

# Co-production of Public Service and Information Technology: A Literature Review

Qianli Yuan

Department of Public Administration & Policy  
University at Albany SUNY, Albany, NY, U.S., qyuan@albany.edu

## ABSTRACT

Recent years have witnessed growing public administration practitioners' and researchers' interests in the involvement of citizens as co-producers of public service design and delivery. With advanced information and communication technologies (ICT) favoring multilateral interactivity and ubiquitous communication, governments are able to expand new opportunities for public service co-production. This literature review contributes to our understanding of current knowledge about the use of ICTs in co-production and the potential outcomes. The results of the review show three models of ICT-enabled co-production: (1) Citizen-sourcing; (2) Automatic Co-production; (3) Government as an Open Platform, each with its unique features in terms of citizens' contributions, citizens' capacities, and government openness. This review highlights future developments in electronic sensors and the use of data could lead to new approaches to co-production. ICT-enabled coproduction is promising to bring positive outcomes on public service provision and citizen engagement, yet the effectiveness of those practices is conditioned on factors both inside and outside government organizations. The review also indicates that ICT-enabled co-production is not a panacea and potential dark sides need to be acknowledged. Future research needs to address critical drivers and barriers for governments to utilize different models of ICT-enabled coproduction as well as to evaluate the outcomes of those practices in multiple contexts.

## CCS CONCEPTS

- Human-centered computing-Computer supported cooperative work

## KEYWORDS

Co-production, Information and Communication Technology, Public Service, Citizen-sourcing, Automatic Co-production, Open Platform

---

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from [permissions@acm.org](mailto:permissions@acm.org).

*dg.o 2019, June 18, 2019, Dubai, United Arab Emirates*

© 2019 Association for Computing Machinery.

ACM ISBN 978-1-4503-7204-6/19/06...\$15.00

<https://doi.org/10.1145/3325112.3325232>

## ACM Reference format:

Qianli Yuan. 2019. Co-production of Public Service and Information Technology: A Literature Review. In *Proceedings of dg.o 2019: 20th Annual International Conference on Digital Government Research (dg.o 2019)*, June 18, 2019, Dubai, United Arab Emirates. ACM, New York, NY, USA, 10 pages. <https://doi.org/10.1145/3325112.3325232>

## 1 Introduction

The concept of co-production has been around for decades since it was first raised by Elinor Ostrom in the 1970s. It can be loosely defined as government engaging with citizens who make substantive contributions in the service design and service delivery process [7, 65]. In recent years, this concept has experienced a revival [85]. Research in public administration has paid increasing attention to the involvement of citizens and other relevant stakeholders in the creation and production of public services. Such growing interests come from the recognition that public services are no longer provided simply by professional and managerial staff in public agencies but are designed and delivered through coordination among multiple actors from the public, private, and non-profit sectors [7]. Facing increasingly complex social problems, uprising public needs and expectations, as well as decreasing fiscal capacity, governments have re-discovered citizens as an important actor with a responsibility to make public service design and delivery more efficient, effective and democratic [85].

Citizens are no longer passive recipients of public services but play proactive roles as co-producers in public service provision to achieve service efficiency and effectiveness [10, 55]. By closely connecting with citizens, governments can not only utilize their intelligence and resources to strengthen organizational capacity for public service provision but also change the relationship between two parties to ensure accountability [85]. Recent studies have further emphasized co-production as intrinsic to public services and recognized the significant role of citizens in the public service provision [5].

Advances in information and communication technology (ICT) have made far easier for public employees to interact with citizens, both individually and collectively, and give rise to a new possibility of public service co-production [45, 56]. Web 2.0 technology, featured by social media, could provide an online platform for interactions between government and citizens through various models of content generation and information sharing [18]. Mobile technology could offer citizens additional

channels to communicate with governments almost anywhere and anytime [62]. These features of ICTs drastically reduce costs for large-scale citizen engagement, break the organizational boundaries, and help public agencies to establish dynamic relationships with citizens that are potentially resourceful for co-production [23]. As those ICTs favoring interactivity, openness, and participation, governments can tap into collective intelligence by soliciting ideas, solutions, and information from a wide range of public service users and citizens, which enables co-production that could hardly be created offline [56].

While the use of ICTs has facilitated citizen engagement in co-production of public services, those ICT-enabled initiatives of co-production have not been widely studied. This spurs a need for more research on this topic. Therefore, it is legitimate to have an understanding of current knowledge about ICT-enabled co-production of public services. By conducting a literature review, this paper aims to show the main issues addressed in the current studies and to point out implications for future research. Particularly, this review will focus on the two research questions: (1) How do governments use ICTs to engage citizens for co-production of public services? (2) What are the outcomes and impacts of ICT-enabled co-production? The rest of the paper is organized as follows: the second section will present the concept of public service co-production. Next, the paper will describe the method for this literature review. Then, the review will present the main results in the fourth section. Finally, the paper will provide discussion and conclusion of findings from the literature review as well as directions for future research.

## 2 Co-production of Public Services and Promises of ICTs

There is a lot of heterogeneity in the meaning of co-production among different studies and scholars [65, 85]. In its initial formulation, co-production is defined as “the process through which inputs used to provide a good or service are contributed by individuals who are not in the same organization” [70]. Some studies define co-production as the direct involvement of citizens as consumers or clients in the delivery of public service with government professional producers to enhance service quality and quantity [13]. Others refer to any active and voluntary behavior by citizens, which is conjoint with professional service production, to enhance quality and quantity [1]. In essence, co-production is an interactive process through which the providers and users of public services apply their different resources and capabilities in its production and delivery [1]. The core element in co-production is a relationship between a paid employee of an organization and (groups of) individual citizens that requires a direct and active contribution from these citizens to the work of the organization for public services [12].

Scholars have identified a variety of actors involved and their roles in co-production of public services [7]. On the professional side, studies show that those actors include not only public employees within government organizations, but also non-government entities that represent public organizations such as a nonprofit, civil society, or private organization [65]. On the co-

producers side, studies find that citizens can engage in the co-production as clients, volunteers, or members of a community [2]. Citizen act as consumers or clients in co-production for personal interests, while as members of a community for collective benefits. Other studies mention that citizens can participate in different stages of public service provision in addition to delivery. Bovaird and Löffler [7] identify a wide range of service activities that co-producers can participate and find citizens can act as co-initiators, co-designers, co-implementers, and co-assessors of public services provision. Some authors suggest that citizens can participate in co-production both individually and collectively [13]. Other studies examine the level of co-producers’ responsibility and found that co-producers can complement, supplement, or even substitute professional regular producers [68, 73]. Brandsen and Honingh [11] found co-producers participate in complementary and non-complementary tasks.

The concept of co-production is related to participation and engagement. It resonates with a gathering interest in citizen participation in decision-making, however, co-production takes participation a stage further emphasizing citizen involvement in the implementation of public policy and services as well as its formulation and design [88]. While the activities of participation are often related to voting, deliberation, decision-making, campaign, petition, and consultation in the political realm [54], co-production refers to activities of public service design and delivery which include the interaction between citizens and administrative organizations [73]. Some studies mention that participation aims to enhance the representation of citizens, while co-production seeks to find feedbacks, expertise, and knowledge that can directly shape service provision [12]. Other studies argue that co-production focuses on building a more cooperative relationship between government and citizens to conduct joint action, whereas participation mainly involves communication processes with joint decision-making [50, 76].

