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Citizens' Participation as an important element for Smart City development

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Abstract. It seems that the smart cities concept is confidently becoming one of the highly exposed current challenges. Undoubtedly, it brings a lot of interest and excitement both among academia and professional researchers since it presents a futuristic project with many intriguing features that will influence the quality of life. The technological aspects of smart cities are quite well researched, while an important issue remains with the acceptance of the technology among individuals. Participation in the projects seems to be one possible solution when it comes to the wider acceptance of the services offered within the smart city. Scholars have already examined different aspects of the participation in smart cities, however, no one has explored and quantified the impact participation would have on overcoming the issues and concerns people feel towards smart cities.

Thus, the main focus of our research is not only to highlight the participation as a possible solution in overcoming well-known issues but also to measure and examine to what extent the participation is a viable solution in terms of changing people's perspective and attitude towards smart cities, towards services provided in the smart city and towards smart city development. The purpose of our research is, therefore, to examine the actual impact participation has on the perceived issues that are related to smart cities. Using an online questionnaire, we empirically tested the research topic on more than 500 individuals in different countries.

Keywords: Smart City adoption, Citizens, Participation, Digital Transformation

1 Introduction

In the world of unlimited connectivity, knowledge, and data, it seems like the smart cities concept is surely becoming one of the most exposed challenges on the earth. Undoubtedly, it brings a lot of interest and excitement to the table since it presents a futuristic project with many intriguing features that could hypothetically take the quality of life to another level. However, it seems like people have not accepted the concept yet as currently, smart cities tend to go hand in hand with a lot of burning issues due to lack of trust. For this reason, more and more scholars are pointing out the importance

of trade-off between tremendously improved services on one hand and challenging issues on the other.

Participation in relation to smart cities is not a novelty as it has been described by several authors. Among them Habib has described issues related to smart cities and has proposed participation as a solution [7]. Besides, a set up framework for participation in building smart cities together with possible implementations was proposed [20]. Additionally, the urge to turn to participation, the urge to turn to smart citizens instead of smart cities was also claimed [10]. Participation was also connected with a fundamental factor in achieving desired level of quality of life in smart cities [2]. In one of the recent systematic literature reviews [22] show some strong evidence about the importance of participation and engagement but also lists anticipated problems that could come with it. Reviewing the literature, we see that scholars have written about different aspects, implementations, etc. of the participation in smart cities, but no one has explored and quantified the impact participation would have on overcoming the issues and concerns people feel towards smart cities. Thus, our main focus of the research is to not only highlight participation as a possible solution in overcoming those issues, but to actually measure and find out if participation is a viable solution in terms of changing people's perspective towards smart cities.

The goal of our research is to examine the actual impact participation has on the perceived issues that are related to smart cities. We are starting with a literature overview, focusing on participation and perceived issues. We continue with explaining our methodology. After that we focus on the perceived issues, explaining our key findings about them. Our last part of the articles is about the impact of the participation has in solving the issues stated in a chapter before that. We highlight the results from the questionnaire and tie our findings to the literature.

2 Literature review

2.1 The definition of smart cities

An immense excitement for 'smart city' concept took its research to another level and the number of 'smart city' papers have exploded. However, there is still no universal description, let alone a definition.

The term 'smart city' is not entirely new since it was already mentioned in the late 1990s by Bollier in his 'smart growth movement'. However, it was not until 2008 that it became globally known as it was used by some big global corporations including IBM, Cisco, and Siemens [18].

Hollands raised doubts about the motive of big corporations in building smart cities. In other words, those descriptions mentioned the importance of people, but were still too 'technocentric'.

While smart city definitions are evolving from day to day a lot of 'new' propositions base on [16] description. They present a smart city as a human concept and therefore implement some sort of socio-institutional dimension. The concept of a smart city

means more than just technological city. City upgrades from technological to smart when the increased quality of life and continued sustainability is possible due to adequate investments in ICT and human capital.

By another popular definition [14] smart city is ‘a community that systematically promotes the overall wellbeing for all of its members, and is flexible enough to proactively and sustainably become an increasingly better place to live, work and play’. Even though this definition made another big step towards citizen-centric smart cities, it still completely respects dimensions defined by Nam and Pardo. Therefore, we adopted this definition as our basis for the purpose of our research.

