St. Petersburg State University
Graduate School of Management

Master in Public Management

THE ROLE OF E-PARTICIPATION IN PUBLIC TRANSPORT CHOICE: THE CASE OF ST. PETERSBURG

Master's Thesis by the 2nd year student
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АННОТАЦИЯ

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Название ВКР	Влияние электронного участия на повышение привлекательности общественного транспорта (на примере Санкт-Петербурга)
Образовательная программа	Высшая школа менеджмента
Направление подготовки	Государственный менеджмент
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Научный руководитель	Екатерина Владимировна Соколова
Описание цели, задач и основных результатов	Цель исследования - выявить влияет ли возможность электронного участия на привлекательность общественного транспорта. Для достижения цели был изучен современный научный дискурс касательно электронного участия. Так как электронное участие является частью “smart” концепта, в работе были изучены основные подходы к данному термину в городском контексте. Также были изучены современные концепции использования “smart” технологий в общественном транспорте. Для достижения поставленной цели в работе использовался метод опросного эксперимента. Эксперимент показал, что возможность электронного участия положительно сказывается на привлекательности общественного транспорта.
Ключевые слова	Электронное участие, умный транспорт, умный город, городская мобильность

ABSTRACT

Master Student's Name	Bortnikov Nikita
Master Thesis Title	THE ROLE OF E-PARTICIPATION IN PUBLIC TRANSPORT CHOICE: THE CASE OF ST. PETERSBURG
Educational Program	Graduate School of Management
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Academic Advisor’s Name	Ekaterina Vladimirovna Sokolova
Description of the goal, tasks and main results	The purpose of the study is to determine whether the possibility of e-participation affects the attractiveness of public transport. To achieve this goal, the current scientific discourse on e-participation was studied. Since e-participation is part of the “smart” concept, the main approaches to this term in the urban context were studied. Modern concepts of using “smart” technologies in public transport were also examined. To achieve the goal of the research, the method of a survey experiment was used. The experiment showed that the possibility of e-participation increases the attractiveness of public transport for citizens.
Keywords	E-participation, smart transport, smart city, urban mobility.

ЗАЯВЛЕНИЕ О САМОСТОЯТЕЛЬНОМ ХАРАКТЕРЕ ВЫПОЛНЕНИЯ ВЫПУСКНОЙ КВАЛИФИКАЦИОННОЙ РАБОТЫ

Я, Бортников Никита Андреевич, студент второго курса магистратуры направления «Государственный менеджмент», заявляю, что в моей магистерской диссертации на тему «Роль корпоративной социальной ответственности в развитии монопрофильных городов в России», представленной в службу обеспечения программ магистратуры для последующей передачи в государственную аттестационную комиссию для публичной защиты, не содержится элементов плагиата.

Все прямые заимствования из печатных и электронных источников, а также из защищенных ранее выпускных квалификационных работ, кандидатских и докторских диссертаций имеют соответствующие ссылки.

Мне известно содержание п. 9.7.1 Правил обучения по основным образовательным программам высшего и среднего профессионального образования в СПбГУ о том, что «ВКР выполняется индивидуально каждым студентом под руководством назначенного ему научного руководителя», и п. 51 Устава федерального государственного бюджетного образовательного учреждения высшего образования «Санкт-Петербургский государственный университет» о том, что «студент подлежит отчислению из Санкт-Петербургского университета за представление курсовой или выпускной квалификационной работы, выполненной другим лицом (лицами)».

_____ (Подпись студента)

03.06.2020 (Дата)

STATEMENT ABOUT THE INDEPENDENT CHARACTER OF THE MASTER THESIS

I, Bortnikov Nikita Andreevich, second year master student, program «Public Management», state that my master thesis on the topic «The Role of Corporate Social Responsibility in the Development of Single-Industry Towns in Russia », which is presented to the Master Office to be submitted to the Official Defense Committee for the public defense, does not contain any elements of plagiarism.

All direct borrowings from printed and electronic sources, as well as from master theses, PhD and doctorate theses which were defended earlier, have appropriate references.

I am aware that according to paragraph 9.7.1. of Guidelines for instruction in major curriculum programs of higher and secondary professional education at St.Petersburg University «A master thesis must be completed by each of the degree candidates individually under the supervision of his or her advisor», and according to paragraph 51 of Charter of the Federal State Institution of Higher Education Saint-Petersburg State University «a student can be expelled from St.Petersburg University for submitting of the course or graduation qualification work developed by other person (persons)».

_____ (Student's signature)

03.06.2020 (Date)

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INTRODUCTION

People in different countries and on different continents are rushing to cities increasingly in search of jobs and opportunities for the future. According to United Nations estimates, the daily growth of the world urban population is about 200 000 people (UN, 2017). Today, half of the world population, that is a approximately 3.5 billion people, lives in cities and urban agglomerations. IBM forecasts that this number increases to 6.5 billions by 2050 (IBM, 2016).

Such rapid urbanization leads to a tremendous strain on the transport infrastructure. The ever increasing traffic has exceeded the capacity of city roads that leads to congestion, the increase of travel time, amount of consumed fuel, and emissions polluting the environment.

Most of city planners and researchers see the solution to traffic problems in the development of public transport (Herzog, at al, 2018; Villani, 2010; Brezina at al, 2019). Modern public transport must become more attractive for city residents in comparison to private cars. At present time, one of the dominant approaches, that tries to achieve this goal, is the use of digital technologies in transport infrastructure (Zawieskaa, Pieriegudb, 2018). A variety of technological means such as sensors, geolocation systems, ticket validators and etc., provide better control over the transport flows and allow to collect big amount of data to improve the network of public transport. Theoretical framework that studies the application of ICT to urban mobility is a “smart transport” concept.

