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PERCEPTION OF SMART CITY TECHNOLOGIES BY CITIZENS OF TYUMEN REGION

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Abstract

At present modern cities are multilevel systems in which inhabitants interact with each other and with city environment elements, using the smart technologies with various degrees of intensity. Besides, the development of many Russian cities is associated with the smart city concept's active introduction. Its effective implementation is impossible without citizens' participation and their awareness and perception of existing smart technologies in the city. There is a lack of reviews concerning the perception of smart technology in Russia. This topic's study is relevant because of the active implementation of this concept into Russian cities' practice. This study aims to analyze smart cities' concept by citizens of the Tyumen region, evaluate smart technologies' perception, and demonstrate their positive and negative perception of them. The article presents various approaches to studying the concept of smart city and its elements in the scientific literature and the role of citizen participation in it. During the research, the questionnaire was developed and used for the citizens of the Tyumen Region. A questionnaire results of three cities of the Tyumen region related to their perception of smart technologies introduced in cities were analyzed. The received results showed that the existing concept of a smart city in the Tyumen region was focused on the Information and communication technology component, smart infrastructure. However, it was developed without considering the needs of the citizens and did not contribute to the improvement of the quality of their life.

Keywords: City, smart citizens, smart city, smart technologies

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1. Introduction

In recent decades, the smart city concept remains one of the most popular concepts of urban development. The popularity of the concept is explained by city authorities' intention to solve the significant problems of urbanization related to the implementation of the smart city concept. However, after two decades, there is no unified definition of a smart city and approaches to smart city projects.

The number of scientific researches concerning smart cities significantly growing. Nowadays there are different approaches and perceptions of the concept of a smart city. But there is no commonly agreed definition of smart cities (Yigitcanlar et al., 2018).

The theoretical and methodological fundamentals of the research are based on results of scientists which are devoted to the theory and practice of creating a smart city. Among the most significant works are the studies in which the profound semantic analysis is presented (Cocchia, 2014) and different definitions of smart city are given (Albino et al., 2015; Eremia et al., 2017; Mora et al., 2017; Trindade et al., 2017). The great attention is paid to the work of Joss where the webometric analysis of the publications regarding the elements of smart city concept as well as the scientific researches which criticize it are pointed out (Joss et al., 2019).

In 1990s smart cities are considered to be the cities using ICT to increase intellectuality, interaction and efficiency of important components of city infrastructure and services, including governance, education, health, public security/ safety, transport, real estate and housing and utilities services (Cocchia, 2014). Today, smart city projects seemed to pay more attention to provide economic development and quality of living outcomes using modern technologies' capabilities - perhaps as, in the short run, these are more profitable and relatively easier tasks to deliver (Hollands, 2015). In other words, during the last decade, the smart city concept became a buzz word predominantly for technocentric urbanisation with recognition of flexible and mobile means of production and innovation.

The issues concerning the role of citizens and their participation in smart city projects realization are often arisen in scientific discussions in early 2013. There are many researches devoted to the role of citizens participation in smart city projects and their perception of modern different technologies implementing in these cities (Cowley et al., 2018; Degbelo et al., 2016; Marsal-Llacuna, 2017; Woetzel & Kuznetsova, 2018).

The investigations of other scientists demonstrate the citizen unwillingness of interacting with this ubiquitous technology (Hollands, 2015; Suopajärvi, 2017). Some studies are based on the analysis of the expert opinion of city managers who have developed and realized the smart city concept (Alawadhi et al., 2012; Valdez et al., 2018). But nowadays modern researches regarding smart city are critical (Griffiths, 2020; Routray et al., 2019). More often social inequality which is appeared in smart cities at the expense of elements of smart city concept implementation is discussed. Townsend and Kitchin highlight the ethical problems of ubiquitous smart city technologies (Kitchin, 2016; Townsend, 2013). Rivera et al. (2015) analyze the danger of the human essence loss due to widespread ICT implementation.

Smart city projects, nonetheless, are big and expensive capital investments - supposed to drive societal and environmental transformations, thus very hard to properly deliver (Yigitcanlar et al., 2018).

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To realize this project successfully it is necessary to take into account the role of citizens and their perception of smart city conception.