Those ICTs offer a number of advantages for fostering co-production of public service. Advanced ICTs are able to decrease the costs of engaging citizens compared to current practices through mass media or face-to-face contacts [57]. They enable information dissemination on a large scale and to build new connections with citizens regardless of geographic constraints [23, 25]. A many-to-many interaction network can be established between governments and citizens to foster information and resource exchange for public service co-production [62]. Rapid information exchange and government-citizen interaction can facilitate real-time citizens’ contributions to the production of public service, especially for emergency situations [16]. Further, some ICTs offer platforms to link and aggregate actors, information, and resources together for collective intelligence that enhances the co-production of public service [36, 58]. Overall, the advent of those ICTs’ multilateral interactivity and ubiquitous communications may not only create new communicative opportunities for citizens to engage in public service provision but also enhance government capacity to effectively connect with citizens and manage their contributions for co-production [46, 72].

### 3 Research Method

To understand current knowledge about public service co-production with ICTs, a literature review is conducted. Since ICT-enabled co-production is still an underdeveloped topic, a qualitative method is applied to analyze the main issues addressed in current studies. Particularly, this review will focus on the two research questions: (1) How do governments use ICTs to engage citizens for co-production of public services? (2) What are the outcomes and impacts of ICT-enabled co-production?

The first step of this literature review is to search for and collect relevant academic studies. Multiple academic databases were selected to search for articles, namely: Ebsco Academic Search Complete, Ebsco Business Source Complete, Public Administration Abstracts, Social Sciences Full Text, Library, Information Science & Technology Abstracts (LISTA), and PAIS Archive. This review conducted two rounds of literature search. First, the author used the keywords “information and communication technology” plus “co-production OR coproduction” to search for relevant articles. This resulted in 71 records from those databases. Second, the author conducted another round of literature search to capture studies investigating ICT-enabled co-production initiatives but using different terms. Recognizing the concept of co-production is related to participation, the keywords used in the second round were “information and communication technology” plus “govern\*” plus “engagement OR involvement OR participation OR collaboration” minus “political OR politics”. This resulted in 1970 records from those databases. Academic journal papers and conference articles published between 2000 and 2018 were included in this literature review. Manual selection was then conducted to eliminate the duplicated articles and those are not relevant to the topic of using ICTs in co-production. Following this procedure, 157 academic papers were selected for further analysis. The excluded studies are mainly about government and citizen communication, political participation, non-digital co-production and collaboration, and e-government development in general.

The second step of the literature review is to conduct qualitative analysis to identify different ways of using ICTs in co-production and potential impacts of ICT-enabled co-production. Qualitative analysis is selected since the use of ICTs has not been explored as widely as other topics about co-production. The author adopted an inductive strategy to analyze and code the main issues and arguments in those articles. With this analysis approach, codes and themes were emerged from those papers and were further categorized to show current knowledge about ICT-enabled co-production. Initial codes from the literature demonstrated a variety of technologies and information used, citizens’ activities and contributions, government’s roles, purposes of ICT-enabled co-production, and their potential outcomes. Those codes were further categorized, and their meaning was evaluated by another scholar. Eventually, the analysis revealed multiple objectives of ICT-enabled co-

production, three models of practices, and two potential outcomes of such practices.

### 4 Objectives of Using ICTs in Co-production

Using advanced ICTs for public service co-production with citizens, current studies suggest that governments often seek to achieve objectives related to efficiency, effectiveness, engagement, and inclusiveness [45, 86].

First, current studies suggest that the use of ICTs in coproduction could improve the efficiency and effectiveness of public service provision. Facing decreasing budgetary availability and increasing public service demands, governments select co-production as an approach for addressing fiscal pressures that limit their ability to provide public service efficiently and effectively to targeted citizens [7, 28, 81]. It is expected that co-production enables governments to bring citizen resources such as time and knowledge to cut down on public spending and complement in-house expertise for service design and delivery. Governments use ICTs to further reduce the cost of information sharing as well as to scale-up networks of public involvement for co-production with low expenditure [9]. With the help of ICTs, governments also aim to exploit large amounts of content and knowledge from citizens for better understanding of public needs and opinions, which better informs public employees of service delivery deficiencies, further refines strategies for public service provision and gains enhanced capacity to execute those strategies [35].

In addition to public service effectiveness and efficiency, other studies argue that the involvement of citizens is a virtue in itself and thereby co-production as a process is a goal in itself. Governments simply seek to create new ways of democratic participation and interaction with a wide range of citizens through the co-production of public service [86]. The adoption of ICTs for co-production further helps to reduce the democratic deficits that usually alienate citizens from the action of public organizations when they provide services that cannot be used by citizens. Governments use ICTs to create channels for open dialogue with ordinary citizens [30] as well as to reach populations who might not otherwise encounter the opportunities to address specific concerns and interests [5]. Potentially, such practices could create an online community and empower individual citizens in public service provision. In this sense, the use of ICT-enabled co-production seeks to transform government structure, process, as well as the model of public management toward a more citizen-centric and participatory approach [18].

However, some studies show governments could use ICTs rhetorically for co-production to improve their legitimacy and perceived image that citizens have of governments [74]. This symbolic use of ICT-enabled co-production seems to be preferred in the public sector as it maintains decision-making processes unchanged but appears to involve citizens to provide public service democratically. Governments may use ICT-enabled co-production without substantive redistribution of power and

responsibilities with citizens or without considering the results of citizens' contributions [15, 46]. One of the key reasons for this symbolic use of ICT-enabled co-production is the costs for a higher level of citizen engagement. Not all governments have the willingness to bear the costs of utilizing ICT-enabled co-production [19].

In this regard, governments' objectives and intentions to engage citizens for co-production of public service can vary substantially. This implies that different levels of government-citizen interaction occur during co-production. Depending on the objectives, governments can choose specific ICTs for a certain degree of interaction with the general citizens. The dynamic relationships and combinations among governments, citizens, and the use of ICTs lead to multiple models of ICT-enabled co-production in which citizens play various roles and share different responsibility for public service design and delivery.

## 5 Models of ICT-enabled Co-production

The development of ICTs leads to a variety of technologies that are used in co-production and enable government to engage and build interaction with a wide range of citizens in a distributed manner. Previous studies have mentioned several major types of those technologies or information, such as social media, mobile applications, and online collaborative platforms [27, 31, 56]. Recent studies further find electronic sensors are becoming more central to the ways citizen engage in the public service provision [14], while open government data could also allow new interactions between government and society that facilitate citizens' contribution to public service provision [52]. The use of those technologies and data enables citizens to play various roles during public service design and delivery. Current studies show three models of ICT-enabled co-production: (1) Citizen-sourcing, (2) Automatic Co-production, (3) Government as an Open Platform.

