing
Monitoring	Citizen reporting <i>Examples:</i> SeeClickFix, FixMyStreet	Open book government <i>Examples:</i> Data.gov, Recovery.gov

Note: Adapted from Linders (2012)

of smart services by Lee and Lee (2014) is disregarded (cf. Brudney and England 1983; Parks et al. 1981; Pestoff 2006).

ICT-enabled coproduction comprises the coproducing activities that take place using varied ICTs, from web-based platforms and mobile applications to sensors and artificial intelligence. In this sense, it is important to identify what Aceto et al. (2018) called “core technology pillars.” These pillars are defined according to the different functionalities of technology, but they can also overlap: *communication* defines the forms of interaction and dissemination of information as well as participation through, for instance, internet infrastructure, wireless communications, and mobile applications; *processing* is related to large-scale processing capabilities and some examples are Big Data analytics and AI; *actuation* can enclose more disruptive technologies such as 3D printing and robots; finally, *sensing* includes wearable devices, smart devices, sensing technology which are able to provide rich contextual data.

Finally, the technologies implemented for coproduction might assume different modes: automatic, informative, and transformative. The *informative* dimension refers to the use of ICT to improve the service by gathering information. The *transformative* dimension refers to the transformation of traditional processes into new services. Finally, the *automatic* dimension entails the replacement of the coproducing actors by automating processes.

The Process of ICT-Enabled Coproduction

The different dimensions discussed in the previous section together with the implementation of digital advances to coproduce might influence the traditional process of coproduction. Particularly, the adopted ICT(s) might have an impact on the coproducing actors’ interaction and motivations, the required resources, and the decision-making process (Lember et al. 2019). Therefore, in order to understand the potential of ICT-enabled coproduction in smart contexts, it is imperative to review the main elements of its process.

Direct Interaction Between the Coproducing Actors

Regular producers need to mobilize and activate citizens to coproduce successfully as well as take care of the conditions that enable better interaction among the coproducers (Steen and Tuurnas 2018). One of the contributions of digital technologies, as mentioned before, is that the direct interaction needed to coproduce is not necessarily face-to-face. Moreover, communication technologies allow to share and access information in real-time, and to adopt more user-friendly and citizen-centric forms of interaction. For instance, in the smart mobility sector, regular producers have also included gaming options allowing citizens to gain points due to the reporting of service-related issues via the mobile application (Lan et al. 2017). Also, regular producers adopt social media channels to improve the interactivity with citizens and to gather new ideas to accomplish the governments’ goals (Rodríguez Bolívar 2016).

However, declining physical interaction can also obstruct the interaction and collaboration between coproducing actors. In order to overcome these challenges, regular producers can facilitate the interaction with citizens by simplifying the coproduction tasks (Kennedy 2005), supporting the collaboration, coordinating the different actors’ interests, and more importantly, ensuring that value is co-realized (Alford 2002; Bovaird and Loeffler 2012; Lember et al. 2019).

Motivated Coproducing Actors

Citizens’ engagement in coproduction is ensured by a combination of their (self-centered and/or community-centered) motivations and capabilities. Saliency of the public service and the ease of becoming involved in the coproduction process are also important factors (Pestoff 2012; van Eijk and Steen 2016). In turn, regular producers’ engagement is influenced by their work environment, such as the level of autonomy, perceived organizational support, and red tape (van Eijk et al. 2019).

The adoption of communication technologies may help in motivating actors to coproduce by lowering the threshold to engage (Lember et al. 2019), since it enhances the speed and reach of communications, and promotes multilateral and rich information exchange between different actors (Fugini and Teimourikia 2016; Meijer 2016). Yet, ICTs might change the perception of personal competence by demanding new and specific skills to coproduce, which might lead to less motivation. Moreover, there is the pitfall that highly educated individuals will have better access and time to participate than other disadvantaged citizens (Rodríguez Müller et al. 2021). Therefore, when adopting ICT-enabled coproduction, regular producers need to overcome challenges related to the citizens’ willingness and capacity to coproduce. For instance, some strategies might involve the inclusion of gamification or the adoption offline activities to support the ICT-enabled coproduction initiatives (Le Blanc 2020; Susanto et al. 2017).

Shared Resources

Coproduction is about coordinating time and efforts of both regular producers and lay actors. It allows the government to combine citizens' resources with its own, which may further enhance government cost savings and better-personalized services (O'Reilly 2010; Linders 2012). Coproduction efforts will also require investment (e.g., personnel, expertise) and support from the regular producers and the political level for ICT-enabled coproduction to work effectively (Le Blanc 2020).