2. Problem Statement

Many studies on smart cities focus primarily on technological aspects. Investments and efforts by city administrations indeed remain important factors in the successful implementation of technologies, but many of them have only an indirect or negligible impact on the lives and behaviour of citizens. The ordinary citizen often does not notice any influence of smart technologies on his everyday life because they do not require his direct participation in them. This does not negate the importance of such solutions for a city, because they allow city authorities and residents to save money, time, and energy. At the same time, the success of implementing the smart city concept will depend on the level of awareness and perception of these technologies by citizens, as well as on the level of their civic activity.

In our research, we focused on these aspects, aiming to study the level of awareness and perception of smart technologies in the Tyumen region's cities to develop recommendations for improving urban development programs.

3. Research Questions

The research questions for this study were: What is the awareness and perception of smart city technologies among the Tyumen region residents?

4. Purpose of the Study

The purpose of the work is to study the perception of a smart city's concept by citizens of Tyumen region, their assessment of both positive and negative effects on the introduction of smart city technologies.

5. Research Methods

The article presents data taken from the survey of residents living in Tyumen region, which was conducted in April-June, 2020 using the «SurveyMonkey» application. 877 people were from Tyumen, 498 people from Khanty-Mansiysk, 442 people were from Tobolsk and all of them took part in this survey. The sample of the people was done by quota, sex and age. The sample error does not exceed 3% of each feature. quantitative data

The respondent perception of smart technologies was assessed during the study using the following questions "Which of the smart city technologies listed in the table are there in your city?», «Which of the smart city technologies do you use and do you have some benefit from them?» A list of 26 the most updated technologies of smart city was presented for the assessment. To assess the results of the survey concerning the use of the smart city technologies the following answers were offered to answer the question: «This technology is not available in our city», «This technology is available in our city, but I don't use it», «I use this technology but I don't have any benefit from it», «I use this technology and it

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makes life easier», «I don't know about this technology». To make the analysis much more convenient and presentative the results of answers versions such as «This is not available in the city» and «I don't know» were transformed into the answer «I am not informed about the existence of this technology in our city».

Respondents were offered to rank smart city technologies according to their influence on life using a scale from 1 to 5 scores (1 score demonstrates a negative influence and 5 score shows a positive one).

6. Findings

Table 1 demonstrates the results of the analysis concerning citizen perception of existing smart technologies in the cities of Tyumen region.

Table 1. List of existing smart city technologies in cities of Tyumen region[1]

Smart technologies	Tyumen				Tobolsk				Khanty-Mansiysk			
	1	2	3	4	1	2	3	4	1	2	3	4
Mobile parking applications	50	30	6	14	94	5	1	1	82	10	4	4
Smart traffic lights	56	12	8	24	92	4	1	3	64	8	5	23
Mobile public transport applications	15	30	6	49	76	12	2	10	63	21	5	11
Information boards or kiosks at city bus stops	30	33	10	27	47	34	5	14	51	28	6	15
Electronic travel tickets	33	27	6	34	26	45	4	25	78	13	3	6
Electronic register for school children	35	34	8	23	26	31	7	36	33	28	7	32
Register in educational institutions	26	35	8	31	32	26	5	37	23	29	7	41
Unified patient's medical card	38	17	10	36	37	14	9	40	53	8	11	28
Official city sites and mobile applications for making doctor appointments	11	25	11	53	22	15	13	50	17	14	13	56

[1] For presentation, the answers to the question are numbered inside the table: 1 - I am not informed about the existence of this technology in our city; 2 - This technology is available in our city, but I don't use it; 3 - I use this technology but I don't have any benefit from it; 4 - I use this technology and it makes life easier.

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Automated electrical and building heating systems	50	16	7	28	87	4	3	6	60	10	6	24
Smart street lighting	47	12	9	32	87	4	2	7	57	9	5	29
Environmental monitoring tools	71	15	5	9	93	4	2	1	84	6	4	6
Separate garbage collection	50	18	11	21	70	6	13	11	35	14	16	35
Remote water quality management	76	10	6	8	98	1	0	1	85	5	4	6
Real-time crime maps	77	10	7	6	97	1	1	1	89	5	3	3
Intelligent surveillance and biometric platforms	74	12	7	7	96	2	1	1	78	11	5	6
Online platforms for Online voting platforms for house residents/owners	68	16	6	10	91	5	1	3	80	9	4	7
The city's official websites and pages in social media sites	19	32	11	38	16	17	21	46	19	25	13	43
E-government	29	36	10	25	62	18	7	13	33	30	10	27
Electronic public services	12	18	9	61	10	7	10	73	13	11	8	68
The possibility of electronic fee-paid services in city transport	10	20	7	63	13	24	4	59	38	15	5	42
City internet stores and delivery services	15	23	6	56	37	17	1	45	26	17	7	50
Unified paying platform for state and municipal services	25	16	7	52	59	7	3	31	36	10	5	49
Bidding or selecting supplier’s application	58	22	6	14	88	5	2	5	69	16	5	10
City free wi-fi	29	36	8	27	87	8	2	3	74	12	4	10
Wireless access to public transport	61	18	6	15	93	4	1	2	84	7	2	7

