

Smart Cities – Overview of Citizen Participation across Application Domains

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Abstract

Smart Cities is a widely discussed topic in the social sciences. At first, awareness of Smart Cities in society was based mainly on the fact that these are cities that use modern information and communication technology (ICT) to ensure the provision of public services to their citizens. However, with the development of technology and the growing openness, the role of citizens in the city administration is changing. Thanks to the day-to-day use of ICT to communicate with the city administration, citizens are gradually becoming from ordinary consumers of public services to their co-designers and co-authors. The existing body of literature has so far focused mainly on describing examples of forms of involving citizens in the design and creation of specific public services in selected application domains. However, a comprehensive overview and comparison of citizen participation between different application domains is lacking in the literature. Therefore, the aim of this article is to provide an overview of the development of citizen participation in the concept of Smart Cities and its various application domains. Our research has shown that the topic of Smart Cities is a widely discussed topic in society, especially over the last 10 years. At the same time, our findings confirmed that there exist differences between application domains in citizen participation. From an analysis of published scientific articles on Smart Cities, we found that most of the articles on Smart Cities deal with the fields of natural resources and energy, transportation and mobility, and living. However, from the perspective of the participation of citizens, there are other application domains at the top of the number of publications.

Keywords

Smart Cities, Citizen Participation, Application Domains, Smart City Governance

JEL Classification

H41, R58

Introduction

Smart Cities and everything connected with them is a widely discussed topic, which can be heard in public especially over the last 10 years. Initially, awareness of Smart Cities in society was mainly based on the fact, that these are cities that use modern information and communication technologies (ICT) to ensure the efficient provision of public services to their citizens (Gil-Garcia, Pardo & Nam, 2015). In principle, Smart Cities meant mainly the city administration, which used various modern technologies that made it possible to produce faster and better services for citizens, and usually for less money. With the development of technology in society, elements of Smart Cities began to gradually manifest themselves in various application domains (Caragliu, Del Bo & Nijkamp, 2011, Lombardi et al., 2012). Simultaneously with the ever-increasing use of ICT in the creation and provision of public services and the daily communication of the city administration with its inhabitants, the traditional roles and perceptions of the main actors gradually began to change. Thanks to the day-to-day use of ICT to communicate with the city administration, citizens together with entrepreneurs are gradually becoming from ordinary consumers of public services to their designers and co-authors. This creates a social system called Smart City Governance (Castelnovo, Misuraca & Savoldelli, 2015; Meijer, 2016; Pereira et al. 2018). In this system, citizens and companies are actively involved in the city and they can submit their own ideas and visions to the administration as inputs for new or improved public services or policies (Lember, 2018). With the growing body of literature on these topics, questions naturally arise about different forms of citizen participation in the context of Smart Cities. These are

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questions about the manifestations of participation in various application domains, whether there are differences in participation between individual domains, or how the topic of citizen participation is developing over time. However, we did not find clear answers to these questions in the available literature.

Therefore, the aim of this article is to provide an overview of the evolution of citizen participation in the Smart Cities concept. We looked at the participation of citizens in different application domains and for each area we described the form in which citizens participate in the context of Smart Cities. Specifically, we tried to answer the following three research questions: 1) How is the participation of citizens evolving in the Smart Cities concept? 2) Are citizens in the various Smart Cities application domains evenly involved? 3) In what ways do citizens participate in better policies in individual domains? By answering these questions, we want to contribute to the ongoing academic discussion on Smart Cities and point out on the evolution trends of citizen participation in various application domains of Smart Cities. The article is divided into five chapters and their content is as follows: in the first chapter we present an overview of the literature on citizen participation in the context of the Smart Cities concept. Chapter two provides an overview of studies that describe the different application domains in which the elements associated with Smart Cities are applied. Chapter three provides the methodological procedures and data we used in our research. Chapter four provides our results and examples of participation in individual domains. In Chapter Five, we discuss our findings and provide relevant conclusions.