Citizens also provide expertise and information that is not available otherwise (Loeffler and Bovaird 2018). In this context, communication technologies can broaden up the scope of citizens' inputs (Lember et al. 2019). For instance, in a smart bike-sharing system, it was observed that citizen-users can voluntarily report service-related issues helping the provider to improve the service in terms of regulation of bikes, technical issues, and software problems (see section "ICT-Enabled Coproduction Initiatives").

Moreover, coproduction literature indicates that the coordination of expertise, knowledge, resources, technology, and processes contributes to better outcomes than when working independently (De Vries et al. 2016). However, with the growing involvement of private actors, due to their technological and financial capacity, the role of the government runs the risk of becoming ambiguous or disintermediated. This may be the product of private companies assuming government's tasks and functions, serving as intermediaries between the government and its citizens (Klievink and Janssen 2012; Ma et al. 2018; Rodriguez Müller and Steen 2019).

Joint Decision-Making Process

The last and more challenging aspect concerning the process of coproduction is the involvement of all coproducing actors in the decision-making process. As discussed before, coproduction challenges the traditional relationship between regular producers and citizens (Moynihan and Thomas 2013), while ICT may further change the game by giving citizens more independence and, at the same time, more responsibility. For instance, the mobile-app *Firedepartment* alerts citizens if someone nearby needs assistance, encouraging them to cooperate actively with the paramedics. They are responsible for indicating their level of training in cardiopulmonary resuscitation (CPR), and then, to provide CPR to the victim until the ambulance arrives (Paletti 2016). The potential redistribution of power will depend on the role assumed by the citizens, from active coproducers with full responsibilities to passive consumers (Lember et al. 2019). Yet, coproduction is criticized due to the possibility of the government offloading its responsibilities to the citizens-users. For instance, Linders (2012) points out that in ICT-based coproduction, the government might still hold the end responsibility. Furthermore, the implementation of ICT to coproduce may also redistribute power and control towards specific groups in society instead of towards citizens in general due to uneven access to/and or engagement in coproduction initiatives.

Potential Outcomes of ICT-Enabled Coproduction Through the Lenses of Public Values

ICT-based coproduction of public services is alleged to improve the realization of public values in the city through the collaboration between diverse stakeholders (De Vries et al. 2016; Lember et al. 2019). Public values theory is considered one of the most significant subjects in matters of public administration and policy (Jørgensen and Bozeman 2007). It refers to “the procedural ethics in producing public services [...] and outcomes made possible by producing public services” (Bryson et al. 2017, p. 451).

In this chapter, “public values” is understood as a normative concept used to give direction to the public action or to legitimize it (Witesman 2016), providing normative consensus about the rights and obligations of citizens, and “the principles on which governments and policies should be based” (Bozeman 2007 p. 17). As Aschhoff and Vogel (2018, p. 776) claim, “when co-production is successful, a service is “better” (in whatever terms; e.g., efficiency) than if it had been produced by a state actor alone.” In the same line, Meijer (2015) claims that “framing e-governance in terms of its contributions to society [the production of public values] is essential for its success” (p. 205), meaning that ICT-based coproduction of public services is also expected to be guided by the aim of using ICT to co-create public value. This implies that ICT is not value-neutral but instead has the potential for positive or negative impact on public values.

Although technology can “follow its own logic,” ICT users, including cities, are also responsible for the value embedded on the technologies and its outcomes (Bannister and Connolly 2014; Skaržauskienė and Mačiulienė 2017). Building on coproduction literature (Jaspers and Steen 2019), coproduction is expected to co-realize different public values that can be clustered into three groups:

- a. Public values related to the service delivery, such as efficiency, effectiveness, quality of the service, user satisfaction.
- b. Public values related to the relationship between citizens and regular producers, such as trust, accountability, responsiveness, transparency.
- c. Public values related to the democratic quality of the service delivery process, including empowerment, equity, social capital, diversity, inclusion.

In the smart city context, the implementation of ICT-enabled coproduction might entail the alteration of public expectations about the co-realization of public values. That means certain values like transparency, e-inclusion, and equality might get more relevant in digital settings. For instance, attitudes and expectations of citizens about the reliability and friendliness of a public sector platform change over time along with technological advances (Karkin et al. 2018).