### 5.1 Citizen-sourcing

Citizen-sourcing refers to situations where government organizations make an open call to a large community of citizens to exploit the skills needed for tasks of public service that are normally performed by public employees [8, 9]. Typically, governments have a defined task or problem and offer an online request to distributed citizens for their contributions to this task. Using online platforms, governments can collect and aggregate citizens' inputs as crowd wisdom to provide a comprehensive view of public needs, to find a better solution, and to improve quality of public service provision [19, 39]. Studies show that the craft of the task and the commitment to utilize citizens' contributions are the responsibility of governments, while an online community of citizens contributes their effort to public service provision [9]. This model of ICT-enabled co-production can be regarded as an additive approach to traditional public service provision, drawing on the creativity and intelligence of an online community.

Studies find that citizens mainly act as a source of local information, knowledge or other human resources that are not available inside government organizations [66]. Depending on the complexity of tasks, the scale of their contribution varies considerably from minimal participation for micro-tasks of data acquisition to intense participation for the design of solutions [19]. Dutton [28] shows that how citizens make contributions during co-production is also related to their capabilities and expertise. In a distributed problem-solving network, ordinary citizens express their opinions and feedbacks during online consultation, while citizen experts contribute their in-depth knowledge and understanding of a concerned issue in the local area. Those contributions add to professional expertise inside government organizations and enrich governments' knowledge about local service provision problems [35, 36]. In this model, citizens' contributions are mainly related to the domain of information or knowledge provision, yet their influence over final results of public service provision is limited [33, 39].

Previous studies have found several examples of citizen-sourcing for the design of public service [42]. For instance, U.S. federal government has launched an online platform, Challenge.gov, for agencies to host challenges and contests to engage citizens and other external actors for innovative designs and solutions to public services in areas such as health, banking, education, transportation, or other pressing issues [59, 61]. Individual or group of citizens can submit their ideas or solutions to challenges posed by federal agencies on the platform and further involve in the design and evaluation of other solutions. Mueller et al. [63] used the term "Citizen Design Science" to describe this strategy which allows bottom-up citizens' local knowledge to be transformed as inputs in the design of public service.

Such ICT-enabled co-production has been applied to multiple areas of public service delivery [29, 64, 69]. For instance, Chatfield Scholl and Brajawidagda [16] found local governments engaged individual Twitter account followers as co-producers to enlarge the size of the information network for providing time-critical public information services. In other cases, the 311 systems in multiple cities enable local governments to engage citizens as "detectors" or "reporters" of the problems facing the city [34, 43]. Citizens are encouraged to submit service requests to government through such ICT platforms and local governments can take advantage of those requests as information inputs to adjust their public employee dispatch and thus increase service quality [57]. Another example, Peer-to-Patent, opens the patent examination process up to external citizen experts who review pending patent applications and provide input and feedback into the process of assessing patent claims [69].

### 5.2 Automatic Co-production

Automatic co-production refers to a model of ICT-enabled co-production where government organizations use smart technologies such as electronic sensors, Internet of Things, application programming interface (API) that allow automatic information and data transmission from citizens to government

organizations for public service provision [45]. Using those advanced sensor technologies, studies show that government organizations can automatically receive real-time feedback about public services to enrich information needed for improvement in design and delivery [3]. Studies also show that government organizations, with the help of algorithm-based decision-making models, can draw conclusions about needs, issues, opinions, arguments and proposals raised by citizens based on the real-time feedback they received to further improve public service provision [51]. In this model, government organizations rely heavily on the use of advanced technologies to collect critical information and data that support public services.

In this model, studies show that citizens mainly act as a source of information that contributes to government organizations in-house expertise and knowledge. Yet, citizens' mere presence and action in the public spaces is sufficient to provide potentially valuable information for public service production [14]. Through those advanced sensor technologies, government can gather information and data from citizens opportunistically, with almost no active participation or consent by citizens [24]. Citizens' active participation is no longer required for co-production while electronic sensors start to play a more central role in the process of information sharing and data transmission. The use of those technologies could drastically reduce the human effort needed to participate and make co-production much easier for citizens. Lember [45] argues that the development of electronic sensors can replace traditional (human-centric) co-production with an automated one.

Previous studies have found several initiatives of using electronic sensors in co-production. Some studies show that mobile or wearable sensors allow citizens to report their own information to government organizations. According to Chessa et al. [17], a crowdsensing application transforms a smartphone into part of a (large-scale) mobile sensor network in which citizens contribute their own information. Some studies show that those sensors can continuously transmit data and information once activated by citizens [19]. For instance, citizens in Boston use a mobile app called Street Bump that collects data about potholes and other road problems and automatically reports this data to the City so that it can make the necessary repairs. The application sends a GPS-located report to the city with the goal of creating a map of potholes to improve road repair efficiency. Other authors suggest some sensors automatically transmits data without the knowledge of the citizens involved in this data production [45]. One example is the increasing use of remote health-monitoring sensors that can provide 24/7 real-time and automated feedback about the health conditions of the patient [4]. The data are made available to the patient and their caregivers and healthcare providers to improve health service delivery.

### 5.3 Government as an Open Platform

Government as an open platform refers to a model of co-production where government organizations share public data

with a large community of tech-savvy citizens to create or improve solutions to public service provision. Without a narrowly defined task or problem, studies show that governments act as platforms to bring together data, citizens, and other stakeholders to exploit inputs for public services or problems that they have never thought about [45, 89]. By releasing government data, governments can facilitate citizens' access to public datasets, establish direct interaction with citizens, and collaboratively transform government data to value-added public services [32, 44]. Cordella and Paletti [23] argue that the entire production process is open to external actors, and there is little possibility for governments to control and pre-define the final outcomes. Instead, governments can play critical roles as enablers and brokers rather than fixers to facilitate citizen participation, to leverage citizens' abilities, and to coordinate collective contributions to public service production [27, 67].

In this model, studies find citizens act as partners to work collaboratively with public employees on the design and delivery of public service [27]. They are empowered to leverage vast stores of open data for public service provision [45, 82]. Concilio, Molinari, and Morelli [22] find that tech-savvy citizens are able to utilize open government data to generate potential ideas or prototypes to public services which could be further incubated into fully functional digital products with partners from governments or other private companies. Other studies show that those citizens with IT background often work as a community and collaborate in loosed networks to leverage open government data for the development of innovative mobile applications that meet citizens' needs [23, 87]. Studies suggest that such a group of highly motivated tech-savvy individuals could provide solutions or products potentially superior in quality and quantity to those produced by in-house professionals [51]. Their contribution may create additional options for public services and decide how to make them available to the community [15].

Several governments have initiated an open platform to engage citizens for co-production during public service design and delivery [37, 41]. This model is often organized in a form of innovation contest or app challenge. For example, New York City runs The NYC BigApps, a software application developer contest, which allows individual and group of citizens to create innovative mobile apps using government data for public service in the fields of transportation, health, education, or other important issues [26]. The winners of this competition can further incubate the apps with financial and technical support from the city government or other private companies. Other studies suggest such a model of ICT-enabled co-production allows citizens to self-organize activities for creating solutions to public service provision with the support of local governments [75]. Local IT developer communities, such as Code for America, voluntarily organize civic hackathons to utilize government open data for innovative technological applications that meet citizens' needs [53].