Literature Review

Smart Cities, Citizen Participation and Public Services

The change in the perception of the role of citizens in the Smart Cities concept occurred after the extension of the Governance models by elements of digitization. Thanks to the gradual introduction of modern ICT into Governance models, new concepts of Governance have emerged, such as E-Government, Smart Government, Smart Governance and Smart City Governance (Linders, 2012; Meijer, 2016; Meijer & Bolívar 2016; Pereira et al., 2018). It is the Smart City Governance model that addresses Governance in Smart Cities as a new form of cooperation between citizens and administration through the use of ICT (Meijer & Bolívar, 2016; Castelnovo, Misuraca & Savoldelli, 2015). Prior to the introduction of ICT into Governance models as a stand-alone element, for many researchers and authors, the conceptualization of Smart Cities was based primarily on the use of modern ICT to achieve more efficient public services (Gil-Garcia, Pardo & Nam, 2015; Anavitarte & Tratz-Ryan, 2010; Washburn et al., 2009). In many articles, citizens were more likely considered as passive recipients of public services, to which the city has been able to produce and provide more efficiently with the help of modern ICT, than as equal partners that are involved in the design and production of public services. According to Meijer (2016), the justification of citizens as an equal partner in the creation of public services and urban policies stems from the initiatives of local communities. It is the inhabitants and local communities who perceive problems and obstacles in public services mostly, as they use them daily. The availability of modern communication technologies and the use of social media have made it easier for them to communicate problems and proposals within the community, as well as between their community and the city administration.

There are many ways in which citizens can participate in better Governance and better policies. From personal participation in public meetings and public discussions with representatives of the city administration, through addressing comments and proposals for changes in public services through communication channels such as mail, email or social media. Castelnovo, Misuraca & Savoldelli (2015) consider distinguishing between ways of involving citizen between traditional, so-called top-down approaches and modern, bottom-up approaches. In top-down approaches, the administration prepares proposals for specific policies or measures in advance and only subsequently, after their creation, invites citizens to comment on them. Common methods in this approach are a mix of online and offline initiatives (organized, created by the administration), which have the task of gathering opinions, criticisms and comments from the population to improve the administration's proposals. Online tools tend to be opinion polls via email, links to city websites, or via social media. The positive thing about these approaches is that in these ways the administration can address and gather opinions and observations even from citizen, who do not normally comment on public policies. The disadvantage of these approaches is that they may lead to a low interest of citizens to participate in solving local problems, or they may be omitted from communication to solve their problems. Tan & Taeihagh (2020) point to such an example that led to a low citizen participation. On the other hand, in bottom-up approaches, citizens are the initiators and proponents of activities and discussions in which they address their everyday problems. Specific examples, such as the Reinventer projects in Paris or the Community Plan and New Urban Platform in Boston, are presented and described by Castelnovo, Misuraca & Savoldelli (2015).

There are several ways to involve citizens in discussions and policymaking in the context of Smart Cities. This is mostly often done through emails, online surveys, social media, and various applications and websites that are freely available to the general public (Pereira et al. 2018). Other ways are the creation of joint working groups, in which along with administrative staff and city planners, residents, the non-profit sector and entrepreneurs also have their place. Examples of such local action groups are, for example, living labs (Carter, 2013; Cellina et al., 2020),

in which the cooperation of all stakeholders leads to the creation of social consensus and higher satisfaction with established services or policies. In the scientific literature, the active involvement of citizens in the joint creation of public services is associated with the concepts of Co-production and Co-creation. Co-production is currently one of the cornerstones of public policy reform worldwide and is presented as a valuable path to public service reform, as the planning and delivery of efficient public services, the response to democratic deficits and the path to active citizenship and communities. Co-production is considered as means of using other resources to provide public services (Osborne, Radnor, & Strokosch, 2016). Co-creation is associated with innovation in public services and the creation of new value for service (Alves, 2013). Brandsen & Honingh (2018) argue that both terms refer to the active involvement of citizens in the formation of services, which distinguishes them from passive clientelism or consumption. The authors further claim that the two concepts share several common features. The first is that they form a direct part of the production process. In other words, they do not include all citizen input, which in some way influences the overall planning, design and delivery of the service, but focus on the direct input of citizens during the production phase of the service. The second is that both terms refer to cooperation between professional service providers in public agencies and citizens. On the other hand, these two concepts represent the different participation of the population in the creation of public services, especially regarding the stages of production. Co-creation is more associated with service design, while Co-production is more with the service production process itself (Lember, Brandsen & Tonurist, 2019). A detailed description of Co-production and Co-creation approaches is provided, for example, by Brandsen, Seen & Verschuere (2018).