Advantages of ICT-Enabled Coproduction

The technological advances have made co-production more feasible and relevant, both in terms of the way citizens can engage in the coproduction process and of the outcomes of such process (Johnston 2010; Le Blanc 2020). A classic example is *FixMyStreet*, a map-based website and mobile application used by people in the United Kingdom who want to report problems that need the attention of the local authority, such as potholes or broken streetlamps (Matthews et al. 2018). Another case of ICT-enabled coproduction is *AirCasting*, consisting of an open-source platform, which allows people to share health and environmental data using their smartphones that otherwise would be very difficult to gather. The collected data was used to inform personal decision-making and public policy (HabitatMap 2020).

Service quality can also be enhanced through expertise and information provided by citizens coproducers, that is not available otherwise (Loeffler and Bovaird 2018). Linders (2012, p. 451) assessed advances of ICT (in the context of coproduction) to provide unique means for real-time, community-wide coordination, “presenting tremendous opportunities for data-driven decision-making, improved performance management, and heightened accountability.” These initiatives can also improve the efficiency of processes, fasten response times, and make them more secure/reduce human errors. Since ICT-enabled coproduction allows the government to combine citizens’ resources with its own, it is seen as a way to enhance government cost savings and better-personalized services (O’Reilly 2010; Uppström and Lönn 2017).

Moreover, ICT-enabled coproduction is expected to increase inclusion, democracy, and participation as it might provide the same opportunities to different actors, empower people/foster local activism, unleash social innovation, and reinvigorate democracy (Linders 2012; O’Reilly 2010; Uppström and Lönn 2017). Some studies perceive digital initiatives as a way to bring the dispersed populations closer, allowing more citizen participation, and coproduction as a way to better democratic quality (Schwester 2009; Verschuere et al. 2018).

Challenges of ICT-Enabled Coproduction

The adoption of ICT in the public sector is not without controversies. For instance, the “digital divide,” referring to uneven access to, or use of ICT, is a well-known obstacle for inclusiveness. The “digital divide” – including digital gender inequality (Choi and Park 2013; van Doorn and van Zoonen 2008) as well as education and age-related inequality – implies that the already more empowered citizens will have better access, time, and skills to participate than other disadvantaged citizens (Lember 2017). Therefore, the reliance on a small and potentially unrepresentative segment of the population risks loss of legitimacy (Bovaird 2007), unequal access to public services, “empowering only the empowered” (Linders 2012).

In a recent study, we observed that the digital divide predicts user’s choice of traditional channels and e-government channels compared to new digital channels (Rodriguez Müller et al. 2021). The prevalence of using traditional channels while

cities are increasingly investing and adopting technological alternatives is puzzling, especially when this phenomenon is observed in smart services that are typically associated with a high uptake of digital channels (Castelnuovo 2019; Wu 2017).

Furthermore, the adoption of technological advances might direct the power and control towards particular social groups such as highly educated, ICT-skilled citizens (Reddick and Anthopoulos 2014; Rodriguez Müller et al. 2021). This scene illustrates the risk that governments replicate traditional paradigms, moving even further away from the citizen-centric approach aimed by smart cities initiatives (Lember 2017). As Castelnuovo (2018) claims, “irrespective of what the participation mechanisms implemented are and how innovative the tools that can be used are, in many cases participation is little more than a formality” (p. 115).

Finally, alike traditional coproduction, ICT-enabled coproduction is feared to include conflict between values being (potentially) co-created such as efficiency and effectiveness, yet here new tensions might arise such as between privacy and openness, or between the expense of setting up a digital platform and the long-term savings it offers (Rodriguez Müller and Steen 2019).

ICT-Enabled Coproduction Initiatives

The way to overcome the challenges and exploit the advantages and promises of ICT-enabled citizen coproduction will be contingent on the way the strategies are designed and implemented by the coproducing actors. As such, Webster and Leleux (2018) proposed a series of mechanisms to engage citizens in the coproduction of smart public services, including hackathons, living labs, faklabs, marker space, smart urban labs, citizens’ dashboard, gamification, open datasets, crowdsourcing, and online reporting. These types of mechanisms are examples of ICT-enabled coproduction strategies to engage citizens in the context of smart city initiatives.

In order to illustrate some of the possibilities of citizen ICT-enabled coproduction, two cases are briefly presented below. The first case concerns the citizen participatory process organized by the city of Leuven (Belgium), involving citizens as co-designers of public policy. The second case is about a smart bike-sharing system in Belgium, engaging citizens as co-monitors of the smart service.