2.2 Burning issues of a ‘smart city’ concept

In our literature overview we have highlighted the most relevant issues based on already existing literature and our own opinion. The expressed issues as such are perceived by individuals and could be nothing but lack of trust. For this reason we think that participation might be a possible solution. We have identified the following issues: 5g, Perceived privacy, Perceived security, Corporate interest and Overwhelmed by technology.

Health and security concerns due to 5G

It has been argued [13] that smart cities cannot be built without the implementation of the 5g network. Due to vast amounts of data needed, being able to be transferred only by 5g network, the timing for the first smart cities will be closely related to the timing of building a 5g network [13]. Different authors [1] have recognized the important social factor of implementing the 5G network. With 5G being crucial factor for implementing Smart cities, raising doubts in 5G network are highlighted in our article as an issue. Kumar have also written that there is a strong movement of people not in favor of 5G network being built. They concluded, that the majority of doubts are related by a distrust in the security of the networks. It has been found in the analysis of the social media activity of users writing about the 5G that the most expressed concerns are related to radiation and a threat of cancer, speaking in general that the most of the doubts are related to potential health issues [9].

Can smart cities fulfill perceived security?

Every single modern technology or invention brings new issues and challenges. Cerrudo [3] discusses different security problems in smart cities including lack of testing, poor security systems, encryption issues on devices, simple technology bugs, etc. Even though initially it seems like terrorism around the world is reducing, thinking that would be very naïve. It’s actually evolving like never before. Individuals with university degrees and very advanced skills are pursuing extremist groups. Since they basically live on the internet, cybercriminals are very well organized and have a lot of resources. Consequently, billions of dollars are lost every year because of many cyber attacks.

Every smart grid or city consists of numerous internet-connected devices. Therefore, a smart city with millions of connected devices over a wide area presents a very tempting target for cyber attackers. In addition, due to a big number of connected nodes attacks like this could be devastating [11].

The attack surface for smart cities is vast and wide open to attacks. The ‘smartening’ of cities does not increase the number or capability of a threat, but it does increase the vulnerability due to increasing complexity and widening the surface. Furthermore, it increases possible consequences since it is possible to deal real-world damage by attacking network or data [8].

For this reason, every technology that smart city implements must be security audited throughout to be completely sure about its safe use. If the data in smart cities system is not used with caution, it could be easily exploited. Thus, preventing security problems and hackings is one of the core things that have to be assured in a city for it to become smart instead of just being a ‘dumb’ city [3].

A thin line between smart and surveillance city

Modern smart city technologies and data-driven urban science raise numerous privacy harms [12]. In the concept of smart cities, privacy exceeds its physical definition of not being observed or disturbed since more advanced technologies collect information that goes beyond the physical sense. Instead, ‘smart’ definition of privacy should be built around modern concepts including IoT and cybersecurity. An important issues is the challenge of privacy in smart cities as the preservation of collected information about an individual’s physical characteristics behavior, habits, communication, location, associations and feelings [5]. More datafication means that people are exposed to even higher rate of surveillance. With every improvement or an innovation there is an increase in number of everyday aspects that are collected as data. With an increasing number of connected devices, cameras and unique identifiers (usernames, emails, IDs, etc.) it is becoming impossible to live without leaving so-called digital footprints and shadows [12].

Thus, excessive data collecting and even activity following may make the belonging citizens feel like they are taking part in Big Brother [7]. The importance of understanding several group’s preferences has also been pointed out [7]. What’s more, it is immensely important to analyze trade-off between city’s effectiveness and its security.

Smart cities as an opportunity for corporations

The process in building the smart cities has been so far made in a strictly top down manner and there is a vast corporate interest, due to an emerging new urban market with a potential of high profits [9]. Even more, doubts about corporatization of city governance were raised out, stating that technological corporations see city governance as a potential future market for their products. Those corporate interests can easily lead to a monopoly over the city’s technological platforms [12].

As stated, this can result in a path of a dangerous corporate dependency [12]. Different authors are emphasizing the rather importance of the smart citizens, not the smart city being run with the corporate interests [10].

How much of a new technology is too much?