**Table 1: Comparison of Three Models of ICT-enabled Co-production**

	Citizen-sourcing	Automatic Co-production	Government as an Open Platform
ICTs Used	Social media, Mobile apps, Collaborative platforms	Electronic sensors, Internet of Things, API	Open government data portals
Purpose of ICTs	Information Reporting	Information Collection and Processing	Information Sharing
Citizens' Contribution	Experiential Information; Local Knowledge; Ideas	Behavioral Information; Personal Data	Complete Solutions; Professional Expertise
Required Human Effort	Moderate	Low	High
Required Capacity	Low	Low	High
Government Openness	Less	Less	More
Service Design	Challenge.gov	Social Media API	NYC BigApps Competition
Service Delivery	311 Systems; Peer-to-Patent	Boston Street Bump; Remote Health Care	Code for America

Table 1 shows the different features and characteristics of the three models of ICT-enabled co-production. Comparing these practices and initiatives, the result shows that the use of different technologies could lead to multiple types of citizens' contributions, different requirements for citizens' capacities and human efforts, and various levels of government openness. Among three models, citizens mainly contribute information, data, ideas, and knowledge to government organizations in the model of citizen-sourcing and automatic co-production, while citizens make prototypes or initial designs of digital solutions to public services in the model of government as an open platform. Citizens need the lowest human effort in the model of automatic co-production as advanced sensor technologies could potentially replace active human effort and play a more central role in the process of information collection and processing. Highest level of human effort is required in the model of open platform since citizens act as partners to work collaboratively with public employees through the whole co-production process of transforming government data into value-added public services. The average requirements of citizens' capacity to make

contributions are also relatively lower in the citizen-sourcing and automatic co-production than government as an open platform. Therefore, government organizations seem to have a higher level of openness to the general citizens in the model of open platform than in the other two models.

## 6 Outcomes of ICT-enabled Co-production

Current studies have also started to discuss the outcomes of ICT-enabled co-production. This section will mainly demonstrate the current understanding of outcomes and impacts on the quality of public service provision and on citizen engagement and empowerment.

### 6.1 Outcomes on Public Service Provision

Several studies suggest that ICT-enabled co-production can improve the effectiveness and efficiency of public service provision. Some evidence shows that ICT-enabled co-production increases service efficiency by reducing organizational inputs or by increasing organizational outputs [49, 57]. Studies have found that governments have reduced staff costs and other public spending to design online service applications when they co-produce them with citizens [79]. Other studies in emergency response demonstrate citizen-sourcing increases the speed of disseminating time-critical public information to a wide range of population at little extra cost [16]. Also, ground-level reports from citizens have increased the speed to evaluate local needs when information collection is challenging at the beginning of an emergency response effort [38]. Studies also find that ICT-enabled co-production improves service quality, resulting from incorporation of citizens' resources to complement professionals' expertise. Evidence shows that professionals acquire valuable insights into critical service expectations, identify key issues perceived by citizens, and tailor public service to citizens' needs, which leads to higher levels of citizen satisfaction [21, 80]. Citizens' innovative ideas help governments to tackle unresolved wicked challenges that public employees do not fully know solutions [9, 47].

However, the effect of ICT-enabled co-production on public service effectiveness and efficiency seems to be dependent on the quality of citizens' contributions. See et al. [78] provides evidence to show that information provided by nonexpert participants was as reliable as the information provided by experts. Yet, studies show mixed results when participants are asked to generate innovative ideas through open calls [48]. Evidence shows that citizens' contributions score relatively low on innovativeness, which indicates that ideation through citizen-sourcing does not yield radical or breakthrough ideas for public service innovation [77]. Such constraints for innovation-oriented outcomes may be caused by the relatively limited capacity of citizens who overall have less expert knowledge [60]. In addition, evidence suggests that trivial, nonimportant, or unjustified problem reports unnecessarily increase the burden of governments and may reduce the overall effectiveness of public service provision [43].

The positive effect on public service effectiveness and efficiency seems also related to governments' commitment and capability to absorb citizens' contributions. Evidence shows that ICT-enabled co-production contributes to improving public service quality in the context where public employees take citizens' contributions seriously into account [36], while such positive effects do not sustain over time when public employees fail to internalize citizens' contributions [35]. Governments' failure to implement citizens' ideas or proposals could discourage citizen engagement and valuable inputs in the future [74]. Other studies show that public employees often find it challenging to fully utilize or integrate citizens' contributions in public service design and delivery [42]. Studies suggest that coordinating citizens' contributions certainly has a cost for ICT platform maintenance, verifying citizen reports, or staff training that might drain resources from professional administrative work [38, 43]. Governments need to have enough willingness and capacity to bear the cost so that citizens' contributions can be synergized with their professional expertise for better public service quality [28].

## 6.2 Outcomes on citizen engagement and empowerment

Those practices of ICT-enabled co-production are also regarded as a useful approach to promoting public participation and citizen engagement in public service provision. Studies have provided evidence to show that such co-production offers an effective way for general citizens to have a voice in the public decisions that impact their lives and to hold administrators accountable [35, 83]. Other studies suggest that ICT-enabled co-production offers a much wider reach of more citizens (representatives of affected citizens' groups and individuals) in comparison with the traditional methods [20]. In addition, some evidence shows that ICT platforms help to strengthen a social capital building by creating an online community of citizens who have a shared identity and value for active citizenship due to similar needs and increased trust [56, 79]. Such practices also facilitate multidisciplinary collaboration between the public and the state. Linders [46] suggests ICT-enabled co-production transforms the relationship between government and citizens as the two parties start to share sovereignty and responsibilities.

However, there still exist challenges and limitations in ICT-enabled co-production to achieve fully effective citizen engagement. There is yet limited systemic evidence available about the impact of ICT-enabled co-production on citizen empowerment or responsibility relocation [33, 45]. Some evidence suggests that local governments select a symbolic adoption of citizen-sourcing initiatives so that they maintain decision-making process unchanged and improve the legitimacy and the perceived image that citizens have of governments [66, 74]. One of the main challenges comes from significant skepticism among public employees toward the idea of empowered citizen participation [83]. They as professionals may become reluctant to give up control and contend that their own expertise is more important than knowledge from lay people

[84]. Their trust in the behaviors and decisions of ordinary citizens could be low [40]. The ability of ICT-enabled co-production to effectively empower citizens is largely determined by the local context—that is, the social and political relations that link or divide individuals, groups, and institutions.

There are also drawbacks observed in the literature regarding ICT-enabled co-production. Some studies suggest that such co-production practices appear to raise issues in equity, inclusiveness, and representativeness. Pak et al. [71] revealed citizen-sourcing tends to marginalize citizens of certain ethnicities as well as those with lower incomes. Yet, such negative effect is not supported in other studies. For instance, Clark and Brudney [20] find no evidence that citizen-sourcing will neglect vulnerable social groups in general. Nevertheless, accessibility to new technologies is unevenly distributed in society, where the educated professionals have more skills and time to engage with ICT-enabled co-production than many other social groups [6, 31]. Only a small portion of the U.S. population are active online content contributors who can potentially become co-producers. This ICT-enabled co-production may risk empowering specific social groups—wealthier, better educated and non-minority citizens—who are more willing and able to engage in co-production.