The results given in table 1 show that most of Tyumen residents are familiar with many «smart technologies». Not more than 15% of the respondents demonstrated a lack of awareness of such technologies as mobile applications for public transport, official city sites and mobile applications for making doctor appointments, electronic public services, the possibility of electronic fee-paid services in

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city transport, city internet stores and delivery services (that is, technologies implemented in the city). 16-30% of respondents from Tyumen were not informed about the city's official websites and pages in social media sites, e-government, a unified platform for paying for state and municipal services, and city free wi-fi. It can be explained that the respondents just do not use these technologies which are implemented in the city. Tyumen residents are poorly informed about technologies such as environmental monitoring tools, remote water quality management, real-time crime maps, intelligent surveillance and biometric platforms, bidding or selecting supplier's application, and wireless access to public transport. More than 60% of respondents said they didn't know whether these technologies were used in their cities. Probably it is because these technologies are not demanded by all groups of citizens who participated in this survey, and their awareness about the implementation of these technologies which are connected with the professional or social activity.

The most demanded smart technologies in Tyumen residents were mobile parking and public transport applications, information boards or kiosks at city bus stops, electronic travel tickets and electronic register for school children, mobile doctors' appointments and children registration at school, official city sites and pages in social media site, e-government, urban free wi-fi. One-third of respondents noted that they used these technologies actively which are required in everyday city life and social services.

Tobolsk citizen perception considerably differs from one of Tyumen respondents. It is related to a small number of technologies in this city. 70% of respondents in Tobolsk showed a lack of information concerning 14 smart technologies of 26. About 30% of these respondents demonstrated unawareness of 5 technologies of 26.

The most common technologies which are used by Tobolsk citizen are the following such as electronic register for school children, an electronic register in educational institutions, a unified patient's medical card, city sites and mobile applications for doctor appointments, official sites and pages of the city in social media sites, city online stores, the possibility of non-cash payments in public transport. Thus, as in Tyumen, the list of smart technologies in Tobolsk includes mainly those related to everyday urban life and social services, but it should be noted that the list of technologies to which Tobolsk residents are adapted is somewhat smaller.

Residents of Tobolsk consider that the most useful smart city technologies are city sites and mobile apps for doctor appointments, e-services and the possibility of non-cash payments in city transport. At least half of the respondents. However, as many as half of the respondents indicated that they use these technologies, it makes their lives easier. Tobolsk residents, as well as Tyumen residents, rarely pointed out the uselessness of smart technologies, but every fifth of considers city sites and city social media pages useless.

The estimation of the smart technologies perception by the residents of Khanty-Mansiysk can be considered as an intermediate version between Tyumen and Tobolsk residents estimation. Actually, it is explained that the governance of Khanty-Mansiysk implemented a wide range of smart technologies than Tobolsk one. More than 70% of Khanty-Mansiysk's residents demonstrated a lack of awareness of 9 smart city technologies out of 26 which were noted in the survey (4 technologies are in Tyumen, 14 is in Tobolsk).

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The residents of Khanty-Mansiysk are the most active user of such technologies as an electronic diary, an electronic register in educational institutions, official sites of the city in social media, mobile applications for doctor appointments, automatical systems of power supply and heating of buildings, smart street lighting, optimization of collection of waste, online shopping services, the possibility of non-cash payment in public transport – at least a third of respondents use them. At the same time, the list of these technologies is somewhat narrower than in Tyumen but wider than in Tobolsk.