Application Domains in Smart Cities

Smart Cities elements are applied in different application domains. A useful review of these domains is provided by several authors, such as Neirotti et al. (2014), Nuaimi et al. (2015), or Ingwersen & Serrano-Lopez (2018). Defining Smart Cities application domains is based on reviews of several articles and a classification of keywords that are specific to a particular public area. A detailed overview of several methods and procedures for analysing scientometric data of Smart Cities publications is provided by Ingwersen & Serrano-Lopez (2018). Neirotti et al. (2014) distinguish between two main areas – hard and soft. The hard domain includes those areas where information and communication technologies are key enabling technologies, which currently increase the efficiency of individual services. The first area includes, for example, energy, public lighting, natural resource management, waste management, the environment, transport, buildings, healthcare, security. In the soft domain, ICT is less important and is not used intensively for real-time data collection and evaluation. The main areas include in particular non-market services such as education, culture, social inclusion, public administration and the economy. Based on the relatedness of some areas, Neirotti et al. (2014) are using a total of six different application domains - Natural resources and energy, Transport and mobility, Buildings, Living, Government and Economy and people. Other authors also classified individual application domains in similar ways. Nuaimi et al. (2015) divides application domains into Transportation, Healthcare, Safety, Education, Environment, Energy and Governance. Allam & Dhunny (2019) reviewed several articles that examined Smart City applications, with his identified domains being Governance, People, Economy, Living, Environment, Mobility, Infrastructure, Education, Healthcare, Public Safety and Culture. The authors state that the most frequently studied domains are Governance, People and Infrastructure. Similarly, Albino et al. (2015) present several classifications, relying in particular on the classification of Lombardi et al. (2012), which use five groups - Economy, Human Capital, Governance, Environment and Living.

Regarding the definition of Smart City application domains from the clear perspective of population participation, in current available literature, we were unable to find any exact definition. However, we believe that from the above-mentioned classifications of application domains, the participation of citizens in Smart Cities may be best illustrated by the approach of Neirotti et al. (2014). Our belief is related to the description of this classification, where authors emphasize the bottom-up approach, in which Smart Cities provide access to data and allow citizens to make their own decisions. Thus, these authors point out on the importance of citizens in some decision-making processes that are directly related with Smart Cities. In this classification authors categorise application domains according to the intensity of required technologies to provide data. In hard domains, a high intensity of involvement of special technologies is required. These technologies are often financially demanding and user complicated. From this point of view, it can be assumed that a large group of citizens probably do not encounter such technologies. On the other hand, in soft domains, more common modern technologies are used, which are also more accessible to citizens. Therefore, based on these assumptions we believe that the classification by Neirotti et al. (2014) also reflects the participation of citizens between different application domains.

Methods

To answer our research questions:

- 1) How is the participation of citizens evolving in the Smart Cities concept?
- 2) Are citizens in the various Smart Cities application domains evenly involved?
- 3) In what ways do citizens participate in better policies in individual domains?

we used the scientometric method of analysis of scientific literature. Scientometric analysis a research method that is used to objectively map the scientific knowledge area while the critical review aims to identify the research themes and the corresponding challenges based on scientometric results. An example of the use of this method to map the characteristics of scientific articles in a scientific journal is provided by Baker, Kumar & Pattnaik (2021). For our analysis, we used the database of Web of Science (WOS) publications, specifically all publications that had the term Smart City in the title, keywords, or abstract. We consider scientific articles on Smart Cities as a proxy to describe the state of use of Smart Cities in the real world. For the purposes of our analysis, we have modified the database of publications in the following ways:

In the first step, we started from application domains classified by Neirotti et al. (2014). We are using the classification of application domains by Neirotti et al. (2014) because we consider it to be the most suitable to reflect the participation of citizens in Smart Cities. We assigned keywords to each of the domains based on the most common terms related to application domains, supplemented with the most related words in that domain from the Related Words database (<https://relatedwords.org/>). As a result, each domain was characterized by approximately 20 terms. Table 1 provides an overview of keywords across domains. Subsequently, we identified the most frequently recurring terms in the abstracts of articles from the WOS database. We then assigned these to the individual application domains based on the most numerous keyword matches.