## 7 Discussion

The advent of interactive ICTs has created new opportunities for governments to communicate with citizens. It appears that those advances in ICTs have further accelerated the transition from traditional governance modes to coproduction as a new mode of public service provision. By reviewing current studies regarding ICT-enabled co-production, this paper shows that there is a variety of technologies used to engage citizens for co-production of public services. Current studies show three models of ICT-enabled co-production: (1) Citizen-sourcing, (2) Automatic Co-production, and (3) Government as an Open Platform. It is expected that those practices of ICT-enabled co-production could improve the effectiveness and efficiency of public service and promote public participation and citizen empowerment. However, there is limited systemic evidence available to show the actual impacts of ICT-enabled co-production. Some studies suggest drawbacks of those practices in terms of the digital divide.

This review contributes to our understanding of current knowledge about how governments use ICTs to engage citizens for co-production of public services. First, the results of the review highlight the use of electronic sensors or automatic systems with sophisticated techniques and algorithms to generate a new approach to co-production in addition to online platforms with simple technological components. This indicates that novice developments in ICTs could further facilitate new opportunities to engage citizens in co-production. While most of the current studies focus on the model of citizen-sourcing [62, 66], new ICT initiatives for co-production are emerging and researchers need to pay more attention. Moreover, the review

indicates that those edging technologies are becoming more central to the ways in which citizens engage with public service provision. Their roles as co-producers may further change in the case of more complicated technologies for automatic information collection and analysis. Second, this review indicates the importance of data in addition to technological artifacts for citizen engagement in co-production. Information sharing is a critical purpose for using ICTs in co-production. In the model of citizen-sourcing and automatic co-production, citizens' information and data are collected and analyzed for public service provision. Recently, ICT-enabled co-production starts to release government data to lure citizen engagement. With an increasing amount of available information and data from both citizen side and government side, it is important for future co-production practices to further utilize those data resources to produce better public services. Citizens could play different roles in the information collection and utilization processes in co-production of public services.

This review also contributes to our understanding of the potential outcomes of ICT-enabled co-production. Our findings show mixed results about the impacts of ICT-enabled co-production. Although the overall mood is highly optimistic and the preliminary evidence demonstrating the positive outcomes is increasing, the effects of ICT-enabled co-production seem to be conditioned on a variety of factors both inside and outside government organizations. As governments use ICTs for co-production and open themselves for citizens' contributions, they also introduce uncertainty in the quality of inputs and undeniable cost of implementation [23, 49]. The positive effects of ICT-enabled co-production are, therefore, influenced by to what extent governments can mitigate those risks and manage dynamic interaction with citizens. To effectively manage those risks and costs is further related to government capacities determined by its internal and external factors, such as managerial leadership, political commitment, policy framework, and technological infrastructure. In addition, researchers cannot ignore the potential dark side of those ICTs in co-production. New risks and challenges are arising from the implementation of ICTs in co-production. Besides potential issues of equity and representativeness caused by "digital divide", other ICT-induced concerns include personal privacy, information security, misuse of government data, and biased open data [62, 90]. Those negative side of ICTs may risk resulting in the negative effect of public service provision and even intensifying the problems in non-digital co-production. Future studies need to further throw light on the actual impacts and outcomes of ICT-enabled co-production and identify critical factors to facilitate positive effects.

This review could further produce implications for government practitioners. First, the review shows multiple models of ICT-enabled co-production that government organizations could choose from. Using ICTs in co-production requires governments to play roles different from traditional public service provision and to complete necessary organizational transformation. A specific model may only fit for certain public services and contexts. When selecting a model of

ICT-enabled co-production, public employees need to take both citizens' and governments' characteristics into consideration. When governments utilize a certain co-production model, they need to align the activities with citizens' capacities, government roles, and features of public services. Second, the review indicates that ICT-enabled co-production is not a panacea for current problems in public service provision. Practitioners need to acknowledge potential risks and dark sides of utilizing ICTs. To further effectively engage citizens in co-production, government organizations need to further manage and guide the processes of online communication and information sharing with citizens.

## 8 Conclusion

Advances in ICTs featuring interactivity and participation have created new opportunities for citizen engagement and raised researchers' attention to ICT-enabled co-production of public service. This paper contributes to our understanding of current knowledge about the use of ICTs in co-production and the potential outcomes. By reviewing current studies, this paper has identified three models of ICT-enabled co-production: (1) Citizen-sourcing; (2) Automatic Co-production; (3) Government as an Open Platform. Each model has unique features in terms of citizens' contributions, citizens' capacities, and government openness. The review highlights that future developments in innovative ICTs and the use of data could further facilitate new approaches to engage citizens in co-production. Evidence showing positive outcomes on public service provision and citizen engagement is increasing, yet such positive effects of ICT-enabled co-production are conditioned on governments' internal and external factors. The review also indicates that ICT-enabled co-production is not a panacea for current problems in public service provision. Potential dark sides of ICTs on public service co-production need to be acknowledged.

Both the research and the practice of ICT-enabled co-production are at an early stage. Governments have begun to adopt different practices but have not yet integrated those practices within organizations. This review points out several directions that worth further research. Future studies could analyze critical drivers and barriers for governments to successfully adopt and implement ICT-enabled co-production. Comparative studies seem preferable to understand the similarity between these three models and unique factors for each of them. In addition, more attention is needed to evaluate the outcomes of ICT-enabled co-production and identify key determinants or barriers for its effectiveness. Also, future research should not ignore the potential negative effects of ICT-enabled co-production. Assessment of different outcomes and effects in different contexts would help to understand the implementation of ICT-enabled co-production and to improve the selection and design of certain co-production practices.

## REFERENCES

- [1] Alford, J. 2009. *Engaging Public Sector Clients: From Service-Delivery to Co-Production*. Springer.