Open innovation and modern technology can help cities reach so-called knowledge-based urbanization which should lead to continued economic development [23]. However, if a city uses advanced technology and connectivity, this does not necessarily mean that it is a smart city. These devices itself do not improve the quality of life or economy [7].

As [15] point out ‘smart city services would be better developed following the actual and precise needs of citizens. Otherwise, new implementations can lead to overwhelming technology. Current situation in China represents great example of several problems that show up while developing and integrating smart governments. The synergy between collected information and business is not as great as it is supposed to be. In addition, smart governments with a lot of modern technology result in high operating costs [4]. However, many question the impact of citizen engagement because of the increasing use of technology [7]. Consequently, lack of use could lead to big loss due to previously mentioned high operating costs.

Thus, it is challenging to assure data security in the process of digitalization of cities and integration of new technology [4]. This again leads to the previously mentioned issues of privacy and security which indicates how closely connected identified issues are. Similarly, [21] listed innovation concept, service quality and perceived privacy as a key factors of whether citizens would accept and use smart city services.

2.3 Participation as a possible solution

With the rise of the Design Thinking methodology, participation is becoming more widely recognized as a successful method in dealing with ‘wicked’ problems. Shelton writes about participation as ‘happy hypothesis of change through involvement of more people rather than fewer’ [19]. Participation is described as a process in which a subject takes a role in the planning and administrative processes of government [20]. Participation has been used as a method in fields that we associate as highly corporate and complex. The usage of participation has described in building hospitals, focusing on the inputs of all the stakeholder, including patients [17].

Several authors have recognized participation as a possible solution to the process of building and implementing smart cities. Extensive explanations and issues arising with smart cities were presented together with participation as a suggested possible solution [7]. Moreover, participation has been emphasized as the only way to keep the process democratic by highlighting the problem of people, who have the interest being unable to express their voice and being far away from the structures of power [19]. Participation has also been recognized as a vital factor in ensuring efficiency and good quality of life in the smart cities. The connection between smart city privacy challenges and people’s willingness to participate was also pointed out [2], meaning that is vital that participation is a building block from the very beginning of the process.

There are various possibilities of implementing participation in building the smart cities. Exploring many different possibilities, it is vital that we take into consideration all the important stakeholders [17]. As stated in the article about building the ‘world smartest city’ Medellin it is important that the focus is shifted from the technological part to the will of the people. In Medellin they have set up elections for people’s representatives, who have a direct word in setting up smart cities [6]. Representative group of citizens has been emphasized as a possible solution, not only in Medellin, but in various projects around the globe [20]. Speaking about the possible solutions, there is still much work to be done, many suggestions haven’t been tried on the smart cities case and it still uncertain, which options will work.

There are a lot of ideas that are currently being discussed and could save smart city concept from rising issues, but it seems like exactly participation seems like the best one. Scholars are even moving the definitions toward the more citizen-oriented smart cities that definitely involve some kind of participation. Therefore, a lot of discussions and literature analysis have been made in the last few years. However, there is a lack of quantitative analysis on this issues. For his reason, we focus on researching the actual impact participation has on issues related to smart cities and examining whether participation can be a solution in solving individuals’ perceived issues towards smart cities’.

3 Methodology

For the purpose of this article we have firstly made an in-depth literature review. After that a web-based questionnaire has been made. A web-based questionnaire has been testing a variety of topics related to smart cities. Among them we have tested issues that are related to the perceived issues by people, and we have tested what effect participation as a possible solution would have. With the questions relevant for our article we have used Likert scale ranging from 1, strongly disagree to 5, strongly agree.

As stated a questionnaire has been used to validate our research question. One question has been used to directly determine and analyze each of our five issues, having at least one question focusing on each of the aspects. Important part of the questionnaire is the one where we quantitatively tested participation as a possible solution. We also proposed some potential solutions, which are all based on participation and are related to perceived issues. We are measuring the impact participation would have in solving those solutions. We also measure how different actions would impact the trust people have towards participation, thus further exploring our research question.

Of the 1529 responses collected, more than 500 were retained after removing the non-completed ones. Data collection process began in May and was completed in August 2020. Table 1 presents the profile of the respondents.