Table 1. Glossary of search keywords for each Smart City application domain.

| Domain | Keywords |
|-----------------------------|---|
| Resources and energy | "sustainable", "energy", "environment", "renewable", "electricity", "electric", "climate", "solar", "grid", "carbon", "lightning", "environmental", "sustainability", "water", "emissions", "ecosystem", "pollution", "green", "CO2", "waste", "natural", "sensor", "grids", "lamp", "lamps", "wind", "recycling", "plants" |
| Transportation and mobility | "parking", "train", "railway", "transportation", "transport", "mobility", "cycling", "car", "cars", "traffic", "vehicles", "modes", "congestion", "accessibility", "bicycle", "driving", "autonomous", "multimodal", "road", "commuter", "pedestrian", "bus", "travel", "transit", "logistics", "multi-modal", "trip", "fuel" |
| Buildings | "building", "buildings", "construction", "residential", "cleaning", "maintenance", "housing", "residential", "ventilation", "condition", "HVAC", "house", "houses", "block", "facade", "roof", "heating", "built", "construction", "estate", "occupant", "cooling" |
| Living | "tourism", "night life", "entertainment", "hospitality", "tourists", "police", "social", "welfare", "diagnosis", "disabled", "culture", "public space", "public spaces", "visitors", "inclusion", "inclusive", "elder", "disease", "medicine", "hygiene", "exercise", "COVID-19", "patient", "medical", "virus", "trust", "risk", "health", "safety", "hospital", "pandemic", "healthcare", "crime", "security", "sanitation", "safe", "risks" |
| Government | "politics", "establishment", "authority", "governmental", "government", "governments", "governance", "procurement", "administration", "initiative", "stakeholder", "transparency", "citizen", "authority", "ballot", "voter", "legislation", "project", "citizens", "policy", "e-government", "citizens", "democracy", "authorities", "municipality", "officials", "openness", "municipal", "reform", "agenda", "institutional", "program"+ |
| Economy and people | "teaching", "school", "teacher", "academia", "lecturer", "graduate", "education", "student", "students", "training", "employment", "university", "skills", "campus", "college", "kindergarden", "undergraduate", "academic", "economy", "economies", "growth", "industry", "industries", "innovation", "sector", "demand", "finance", "trade", "production", "recession", "businesses", "market", "unemployment", "productivity", "business", "industrial", "company", "corporation", "companies", "entrepreneurship", "incubator", "whiteboard", "human capital", "brain drain", "talents" |

Source: Authors.

If the analyzed article was not assigned to any domain, we included it in the category Other. There are also articles in this category that did not have an abstract in the WOS database. We also categorized an article that had at most one keyword in the domain, even though it had one keyword in more than one domain. If the number of words identified in an article were 2 or more, but the number of words was the same in more than one category, we included this article in the Mix category.

The export of the database of articles from WOS took place in November 2020. In November 2020, the database of WOS contained a total of 6259 articles. A total of 200 publications did not have an abstract, so they were excluded from the subsequent analysis. Of the remaining 6059 publications, 456 publications in the Mix category and 1382 publications in the Other category were identified by text analysis. Therefore, to answer our questions, we excluded from our sample all publications that were included in the Mix and Other categories. The final sample thus consisted of 4421 publications, which were published between 1999 and 2020.

In the second step, we searched in the categorized articles for keywords that express the participation of citizens. We again searched for keywords in the abstracts of articles. The keywords that express the citizen participation were taken from Simonofski et al. (2017) and supplemented them with their related words from the Related Words database. We also added the terms co-production and co-creation to these keywords because they are associated with the participation of citizens in the creation of public services. The final list consisted of the following 12 keywords in the form of nouns¹:

If at least 2² of the mentioned keywords were identified in the analyzed article, we marked the article as a publication that indicates the citizen participation. If only 1 of the mentioned keywords was identified in the analyzed article, or none of the terms were included in it, we marked the article as a publication that does not indicate the participation of citizens.