- [2] Alford, J. 2014. The Multiple Facets of Co-Production: Building on the work of Elinor Ostrom. *Public Management Review*. 16, 3 (Apr. 2014), 299–316. DOI:https://doi.org/10.1080/14719037.2013.806578.
- [3] Athey, S. 2017. Beyond prediction: Using big data for policy problems. *Science*. 355, 6324 (Feb. 2017), 483–485. DOI:https://doi.org/10.1126/science.aal4321.
- [4] Barrett, M.A. et al. 2013. Big Data and Disease Prevention: From Quantified Self to Quantified Communities. *Big Data*. 1, 3 (Aug. 2013), 168–175. DOI:https://doi.org/10.1089/big.2013.0027.
- [5] Bertot, J.C. et al. 2010. Crowd-sourcing Transparency: ICTs, Social Media, and Government Transparency Initiatives. *Proceedings of the 11th Annual International Digital Government Research Conference on Public Administration Online: Challenges and Opportunities* (Puebla, Mexico, 2010), 51–58.
- [6] Bovaird, T. 2007. Beyond engagement and participation: User and community coproduction of public services. *Public administration review*. 67, 5 (2007), 846–860.
- [7] Bovaird, T. and Loeffler, E. 2012. From Engagement to Co-production: The Contribution of Users and Communities to Outcomes and Public Value. *VOLUNTAS: International Journal of Voluntary and Nonprofit Organizations*. 23, 4 (Dec. 2012), 1119–1138. DOI:https://doi.org/10.1007/s11266-012-9309-6.
- [8] Brabham, D.C. et al. 2014. Crowdsourcing Applications for Public Health. *American Journal of Preventive Medicine*. 46, 2 (Feb. 2014), 179–187. DOI:https://doi.org/10.1016/j.amepre.2013.10.016.
- [9] Brabham, D.C. 2009. Crowdsourcing the Public Participation Process for Planning Projects. *Planning Theory*. 8, 3 (Aug. 2009), 242–262. DOI:https://doi.org/10.1177/1473095209104824.
- [10] Brandsen, T. et al. 2018. Co-Creation and Co-Production in Public Services. *Co-Production and Co-Creation: Engaging Citizens in Public Services*. 6.
- [11] Brandsen, T. and Honingh, M. 2018. Definitions of Co-Production and Co-Creation. *Co-Production and Co-Creation: Engaging Citizens in Public Services*. 9.
- [12] Brandsen, T. and Honingh, M. 2015. Distinguishing Different Types of Coproduction: A Conceptual Analysis Based on the Classical Definitions. *Public Administration Review*. 76, 3 (2015), 427–435. DOI:https://doi.org/10.1111/puar.12465.
- [13] Brudney, J.L. and England, R.E. 1983. Toward a Definition of the Coproduction Concept. *Public Administration Review*. 43, 1 (1983), 59–65. DOI:https://doi.org/10.2307/975300.
- [14] Cardullo, P. and Kitchin, R. 2019. Being a ‘citizen’ in the smart city: up and down the scaffold of smart citizen participation in Dublin, Ireland. *GeoJournal*. 84, 1 (Feb. 2019), 1–13. DOI:https://doi.org/10.1007/s10708-018-9845-8.
- [15] Castelnuovo, W. 2018. Citizens Coproduction, Service Self-Provision and the State 2.0. *Network, Smart and Open*. Springer, Cham. 109–125.
- [16] Chatfield, A.T. et al. 2013. Tsunami early warnings via Twitter in government: Net-savvy citizens’ co-production of time-critical public information services. *Government Information Quarterly*. 30, 4 (Oct. 2013), 377–386. DOI:https://doi.org/10.1016/j.giq.2013.05.021.
- [17] Chessa, S. et al. 2016. Empowering mobile crowdsensing through social and ad hoc networking. *IEEE Communications Magazine*. 54, 7 (Jul. 2016), 108–114. DOI:https://doi.org/10.1109/MCOM.2016.7509387.
- [18] Chun, S. et al. 2010. Government 2.0: Making connections between citizens, data and government. *Information Polity*. 1,2 (2010), 1–9. DOI:https://doi.org/10.3233/IP-2010-0205.
- [19] Clark, B.Y. et al. 2016. A Framework for Using Crowdsourcing in Government. *International Journal of Public Administration in the Digital Age (IJPADA)*. 3, 4 (Oct. 2016), 57–75. DOI:https://doi.org/10.4018/IJPADA.2016100105.
- [20] Clark, B.Y. and Brudney, J. 2017. *Citizen Representation in City Government-Driven Crowdsourcing*. Technical Report #ID 2473543. Social Science Research Network.
- [21] Clark, B.Y. and Shurik, M. 2014. *Do 311 Systems Shape Citizen Satisfaction with Local Government?*. Technical Report #ID 2491034. Social Science Research Network.
- [22] Concilio, G. et al. 2017. Empowering Citizens with Open Data by Urban Hackathons. *2017 Conference for E-Democracy and Open Government (CeDEM)* (May 2017), 125–134.
- [23] Cordella, A. and Paletti, A. 2018. ICTs and value creation in public sector: Manufacturing logic vs service logic. *Information Polity: The International Journal of Government & Democracy in the Information Age*. 23, 2 (Apr. 2018), 125–141. DOI:https://doi.org/10.3233/IP-170061.
- [24] Crowdsensing: State of the Art and Privacy Aspects: 2014. <https://resources.infosecinstitute.com/crowdsensing-state-art-privacy-aspects/>. Accessed: 2019-03-22.
- [25] Dailey, D. and Starbird, K. 2014. Journalists as Crowdsourcers: Responding to Crisis by Reporting with a Crowd. *Computer Supported Cooperative Work: The Journal of Collaborative Computing*. 23, 4–6 (Dec. 2014), 445–481. DOI:https://doi.org/10.1007/s10606-014-9208-z.