The sample was selected from population of people living mostly in Slovenia. The pretest was done by a sample of 10 representative students. The results of the survey were analyzed using quantitative approaches. Participation oriented questions were analyzed and compared based on descriptive statistics. Independent t-test and ANOVA test will also be used for purpose of identifying differences between different groups based on gender and level of education.

Table 1. Profile of the respondents.

		Percent (%)
Gender	male	40.9
	female	59.1
Education	primary or less	5.2
	secondary	55.6
	tertiary	39.2
Type of settlement	urban settlement	62.2
	suburban areas	17.3
	small city	14.7
	village areas	5.8

4 Data Analysis

In the preliminary data analysis, we identified perceived issues of the participants towards the smart city concept. In order to answer our research question, firstly we wanted to see to which extent some problems identified in the literature are actual concerns of our participants. Participants agreed with listed issues, as ‘Implementing 5G networks’, with an average of 2.9, is the only one with an average below 3 (neutral).

Furthermore, we can see from the results that the majority of the concerns identified in the literature are actual problems perceived by our participants. With an average answer of 4,0 or above the participants have highlighted ‘data privacy’, ‘security issues’ and ‘the use of my data and preferences by the third parties’ as their biggest concerns. Among them ‘data privacy’ was identified as the most challenging issue with an average of 4.1. With the concerns being highlighted we have devoted the rest of our analysis in testing participation and its solutions as a possible solution.

Further, we asked participants to give opinion on actual solutions in development of smart cities. We highlighted seven possible solutions, which are related to participation and measured if the participants would trust more in the concept of smart cities. This question is focusing directly on our research question and are measuring how participation could affect the trust people have in smart cities.

Results can be seen in the Table 2 and Table 3. It is definitely positive that mostly it seems like the most attractive measures are also the ones that are fairly easy to implement, e.g. 81% of participants have agreed or strongly agreed that they would trust smart cities more if they would be introduced to potential dangers and corresponding benefits..

We additionally compared results based on gender variable. A T-test analysis has been conducted, calculating if there is a statistical significance in answers among the genders. The results of the analysis can be found in the third column.

The last part of the analysis consists of segmenting the audience based on their finished level of education. We have grouped individuals in four groups: high school, undergraduate programme, graduate programme and doctoral programme. In both tables in the column 4 results of the Anova test can be found.

Table 2: Attitude towards possible participation solutions

Variable I would...	Average	Std. Dev.	Sig. (gen.)	Sig. (edu.)
...trust smart cities more if they were built by local businesses.	2.9	0.94	.604	.079
...be willing to participate in building smart cities.	3.6	0.91	.008	.000
...have more confidence in the safety of smart cities if each individual could participate in round tables.	3.2	0.97	.207	.012
...trust the privacy of smart cities more if I could express my concerns at any point and talk to someone about the problem.	3.6	0.92	.635	.006
...trust smart cities more if I could make my own suggestions for improvements.	3.6	0.88	.090	.001
...trust smart cities more if I could elect representatives to represent me in decision-making.	3.5	0.93	.225	.002
...trust smart cities more if I were introduced to certain potential dangers (without embellishment) and corresponding benefits of smart cities.	4.1	0.81	.157	.108

Table 3: Attitude towards possible participation solutions

Variable: I would trust more in smart cities if...	Average	Std. dev.	Sig. (gen.)	Sig. (edu.)
...advantages and potential dangers of each upgrade or novelty would be presented to me before implementation.	4.1	0.79	.071	.008
...each innovation would be implemented only after a successful trial period.	4.2	0.72	.069	.357
...I could test certain functions by myself before implementation.	3.9	0.84	.402	.090
...in the case of a negative testing experience, the idea could also be rejected by the users themselves.	4.2	0.73	.686	.487

5 Discussion

As seen in our analysis we have determined that there are various problems and concerns identified in the literature, which are actually present among the people. In the beginning of our article we have proposed the research question if participation could be a solution. In the preliminary analysis we have examined participation and, being aware of the sample the size, we would like to express that participation is a viable solution in solving concerns people have towards smart cities.