In the third step, we focused on publications with identified participation in individual application domains. The total number of publications that expressed the participation of the population was 234 articles. We manually checked the abstracts of articles in all application domains to see if citizen participation was reported correctly. Afterwards, based on a random sample of articles we described in what ways citizens participate in better policies in individual domains.

Results

The results of the text analysis of the abstracts of the articles showed that the most published articles on the topic of Smart Cities come from the Resources and energy domain. Approximately 33% of all published articles between 1999 and 2020 are published on this area. The second most published domain is Transport and mobility (22%). The following domains are Living (15%), Government (14%) and Economy and people (12%). The domain with the smallest share of publications is Buildings. Only 4% of all analysed articles on Smart Cities dealt with issues related to the Buildings domain. The development of the number of publications in individual Smart Cities domains is provided in Figure 1.

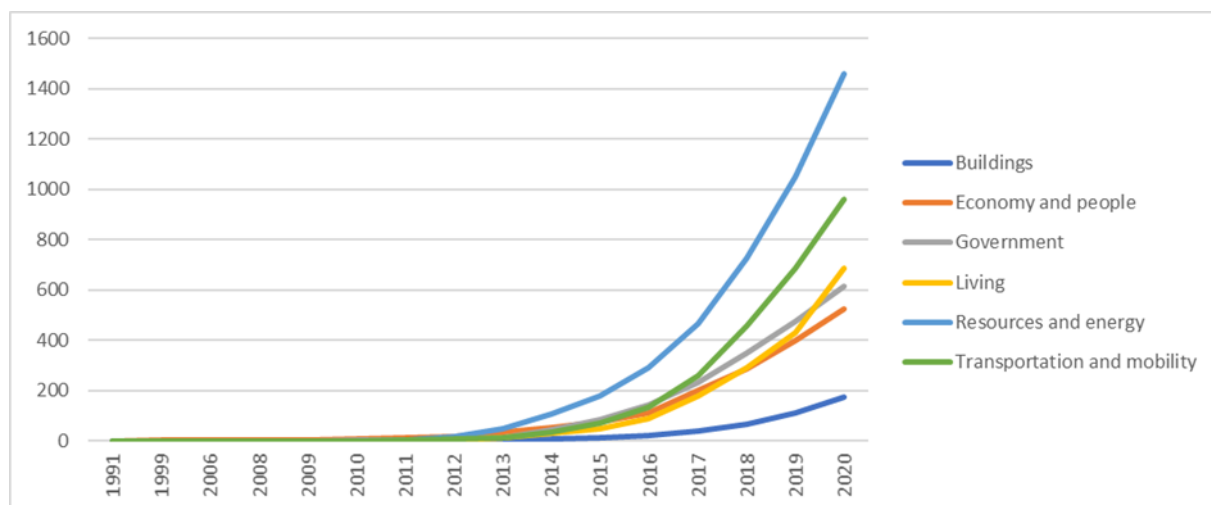


Fig. 1. Cumulative development of all publications in each Smart City application domain.

Source: Authors.

A total of 234 articles were identified from the search results for keywords expressing citizen participation. The number represents approximately 5% of all published articles on Smart Cities. Subsequent analysis of publications with identified citizen participation showed that a similar development trend can be observed in most application domains. The participation of citizens in the concept of Smart Cities began to be described in articles with a certain time lag. Publications referring to citizen participation have not been published in most domains since 2012, and the topic of Smart Cities has been gradually addressed by researchers since the 1990s. Furthermore, the results of the analysis show that there are differences in the participation of the citizens between the individual domains. Most articles indicating citizen participation have been identified in the Government domain. A total of 146 publications were identified in this domain. The share of publications with identified population participation in all publications in this domain is approximately 22%. Approximately 5% of publications expressing participation were

¹ Note: We also considered using the Stemming algorithm and Lemmatization processes for all 12 words. However, the resulting values of the analyzes differed significantly depending on the use of the form of the resulting words (lemmas).