- [26] Dawes, S.S. et al. 2016. Planning and designing open government data programs: An ecosystem approach. *Government Information Quarterly*. 33, 1 (Jan. 2016), 15–27. DOI:https://doi.org/10.1016/j.giq.2016.01.003.
- [27] Desouza, K.C. and Bhagwatwar, A. 2014. Technology-Enabled Participatory Platforms for Civic Engagement: The Case of U.S. Cities. *Journal of Urban Technology*. 21, 4 (Oct. 2014), 25–50. DOI:https://doi.org/10.1080/10630732.2014.954898.
- [28] Dutton, W.H. 2011. *Networking Distributed Public Expertise: Strategies for Citizen Sourcing Advice to Government*. Technical Report #ID 1767870. Social Science Research Network.
- [29] Ernst, C. et al. 2017. Collaboration and crowdsourcing in emergency management. *International Journal of Pervasive Computing and Communications*. 13, 2 (Jun. 2017), 176–193. DOI:https://doi.org/10.1108/IJPC-03-2017-0026.
- [30] Evans, L. et al. 2018. Voices in the cloud: social media and trust in Canadian and US local governments. *Records Management Journal*. 28, 1 (Mar. 2018), 18–46. DOI:https://doi.org/10.1108/RMJ-11-2016-0041.
- [31] Falco, E. and Kleinhans, R. 2018. Digital Participatory Platforms for Co-Production in Urban Development: A Systematic Review. *International Journal of E-Planning Research (IJEP)*. 7, 3 (Jul. 2018), 1–27. DOI:https://doi.org/10.4018/IJEP.2018070105.
- [32] Gagliardi, D. et al. 2017. Information and communication technologies and public participation: interactive maps and value added for citizens. *Government Information Quarterly*. 34, 1 (Jan. 2017), 153–166. DOI:https://doi.org/10.1016/j.giq.2016.09.002.
- [33] Ganapati, S. 2011. Uses of Public Participation Geographic Information Systems Applications in E-Government. *Public Administration Review*. 71, 3 (2011), 425–434. DOI:https://doi.org/10.1111/j.1540-6210.2011.02226.x.
- [34] Gao, X. 2018. Networked Co-Production of 311 Services: Investigating the Use of Twitter in Five U.S. Cities. *International Journal of Public Administration*. 41, 9 (Jul. 2018), 712–724. DOI:https://doi.org/10.1080/01900692.2017.1298126.
- [35] Grossman, G. et al. 2018. Crowdsourcing accountability: ICT for service delivery. *World Development*. 112, (Dec. 2018), 74–87. DOI:https://doi.org/10.1016/j.worlddev.2018.07.001.
- [36] Haltofova, B. 2018. Using Crowdsourcing to Support Civic Engagement in Strategic Urban Development Planning: A Case Study of Ostrava, Czech Republic. *Journal of Competitiveness*. 10, 1 (Jun. 2018), 85–103. DOI:https://doi.org/10.7441/joc.2018.02.06.
- [37] Hartmann, S. et al. 2016. Opportunities and Challenges for Civic Engagement: A Global Investigation of Innovation Competitions. *International Journal of Knowledge Society Research*. 7, 3 (Jul. 2016), 1–15. DOI:https://doi.org/10.4018/IJKSR.2016070101.
- [38] Heinzelman, J. and Waters, C. 2010. Crowdsourcing Crisis Information in Disaster-Affected Haiti. (2010), 16.
- [39] Hilgers, D. and Ihl, C. 2010. Citizensourcing: Applying the concept of open innovation to the public sector. *International Journal of Public Participation*. 4, 1 (2010), 67–88.
- [40] Holmes, B. 2011. Citizens’ engagement in policymaking and the design of public services. (2011), 64.
- [41] Johnson, P. and Robinson, P. 2014. Civic Hackathons: Innovation, Procurement, or Civic Engagement?: Civic Hackathon: Procurement or Civic Engagement? *Review of Policy Research*. 31, 4 (Jul. 2014), 349–357. DOI:https://doi.org/10.1111/ropr.12074.
- [42] Kahila-Tani, M. et al. 2016. Let the Citizens Map—Public Participation GIS as a Planning Support System in the Helsinki Master Plan Process. *Planning Practice & Research*. 31, 2 (Apr. 2016), 195–214. DOI:https://doi.org/10.1080/02697459.2015.1104203.
- [43] Kurniawan, M. and de Vries, W.T. 2015. The Contradictory Effects in Efficiency and Citizens’ Participation when Employing Geo-ICT Apps within Local Government. *Local Government Studies*. 41, 1 (Jan. 2015), 119–136. DOI:https://doi.org/10.1080/03003930.2014.937001.
- [44] Lee, S. et al. 2012. Open innovation in the public sector of leading countries. *Management Decision*. 50, 1 (Feb. 2012), 147–162. DOI:https://doi.org/10.1108/00251741211194921.
- [45] Lember, V. 2018. The Increasing Role of Digital Technologies in Co-Production and Co-Creation. *Co-Production and Co-Creation: Engaging Citizens in Public Services*. Routledge. 115–127.
- [46] Linders, D. 2012. From e-government to we-government: Defining a typology for citizen coproduction in the age of social media. *Government Information Quarterly*. 29, 4 (Oct. 2012), 446–454. DOI:https://doi.org/10.1016/j.giq.2012.06.003.
- [47] Liu, H.K. 2017. An analysis of online interaction in idea generation for public policies. *Information Polity*. 22, 2–3 (Jan. 2017), 117–135. DOI:https://doi.org/10.3233/IP-170411.
- [48] Liu, H.K. 2017. Crowdsourcing Government: Lessons from Multiple Disciplines. *Public Administration Review*. 77, 5 (Sep. 2017), 656–667. DOI:https://doi.org/10.1111/puar.12808.
- [49] Loeffler, E. and Bovaird, T. 2018. Assessing the Effect of Co-Production on Outcomes, Service Quality and Efficiency. *Co-Production and Co-Creation: Engaging Citizens in Public Services*. Routledge. 269–280.