The Case of “Leuven, Maak het Mee,” Belgium

In 2019, the city of Leuven (Belgium) launched their first large-scale citizen participatory initiative called “Leuven, maak het mee” (a wordplay that implies both experience and co-create the city in Dutch). The aim was to engage citizens as co-designers of the strategic multi-annual plan of the city (2020–2025) by gathering their ideas and proposals over 10 different topics. The topics were determined by the policy memorandum which was drawn up in consultation with experts and city officials. Three main goals were pointed out by the city: (a) to inform the citizens about the programs, show and explain the objectives clearly and raise

awareness; (b) to obtain commitment of the citizens by asking “how to achieve these objectives together?”; and (c) to make it concrete by obtaining new inputs to achieve the objectives (Rodriguez Müller 2021).

With the aim of reaching as many citizens as possible, the city implemented a digital participation platform as the project’s main channel. The platform was outsourced by CitizenLab, a Brussels-based SaaS start-up in civic tech. The company provides an online platform that can be used to engage citizens in a variety of initiatives, including participatory budgeting, survey and polling, voting, collection of ideas, among others. CitizenLab has been recognized as one of the Top European Social Impact start-ups since the launch of the platform in 2015 (2019, DT50 awards at the TechCrunch Disrupt conference, Berlin), and the Top “Digital and Inclusion” start-up awarded by VivaTech Paris and Métropole du Grand (2019) (CitizenLab 2020).

Within the initiative, citizens could post an idea, comment, or vote during the period of 6 weeks. They could directly participate through the online platform via the link www.leuvenmaakhetmee.be, with or without an account. The account would allow the city to send them newsletters, feedback from the ideas posted or liked, related events, among other information. When the idea was posted, other citizens could read, vote, and comment on them. In order to overcome challenges related to digital coproduction, such as the digital divide, the city also offered an offline opportunity for citizens to participate. Each resident received a postcard, which could be filled out with their ideas and sent back to the city without any cost (CitizenLab 2020; Rodriguez Müller 2021).

Between April 30th and June 9th, 2331 ideas were posted by citizens of which approximately 22% were collected through postcards and included later into the platform by the platform’s administrators (see more results in Table 3). As mentioned before, the ideas cover the ten priorities outlined by the political level in the policy memorandum for the 6-year governance term. The most popular topics were (smart) mobility, leading the group with 640 ideas gathered, followed by Streets and Squares ($n = 259$) and Nature and Biodiversity ($n = 213$). The topics with less citizens’ proposals were Technology ($n = 35$), Service Provision ($n = 54$), Citizenship ($n = 61$) and Employment, Economy and Trade ($n = 64$).

Although the platform has been implemented in other cities around the globe, Leuven was one of the first ones in providing personal feedback to each of the citizens who provided an idea or commented on an idea of other citizens. More than 96% (around 2238 ideas) of all gather ideas received official feedback by the administration of Leuven.

A systematic assessment was implemented to evaluate all the ideas gathered. Before being approved for implementation, in the context of the ten priorities established in the memorandum, citizens’ ideas had to pass two evaluation processes. First, the domain experts of each of the ten priorities needed to approve the idea based on its feasibility. Second, after collecting all the ideas (online and offline), domain experts read and bundled all the citizens’ proposals, and then presented them to the mayor and city council who decided if they match with the city goals. The city council had to approve the decisions of the domain experts, and later, the feedback to

Table 3 Results of “Leuven, maak het mee”

Indicator	Total
Registrations	3007
Citizens’ proposals	2331
Comments on proposals	2253
Votes on proposals	30,328

be provided to the citizens. Ten percent of the ideas were disregarded due to unfitness with the political vision of the city. Depending on the type of citizens’ proposals, some were taken by the unit responsible (such as mobility), and some ideas were selected to be later co-created with external stakeholders, including citizens (Rodriguez Müller 2021).

From the beginning of 2020 till 2025, the final ideas are expected to be implemented by the city. Therefore, conclusions concerning the actual impact of the participatory initiative on the decision-making process is still to be seen. Yet, new projects have already been started with the support of the online platform by other units of the city, such as *Buurtmobipunten* (Neighbourhood E-hubs) or *Beweegbanken* (Sport Benches) supported by the Sports Administration of the Flemish government. The continued use of the platform by the city to engage citizens shows that beyond the impact of “Leuven, maak het mee,” it has been a game changer for the role of citizens in the design and implementation of public policy and public services in the city.