² Note: We have used a different number of keywords in the analysis. Using 1 keyword, the results of the analysis were misleading, as a large number of identified articles in the resulting database did not describe any participation of citizens. Using 3 or more keywords, a large number of articles describing the participation of citizens were dropped from the database. Therefore, we used 2 keywords for identifying publications for further research.

identified in Living and Economy and people domains. In the Resources and energy domain, the share of publications with a citizen participation is approximately 2% and, in the Transport, and mobility is 1%. A total of 174 articles on the topic of Smart Cities were published in the Buildings application domain. However, none of these articles identified citizen participation. An overview of the number of published publications in individual Smart Cities application domains for the entire monitored period is provided in Table 2. Table 2 is in the appendix to this document. The development of the share of publications indicating the participation of citizens for all Smart City application domains is shown in Figure 2.

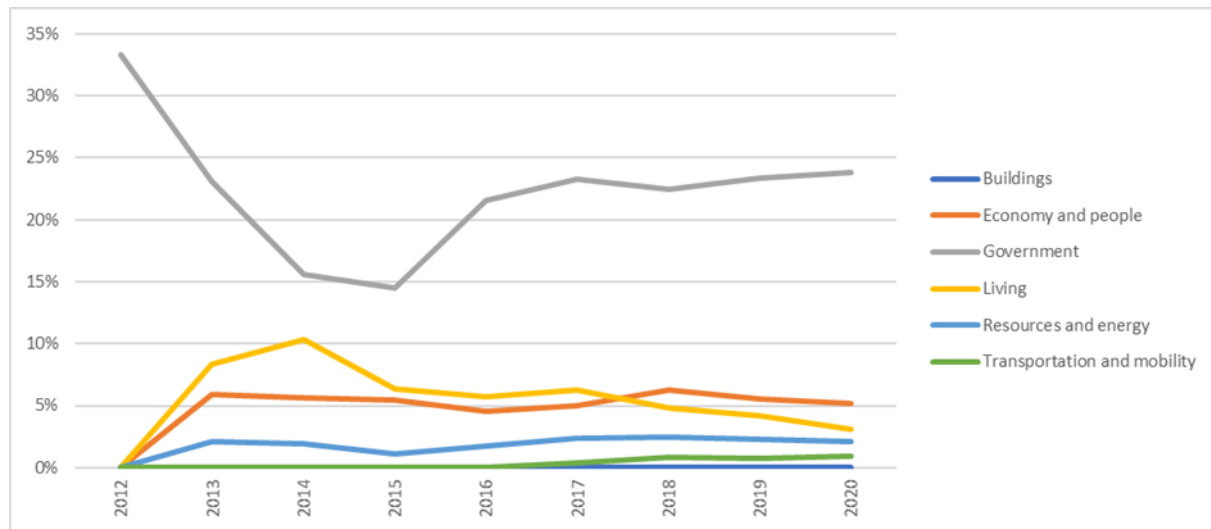


Fig. 2. Share of publications indicating the participation of citizens in each Smart City application domain.
Source: Authors.

From the presented results in Figures 1 and 2 it can be seen the differences of representation of individual domains. Most articles on Smart Cities are published in application domains, which Neirrotti et al. (2014) classified as hard domains. On the other hand, most articles on citizen participation in Smart Cities are published in application domains, which Neirrotti et al. (2014) classified as soft domains. This result is in line with our assumption, that more articles are published in application domains, which do not require the use of special technologies, which often tend to be too expensive. However, further research is needed to clarify why the citizen participation in some domains is higher than in others.

Examples of Citizen Participation in Smart City Application Domains

The oldest article with identified participation in the Living domain dates from 2013 (Pultrone, 2013). However, this article is in Italian and it is not possible to clarify from the English abstract in what forms or ways the citizens participated in the activities in the context of Smart Cities. Presenza et al. (2014) describe how to involve stakeholders in the field of tourism in the creation of a joint tourist plan of the region through a freely accessible website. Hotel managers, officials, residents as well as visitors to the region were able to log on to the website and comment on various aspects of tourism. Using the given example, the authors pointed out how easily it is possible to involve residents and other stakeholders in the creation of a development plan in the field of tourism. However, the authors did not describe whether the involvement of diverse actors also contributed to a better or more targeted policy. The article only described the specific possibility of involving various stakeholders in the creation of the tourist plan through ICT. The article by Pultrone (2014) is a conceptual one that describes the participation of citizens in the context of Smart Cities in general, without more specific examples. Júnior et al. (2020) describe the involvement of residents in Smart Cities in Brazil. The authors describe a case study that examined the involvement of Brazilian residents in participatory budgeting. Residents participated in city budget decisions through email and social media.