- [50] Loeffler, E. and Bovaird, T. 2016. User and Community Co-Production of Public Services: What Does the Evidence Tell Us? *International Journal of Public Administration*. (Nov. 2016), 1–14. DOI:https://doi.org/10.1080/01900692.2016.1250559.
- [51] Loukis, E. and Charalabidis, Y. 2015. Active and Passive Crowdsourcing in Government. *Policy Practice and Digital Science*. Springer, Cham. 261–289.
- [52] McBride, K. et al. 2018. Open Government Data Driven Co-creation: Moving Towards Citizen-Government Collaboration. *Electronic Government* (2018), 184–195.
- [53] McNutt, J.G. et al. 2016. The diffusion of civic technology and open government in the United States. *Information Polity*. 21, 2 (Jul. 2016), 153–170. DOI:https://doi.org/10.3233/IP-160385.
- [54] Medaglia, R. 2012. eParticipation research: Moving characterization forward (2006–2011). *Government Information Quarterly*. 29, 3 (2012), 346–360.
- [55] Meijer, A. 2016. Coproduction as a structural transformation of the public sector. *International Journal of Public Sector Management*. 29, 6 (Aug. 2016), 596–611. DOI:https://doi.org/10.1108/IJPSM-01-2016-0001.
- [56] Meijer, A.J. 2012. Co-production in an Information Age: Individual and Community Engagement Supported by New Media. *VOLUNTAS: International Journal of Voluntary and Nonprofit Organizations*. 23, 4 (Dec. 2012), 1156–1172. DOI:https://doi.org/10.1007/s11266-012-9311-z.
- [57] Meijer, A.J. 2014. New Media and the Coproduction of Safety: An Empirical Analysis of Dutch Practices. *The American Review of Public Administration*. 44, 1 (Jan. 2014), 17–34. DOI:https://doi.org/10.1177/0275074012455843.
- [58] Mergel, I. 2015. Open collaboration in the public sector: The case of social coding on GitHub. *Government Information Quarterly*. 32, 4 (Oct. 2015), 464–472. DOI:https://doi.org/10.1016/j.giq.2015.09.004.
- [59] Mergel, I. 2015. Opening Government: Designing Open Innovation Processes to Collaborate With External Problem Solvers. *Social Science Computer Review*. 33, 5 (Oct. 2015), 599–612. DOI:https://doi.org/10.1177/0894439314560851.
- [60] Mergel, I. et al. 2014. The Challenges of Challenge.Gov: Adopting Private Sector Business Innovations in the Federal Government. *2014 47th Hawaii International Conference on System Sciences* (Jan. 2014), 2073–2082.
- [61] Mergel, I. and Desouza, K.C. 2013. Implementing Open Innovation in the Public Sector: The Case of Challenge.gov. *Public Administration Review*. 73, 6 (Nov. 2013), 882–890. DOI:https://doi.org/10.1111/puar.12141.
- [62] Moon, M.J. 2017. Evolution of co-production in the information age: crowdsourcing as a model of web-based co-production in Korea. *Policy and Society*. 0, 0 (Sep. 2017), 1–16. DOI:https://doi.org/10.1080/14494035.2017.1376475.
- [63] Mueller, J. et al. 2018. Citizen Design Science: A strategy for crowd-creative urban design. *Cities*. 72, (Feb. 2018), 181–188. DOI:https://doi.org/10.1016/j.cities.2017.08.018.
- [64] Munro, R. 2013. Crowdsourcing and the crisis-affected community. *Information Retrieval Journal*. 16, 2 (Apr. 2013), 210–266. DOI:https://doi.org/10.1007/s10791-012-9203-2.
- [65] Nabatchi, T. et al. 2017. Varieties of Participation in Public Services: The Who, When, and What of Coproduction. *Public Administration Review*. 77, 5 (2017), 766–776. DOI:https://doi.org/10.1111/puar.12765.
- [66] Nam, T. 2012. Suggesting frameworks of citizen-sourcing via Government 2.0. *Government Information Quarterly*. 29, 1 (Jan. 2012), 12–20. DOI:https://doi.org/10.1016/j.giq.2011.07.005.
- [67] Nambisan, S. 2008. Transforming Government through Collaborative Innovation. *Public Manager; Alexandria*. 37, 3 (2008), 36–41. DOI:https://search.proquest.com/openview/5148b52ec3eea1d569fda380dc4b0cf7/1?pq-origsite=gscholar&cbl=47605.
- [68] Needham, D.C. and Carr, S. 2009. *Co-production: an emerging evidence base for adult social care transformation*. Social Care Institute for Excellence.
- [69] Noveck, B.S. 2009. *Wiki Government: How Technology Can Make Government Better, Democracy Stronger, and Citizens More Powerful*. Brookings Institution Press.
- [70] Ostrom, E. 1996. Crossing the great divide: Coproduction, synergy, and development. *World Development*. 24, 6 (Jun. 1996), 1073–1087. DOI:https://doi.org/10.1016/0305-750X(96)00023-X.
- [71] Pak, B. et al. 2017. FixMyStreet Brussels: Socio-Demographic Inequality in Crowdsourced Civic Participation. *Journal of Urban Technology*. 24, 2 (Apr. 2017), 65–87. DOI:https://doi.org/10.1080/10630732.2016.1270047.
- [72] Paletti, A. 2016. Co-production Through ICT in the Public Sector: When Citizens Reframe the Production of Public Services. *Digitally Supported Innovation*. Springer, Cham. 141–152.
- [73] Pestoff, V. 2012. Co-production and Third Sector Social Services in Europe: Some Concepts and Evidence. *VOLUNTAS: International Journal of Voluntary and Nonprofit Organizations*. 23, 4 (Dec. 2012), 1102–1118. DOI:https://doi.org/10.1007/s11266-012-9308-7.
- [74] Royo, S. and Yetano, A. 2015. “Crowdsourcing” as a tool for e-participation: two experiences regarding CO<sub>2</sub> emissions at municipal level. *Electronic Commerce Research*. 15, 3 (Sep. 2015), 323–348. DOI:https://doi.org/10.1007/s10660-015-9183-6.
- [75] Sawhney, N. et al. 2015. Civic Engagement through DIY Urbanism and Collective Networked Action. *Planning Practice & Research*. 30, 3 (Jun. 2015), 337–354. DOI:https://doi.org/10.1080/02697459.2015.1054662.
- [76] Schmidhuber, L. and Hilgers, D. 2018. Unleashing Innovation beyond Organizational Boundaries: Exploring Citizensourcing Projects. *International Journal of Public Administration*. 41, 4 (Mar. 2018), 268–283. DOI:https://doi.org/10.1080/01900692.2016.1263656.
- [77] Schuurman, D. et al. 2012. Smart Ideas for Smart Cities: Investigating Crowdsourcing for Generating and Selecting Ideas for ICT Innovation in a City Context. *Journal of Theoretical & Applied Electronic Commerce Research*. 7, 3 (Dec. 2012), 49–62. DOI:https://doi.org/10.4067/S0718-18762012000300006.
- [78] See, L. et al. 2013. Comparing the Quality of Crowdsourced Data Contributed by Expert and Non-Experts. *PLOS ONE*. 8, 7 (Jul. 2013), e69958. DOI:https://doi.org/10.1371/journal.pone.0069958.
- [79] Sokolov, A. and Verevkin, A. 2016. Digitalization and Evolution of Civic Engagement: New Ways of Participation in Public Policy. *Digital Transformation and Global Society* (2016), 269–274.
- [80] Soomro, K. et al. 2017. Participatory governance in smart cities: the urbanAPI case study. *International Journal of Services Technology & Management*. 23, 5/6 (Sep. 2017), 419–444. DOI:https://doi.org/10.1504/IJSTM.2017.10009859.
- [81] Thomas, J.C. 2014. *Citizen, Customer, Partner: Engaging the Public in Public Management*. Engaging the Public in Public Management. Routledge.
- [82] Toots, M. et al. 2017. Open Data as Enabler of Public Service Co-creation: Exploring the Drivers and Barriers. *2017 Conference for E-Democracy and Open Government (CeDEM)* (May 2017), 102–112.
- [83] Torres, L.H. 2007. Citizen sourcing in the public interest. *Knowledge Management for Development Journal*. 3, 1 (2007), 134–145.
- [84] Vamstad, J. 2012. Co-production and Service Quality: The Case of Cooperative Childcare in Sweden. *VOLUNTAS: International Journal of Voluntary and Nonprofit Organizations*. 23, 4 (Dec. 2012), 1173–1188. DOI:https://doi.org/10.1007/s11266-012-9312-y.
- [85] Verschuere, B. et al. 2012. Co-production: The State of the Art in Research and the Future Agenda. *VOLUNTAS: International Journal of Voluntary and Nonprofit Organizations*. 23, 4 (Dec. 2012), 1083–1101. DOI:https://doi.org/10.1007/s11266-012-9307-8.
- [86] Voorberg, W.H. et al. 2015. A Systematic Review of Co-Creation and Co-Production: Embarking on the social innovation journey. *Public Management Review*. 17, 9 (Oct. 2015), 1333–1357. DOI:https://doi.org/10.1080/14719037.2014.930505.
- [87] Webster, C.W.R. and Leleux, C. 2018. Smart governance: Opportunities for technologically-mediated citizen co-production. *Information Polity*. 23, 1 (Jan. 2018), 95–110. DOI:https://doi.org/10.3233/IP-170065.
- [88] Whitaker, G.P. 1980. Coproduction: Citizen Participation in Service Delivery. *Public Administration Review*. 40, 3 (May 1980), 240. DOI:https://doi.org/10.2307/975377.
- [89] Zuiderwijk, A. and Janssen, M. 2014. Open data policies, their implementation and impact: A framework for comparison. *Government Information Quarterly*. 31, 1 (Jan. 2014), 17–29. DOI:https://doi.org/10.1016/j.giq.2013.04.003.
- [90] Zuiderwijk, A. and Janssen, M. 2014. The Negative Effects of Open Government Data - Investigating the Dark Side of Open Data. *Proceedings of the 15th Annual International Conference on Digital Government Research* (New York, NY, USA, 2014), 147–152.