The residents of Khanty-Mansiysk suppose that they have the greatest of using official city sites, mobile applications for doctor appointments, the e-governance services, as well as online stores and delivery services. All of these services make their life much more comfortable. As for the residents of Khanty-Mansiysk they rarely noted the uselessness of applying smart technologies as compared to the residents of other cities. But 16% of surveyed residents in Khanty-Mansiysk considered the separate garbage collection to be useless (11% in Tyumen and Tobolsk). In the case of Tobolsk residents, 31 percent of respondents gave average estimates and the proportion of positive evaluations was also noticeably higher than the proportion of negative evaluations - 47 percent as against 21 percent (1 percent difficult to answer). It should be noted that the proportion of negative efficiency ratings is higher in Tobolsk than in Tyumen, which is likely to be due to the fact that technology is less widely adopted in the city and more mistrustful of its inhabitants. Khanty-Mansiysk residents' estimates were closer to those of Tobolsk residents: a positive-negative ratio of 47% to 17%, average score of 35 percent (1 percent of respondents having difficulty answering).

Respondents were offered to rank smart city technologies according to their influence on the life using the scale from 1 to 5 scores (1 score demonstrates a totally negative influence and 5 score shows totally positive one). Among the Tyumen population, average scores predominated (37 percent of respondents rated the effect as 3), while negative scores (1+2 point) were significantly lower than positive scores (12 percent versus 49 percent). Only 2 percent of the respondents had difficulties in giving estimates.

The received results showed that an average score for Tyumen citizens was 3.6, an average score for Tobolsk residents was 3.4, and 3.5 was in Khanty-Mansiysk residents. These results indicated that the inhabitants of these cities were sufficiently adaptable to smart technologies. It also shows that the more technologies are introduced in the city, the more the city residents appreciate their efficiency. Despite high ratings of the effectiveness of smart technologies, at the same time citizens evaluate the negative effects of their implementation (table 2).

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Table 2. Distribution of answers of respondents to the question: «What effects of smart city technologies negatively influence on you and your city? », % of the amount of respondents Tyumen region cities

List of negative effects	Tyumen	Tobolsk	Khanty-Mansiysk
Identity loss	15	14	11
City cultural heritage loss	18	21	7
Increase in disunity between people	23	30	18
Increase the digital inequality between generations	37	31	36
Increase in control for citizens	36	30	46
Blurring differences between cities and countries	6	5	4
Increase in social inequality	20	15	17
Privacy loss	32	30	44
City and tax resources, funds waste	14	13	18
Demand of spending time on mastering new technologies	14	18	12
Increase in risk of fraud and manipulation of citizens	42	58	48
Introduction of a citizen's loyalty card	8	8	10

The table 2 shows that the respondents often associate the negative effects of smart technologies with the increased risks of fraud and manipulation of the citizens, growing digital inequality between generations and high control for citizens, loss of privacy. In addition, respondents often are afraid that digital technologies can lead to social disconnection between people. Citizens are less concerned about the impact of digital technologies on the loss of the city's cultural heritage, identity, as well as the loss of resources associated with the development of smart technologies such as economic and temporary. Citizens are least concerned about the introduction of a citizen's loyalty card and the blurring of differences between cities and countries. 46% of Khanty-Mansiysk respondents are more often concerned about increased control over citizens and 44% of them are worried about loss of privacy. 7% of Khanty-Mansiysk respondents notice the loss of the city's cultural heritage as compared to 18% of respondents

Tyumen and 21% of them is in Tobolsk. It can also be noted that residents of Tobolsk are much more concerned about the risks of fraud and manipulation, and much more often about the loss of the city's cultural heritage.

7. Conclusion

The study showed that the perception of smart technologies by residents of the Tyumen region depended on the direction of the technologies themselves and their implementation scale. Thus, Tyumen residents showed a higher level of awareness and adaptation to smart technologies than residents of Khanty-Mansiysk. Simultaneously, the residents of Khanty-Mansiysk demonstrated a higher level of awareness and adaptation to smart technologies higher than residents of Tobolsk due to the number of smart technologies implemented in these cities. In addition, residents of all cities marked a higher level of awareness and adaptation to technologies which were closely related to everyday urban life and social services, and a lower level – to those technologies that were not in demand in all categories of citizens, but were related to their professional or social activities. In general, the survey results showed a low level of awareness among citizens of Tyumen region concerning the elements and technologies of a smart city. The survey results confirmed that cities with a higher standard of living were transformed faster, despite low level of public awareness of smart solutions.

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