In Economy and People, Komninou, Pallot & Schaffers, (2013) describe how the development of information and communication technologies and the rise of the Internet have influenced urban governance. In selected European cities, the authors further describe how technological progress has translated into urban strategies and how these strategies have affected citizens. Participation is presented on the examples of access of citizens to various open data. Carter (2013) describes the implementation of a digital strategy in Manchester, UK and its impact on the city's population. Thanks to this strategy, several projects have been implemented that have increased the availability of ICT services and improved the information literacy of the city's inhabitants. Kamnuansilpa et al. (2020) describe how the people of Khon Kaen, TH perceive the concept of Smart Cities and its components. The purpose of the research was to examine, through online surveys and interviews with citizens, how citizens perceive the concept of Smart Cities in their cities and in which areas they would like to further develop the digitization of services.

In the application domain of Government, Ortiz-Fournier et al. (2010) described the integration of educational institutions into the strategic planning of the city of Caguas, PR. This example describes the involvement of representatives of local educational institutions such as secondary schools, colleges and universities in urban planning, in order to raise the educational level of the city's population. Representatives of educational institutions were involved in this process through in-depth interviews and their views and recommendations were incorporated into the city's strategic plans. Matheus, Janssen & Maheshwari (2020) describe the involvement of Rio de Janeiro, BR residents in the urban traffic information system through the online Dashboard application. Based on the mobile application, residents report traffic restrictions and accidents in the city, thus sharing valuable information for other passengers and the city administrative. Based on this information, the city administration can react flexibly to changes and regulates the transport policy in the city in real time. De Guimarães et al. (2020) examine whether communication, participation, and partnership of citizens with the city administration leads to their higher satisfaction and quality of life. Through an online questionnaire survey, the authors of the article found out from which elements of Smart Cities the inhabitants of selected Brazilian cities perceive benefits and from which shortcomings and limitations.

In Resources and Energy, Moraci & Fazia (2013) described the design of a modern Smart City that generates new directions for architecture and urban areas. The authors emphasize the role of the inhabitants because they bring new and refreshing ideas to architectural directions and urban areas. However, more detailed, and specific information on citizen participation, as well as information on forms of citizen participation in the context of Smart Cities, is absent. Similarly, an article by Viitanen & Kingston (2014) only formally and generally emphasizes the importance of involving citizens in Smart City policies, aimed at a low-carbon economy. Mingaleva et al. (2020) examined elements of Smart Cities in the field of waste management. Their research has shown that the effectiveness of green technologies in modern cities depends on the degree of citizen participation in waste separation. The authors further state in the article that people are active participants in the life processes of cities and have a direct impact on the urban environment. However, a more detailed description of their participation activities is missing.

In Transport and Mobility, Cellina et al. (2020) report the experience of Bellinzona, CH, where a laboratory experiment was conducted to reduce car traffic in the city. The participants of the experiment were citizens of the city (car drivers, cyclists, and pedestrians), who participated in the creation of an online application. It is intended to change the behaviour of residents to reduce car traffic in the city. The results of the experiment were also passed on to the city administration as an opportunity to improve its transport policy. In an article by Suresh et al. (2020) is a detailed process of citizen participation. The article deals with the relationship between sustainability and intelligent transport technologies in the United Kingdom. The authors state that the participation is essential for the introduction of sustainable transport. The experience and opinions of transport users on the used technologies provide valuable information for the administration. Online surveys and questionnaires are good tools for gathering information for better transport policies.

In the Buildings application domain, no article describing population participation has been identified with this research approach. Therefore, for this area we are not providing any examples of forms of citizen participation in the context of Smart Cities.