The Case of “SmartBike,” Belgium

The second case concerns a smart bike-sharing service (hereafter SmartBike) located in one of the major cities in Flanders, Belgium. SmartBike was launched in 2011 by the Department of Urban Development of the city and provided by a private company who offers the service internationally. The aim of the city is to provide a more sustainable and healthy form of public transportation, available 24/7 and to offer a solution to the “first/last mile problem,” filling the missing links between the bus and tram networks (Rodriguez Müller and Steen 2019). The service has been growing and becoming even more popular since day one. It is one of the most “successful” smart bike-sharing systems in Belgium in terms of the growing number of users, currently having more than 60.000 active annual memberships. According to the latest data from the city’s open data portal, more than 80% of its inhabitants live within 5 min by foot from a SmartBike station.

The case is particularly interesting to illustrate the potential of ICT-enabled coproduction because of two aspects. First, the sharing feature of the service entails the engagement of multiple stakeholders and the “crowd,” while the “smart” aspect implies that the interactions between the coproducing actors and their context are redefined (Ma et al. 2018; Webster and Leleux 2018). Second, the service involves the engagement of citizens in coproduction efforts. SmartBike, with the aim to improve the efficiency of the service and responsiveness towards its users, engages

its users in the evaluation phase of the service management through a reporting system. Citizen-users can report service-related issues they experienced concerning the bikes and bike stations. The report-service is not part of the rules of the service, meaning that citizens have the right to choose how active they want to be. Besides the voluntary nature of the monitoring system, the number of citizens' reports reached 19,674 just in 2019.

To connect with most of its users, SmartBike offers a variety of reporting channels from traditional to new digital channels, such as visiting the office or making a call, email, website, and social media. Moreover, in order to gather better insights from the citizen-users and provide a better user experience, SmartBike launched a mobile application through which citizens can indicate more precisely the issue they are reporting, location, number of the bike or station, among other details (Rodriguez Müller and Steen 2019).

With the implementation of the mobile application, citizens could report issues in-situ and quickly on-the-go. This phenomenon is also known as "situated engagement" and it is one of the mobile's participation greatest promises (Ertiö et al. 2016). For instance, a study on citizen reporting of a smart public services shows that the reports made by the citizen-users using a mobile platform increased the percentage of resolved problems, leading to a more effective service provision (Allen et al. 2020).

However, it seems that traditional channels continue to be the most used by citizens over (new) digital channels to report service-related issues (Ebbbers and van de Wijngaert 2020). A recent study on SmartBike examined user-reporters actual behavior and found that the digital divide determinants, satisfaction with the mobile application and users' experience with the service can explain the users' choice of traditional and e-government channels over the newly implemented m-governments channels (Rodriguez Müller et al. 2021). Therefore, the strategy of SmartBike to present citizens both offline and online opportunities to engage in coproduction efforts presents an alternative to overcome some of the challenges posed by the digital divide.

To sum up, both cases present some of the opportunities and challenges of citizens' coproduction in different contexts, including citizens as co-designers and as co-monitors. The cases illustrate the potential of ICT-enabled coproduction while highlighting the need of offline opportunities for less tech-savvy citizens. In addition, the cases show the need for a reconfiguration of the role of citizens as they are both users and providers of the service' information (Docherty et al. 2018).

Concluding Remarks

Smart cities around the globe, aiming to improve smart public services, are confronted with the need to adopt a citizen-centric approach in order to overcome challenges such as resource constrains and lack of information. An alternative to overcome some of these challenges is the reliance on public service users through

coproduction efforts in the different stages of public service delivery, including service design, service execution, and service monitoring.

While we have presented two cases where citizens play an active role in the process of ICT-enabled coproduction of (smart) public services, this is not the case for most smart cities. In turn, the role of citizens in the conception, development, and governance of smart cities needs to be reconfigured. In this context, ICT-enabled citizen coproduction is presented as an attractive alternative for overcoming the challenges towards the building of truly citizen-centric initiatives (Cardullo and Kitchin 2019b).

Therefore, this chapter presented a thorough overview of ICT-enabled coproduction and its potential in the context of smart cities. A description of the characteristics of ICT-enabled coproduction, the different elements of the coproduction process, and its potential to enhance or obstruct the co-realization of public values was presented. Moreover, two cases were introduced as an illustration of some of the possibilities and challenges behind the engagement of citizens in digital coproduction initiatives.

While we have shown the main aspects of ICT-enabled coproduction in a smart city setting, there is a need for empirical evidence and action research to uncover the potential of ICT-enabled citizen coproduction to co-realize a citizen-centric smart city. In addition, there is a need to focus on diverse factors beyond technological factors, broadening the focus to social and institutional aspects. To sum up, the chapter outlines the surface of how relevant the convergence of smart cities and ICT-enabled citizen coproduction can be, and calls for further dialogue and in-depth analysis complementing the views exposed.

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