Our issues were well accepted as every highlighted concern got an average answer of at least 3 with an exception of 5G networks which was very surprising. Due to all the smoke in media we expected that implementation of 5G networks would present a huge concern for participants. As it has also been pointed out [1] that there is an important social factor of building a 5g network. Concluding the analysis, we can state that the social factor of building a 5g network should not be the biggest concern of the stakeholders. It has been stated [13] that there is a ‘strong movement’ not in favor of the implementation. From our results we can conclude that there may be a movement, but the concern does not irritate the majority of the people.

Perceived security has been highlighted in the literature as being ‘one of the most important issues’ [11]. Similarly, it is not only an issue in the technological terms, but also in the minds of the people. Perceived security is with an average answer above 4, among the three issues that concern the people the most. It has been argued [12] that it is becoming impossible to live without living digital footprints and shadows. People are deeply aware of that and this reflects in their perceived issues towards the smart cities. ‘Data privacy’ and ‘The use of my data’ are among the perceived issues with the biggest average. To some extent we have proved that those issues could be overcome by participation. But, there is a paradox that when you participate, even more data about you is collected and could be potentially misused.

Being a part of a project like building smart cities, can due to ethical concerns regarding the data collection be discouraging for some. In order to participate or to collaborate you have to be even more involved in the ‘system’, thus more of your data is being collected. On one hand we are trying to mitigate the perceived issues, but on the other we are suggesting that people would be even more exposed to it. There is a thin line between participation and too much participation.

In following research we have presented participation as a possible solution. We measured to which extent the people would be willing to participate in building the smart cities. As it has been found [2] in the theoretical framework there is a connection between arising issues and people willing to participate. With an average of 3.6 we can state that people are to some extent willing to participate in the process. This average more or less aligns with the average of the perceived issues towards the smart cities concept.

Furthermore, when measuring the different possibilities for participation, which were already pointed out [20], we found out that the answer that would change the individuals perception the most is the one focusing on explaining the potential benefits and dangers of the project. This is mostly the case with implementing participation. We

can see a big impact already in implementing steps that are relatively easy to implement, such as educating the people about the concept and project. Interestingly enough some ideas, which are harder to implement have yielded worse results. For example, the answer 'I would trust smart cities more if they were built by local businesses' has had an average answer of 2.9. Meaning that the average was below neutral. One could argue that moneywise it could be easier to educate people than to solely rely on local companies when building the smart cities.

In general, all of the ideas would greatly affect individual's perceived issues with the average being way above the neutral. We have only focused slightly more on a concept, which is very popular among scholars, trial periods. Trial period has proved in our research to be the idea that would yield the highest result in solving individuals perceived issues towards the smart cities. One question focusing on the topic has an average of 4.1 and the other has an average of 4.2. It is very important that the ideas that have yield the highest results are implemented and tested, when building smart cities.

As mentioned in the analysis we have conducted analysis based on gender and education. Starting with the gender, as it can be seen from the data small differences can be seen. The only question where significant difference has been calculated is the one regarding how willing individuals are to participate in the project of building smart cities. We can see that men would be more willing to participate than women. However, generally no other significant difference has been detected and therefore we can conclude that gender does not play a role in perceiving participation as a viable solution to our research problem.

Lastly, we conducted a segmentation based on education level. A statistical significance has been found in the majority of the questions (6/11), meaning that answers were greatly impacted by the education level of the individuals. In addition, an interesting observation can be made. Individuals with undergraduate and graduate level are found to be more prone to accept participation as a solution in overcoming their perceived problems. We can observe similar patterns among the individuals with the undergraduate (2) and graduate (3) education level and on the other hand there are similar patterns with the individuals who have high school (1) or doctoral (4) level of education. Results conducted in segmentations are very interesting and should be researched furtherly, especially in finding the reason behind those connections between very different groups.

6 Conclusion

We believe that there is a positive answer to our research question and that participation is a solution in solving individuals' perceived issues towards smart cities. Even more, we would like to express that there are some participation solutions and practices, which are easy to implement and would have a significant impact on the trust people have in smart cities. We would like to emphasize that those solutions should be studied and used by innovators, researchers, governments and builders of the smart cities.

Now that we have highlighted and proved that participation is a viable solution, we have only laid the fundamentals. There is a vast space of unknown that can be explored by implementing participation in real case studies and measuring the impact it has on real scenarios. We are looking forward to further researching and discussing this specific topic.

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