Discussion

Our research has shown that the topic of Smart Cities is a widely discussed topic in society and its intensity has been increasing, especially in the last 10 years. At the same time, the first publications which began to describe a different role of the population in this concept began to appear. As stated by Gil-Garcia, Pardo & Nam (2015), most publications on Smart Cities focus on describing the individual elements of Smart Cities, their specific roles and the benefits to society. In most publications, the role of citizens is mentioned as passive recipients of the benefits of public services that flow from the use of modern ICT. They are often referred to as public service consumers, who do not participate in the creation of services and in joint efforts to improve the quality of life. However, this perception is gradually changing, as since 2012 it can be seen a growing volume of literature that describes the participation of citizens in this concept. Regarding the connection between the city administration, citizens and the use of modern ICT, there are differences between application domains. These are described, for example, by Neirotti et al. (2014), Nuaimi et al. (2015) or Allam & Dhunny (2019). Our findings confirm that differences between application domains exist also in the scope of discussions and in citizen participation. The most published articles on Smart Cities are published in domains of Natural resources and energy, Transport and mobility, and Living. However, in terms of involving citizens in the creation of public services, there are other domains at the top. Governance, Economics and people and Living represent domains with the largest share of publications with identified participation. From the point of view of differences in citizen participation between application domains, our findings confirmed our assumption based on the division of domains into hard and soft domains (Neirotti et al., 2014). In domains where the use of technologies is probably more expensive and more difficult to use, citizen participation is less widespread than in other domains. However, further research is needed to clarify why the citizen participation in some domains is higher than in others. The presented examples of publications with identified citizen participation confirmed

differences between individual domains. In addition, the described examples of participation in individual application domains can act as an inspiration for those administrations of cities, where the participation of citizens is low or non-existent.

Conclusion

We believe that this article is a contribution to the ongoing discussion on the Smart Cities concept and provides a useful overview of the evolution of citizen participation between individual application domains. At the same time, this article provides a pragmatic overview of several practical examples of citizen participation for individual application domains. In addition, we believe that this article also provides some interesting ideas for future research. For example, it would be particularly interesting to examine the reasons for greater citizen participation in some domains. Moreover, it would be useful to examine and compare the most common forms of citizen participation in individual application domains in more detail. Furthermore, some of the presented practical examples of citizen participation may be helpful for local governments. These examples can inspire the administration of some cities to increase the participation of their citizen in individual areas of public services.

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Appendix

Table 2. Number of published publications in Smart Cities application domains³.

| | 1999 | 2006 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|------------------------|----------|----------|----------|----------|----------|-----------|-----------|------------|-------------|-------------|-------------|--------------|--------------|--------------|---------------|
| Buildings | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 1 (1) | 2 (0) | 3 (0) | 4 (1) | 13 (0) | 14 (1) | 28 (3) | 44 (2) | 65 (5) |
| Economy and people | 1 (0) | 1 (0) | 0 (0) | 1 (0) | 3 (2) | 8 (1) | 3 (1) | 17 (5) | 19 (6) | 20 (6) | 36 (8) | 91 (24) | 88 (21) | 110 (27) | 127 (22) |
| Government | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 1 (1) | 2 (2) | 3 (1) | 7 (4) | 32 (12) | 38 (19) | 61 (38) | 88 (58) | 115 (68) | 128 (77) | 139 (84) |
| Living | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 1 (0) | 2 (1) | 9 (2) | 17 (8) | 18 (3) | 40 (8) | 89 (17) | 114 (17) | 142 (18) | 253 (35) |
| Resources and energy | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 1 (0) | 17 (3) | 29 (5) | 59 (11) | 73 (8) | 110 (12) | 178 (31) | 262 (30) | 321 (44) | 411 (34) |
| Transport and mobility | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 3 (0) | 3 (2) | 6 (2) | 23 (1) | 35 (2) | 63 (5) | 127 (17) | 196 (20) | 232 (23) | 274 (23) |
| Σ | 1 (0) | 1 (0) | 0 (0) | 1 (0) | 4 (3) | 15 (3) | 29 (9) | 70 (18) | 153 (38) | 188 (39) | 323 (71) | 587 (148) | 803 (159) | 977 (191) | 1269 (203) |

Source: Authors.

³ Note: Data in parentheses indicate the number of publications with the term participation.