The “smart transport” concept is highly techno-centric because it focuses only on a technical domain of “smartness” (Giuffrè, Di-Dio, 2017) while “smartness” in the urban context means not only filled with modern technologies but also the development of human capital and communication between stockholders. The review of existing smart transport solutions also showed that there are no special ICT-based solutions on the current market that would provide communication between passengers and public transport provider.

Citizen participation is considered to be a crucially important factor of development more sustainable society, since it gives an access to more information that can be used by authorities to make more accurate decisions (Council of Europe, 2009). This statement is also relevant for the development of urban mobility. Modern city transport systems are characterized by their complexity, and the governance of complex systems requires the establishment of multiple feedback and self-regulation mechanisms, that can be provided by participation tools.

Thus, it is reasonable to ask if the communication domain of “smartness” should become a part of the “smart transport” concept to increase the attractiveness of public transport. In other words, if city residents are provided with opportunity to e-participate (which means to complain or comment on the work of public transport online as well as to share and vote for ideas about its

development), would it influence their transport behavior, making them to choose public transport instead of private cars? The answer to this question gives city authorities possibility to define whether it is worth to spend money on introduction of e-participation in public transport sphere or not. Therefore, the goal of the current research is to determine whether the possibility of e-participation increases the attractiveness of public transport for city residents.

To get the full answer to the research question, several sub-questions should be researched:

- Do citizens want to e-participate in the development of urban mobility?
- If they want, what degree of participation do they prefer and what is the most preferred e-participation channel for them?

Serving the goal, the research sets the following objectives:

1. To identify citizen e-participation and highlight its levels;
2. To study e-participation in the transport context;
3. To find the main features of "smart public transport";
4. To study the best practices in the current market of smart public transport solutions;
5. To develop questionnaire for survey-based experiment to find if e-participation increases the attractiveness of public transport;
6. To determine the readiness of citizens to e-participate and the most preferred e-participation channel for them;
7. To develop logit regression model to find what socio-demographic characteristics affect the readiness of citizens to e-participate;

Hence, the object of the research is citizen e-participation, whereas the subject is the role of e-participation in public transport choice.

To test the hypothesis if opportunity of e-participation increases the attractiveness of public transport, method of survey-based experiment was used. This method is becoming an increasingly widely used in such science as: sociology, psychology, management, economics, public police, law, etc. The full description of the method and the reasons for its use are provided in the first part of the second chapter. The method of logit regression was also used in the paper to define which socio-demographic characteristics of respondents influence on their readiness to e-participate.

The experiment was conducted in Saint Petersburg because of two reason: the first one, the city experiences the problems with transport traffic (hence, it crucially important to encourage people to use public transport), the second one, the government of the city plans a transport reform (the findings of the research potentially may be used for the reform). According to the reform plan, the city administration does not plan to develop e-participation tools. If the results of the study show that e-participation increases the attractiveness of public transport, then the city authorities should add this item to the reform agenda.

The novelty of the paper is that currently there are no any theoretical or empirical researches about the role of e-participation in public transport choice. The result of the research will cover this gap and also provide practical recommendations for city authorities to improve the attractiveness of public transport

1. E-PARTICIPATION IN TRANSPORT CONTEXT

The current chapter presents the analysis of modern approaches to e-participation. Since e-participation is usually considered as a part of "smart" concept, the "smart city" concepts are examined to define the main features of "smartness" in urban context. Furthermore, in the third and the forth parts of the chapter the application of "smart" ideas to city mobility is studied both on theoretical and empirical levels.

1.1. Citizen Participation in development of urban mobility

Citizen participation, also known as public participation or political participation, is the inclusion of people, who are not vested with power, in the political decision-making process by state and local authorities on issues that directly affect the interests of these people. Political participation refers to the voluntary activities of ordinary citizens (Council of Europe, 2009).

The main goal of citizen participation is to improve the quality and efficiency of public administration processes. In this case, "efficiency" means, on the one hand, reducing the cost of finding an optimal solution to complex management problems that affect the interests of a significant number of citizens and businesses, and, on the other, preparing a solution that takes into account the interests of all affected parties to the maximum extent possible (Avritzer, 2014; Cornwall, Gaventa, 2001).

Before to go to citizen participation in urban mobility, it is necessary to understand what is public participation in general. The research that addresses to the topic began in the late 60s of the 20th century. In that time, so called "classical theories" of citizens participation were developed (Smyth, 2001).

The Code of Good Practice for Political Participation in the Decision-Making System (Council of Europe, 2009) summarizes the main ideas of the original approach to political participation. In this report tools and mechanisms of citizen participation were classified into four categories depending on the levels of involvement:

- Information: citizens have free access to up-to-date, relevant, accurate and timely information. In this group, the information distribution is one-way and there are also no direct tools for citizens to defend their interests. At these level citizens are not really involved in the planning or implementation of programs;
- Consultation: authorities collect suggestions from citizens. However, gathered in this group instruments do not guarantee a high degree of participation because local administration accepts the initiatives of public at their own discretion. It implies that

merely delivering information to the public and collecting feedbacks is not considered as a real involvement until information, that is collected, is eventually considered;

- Dialogue; the authorities initiate public discussions to determine the interests and opinions of different public groups. In this form, public groups have the opportunity to defend their interests and rights.
- Partnership; working groups are formed on a permanent or ad hoc basis to express public opinion and to actively protect the interests of citizens. The authorities not only make decisions taking into account the public opinion, but also involve the citizens in design and implementation of projects.

It can be noticed that citizen participation actually is the scale of different forms of involving from just informing to active engagement citizens in decision-making process. Moreover, the scale is vertical, which means that the higher level of participation cannot been achieved if the previous one is not properly developed. The figure 1 illustrates this scale.

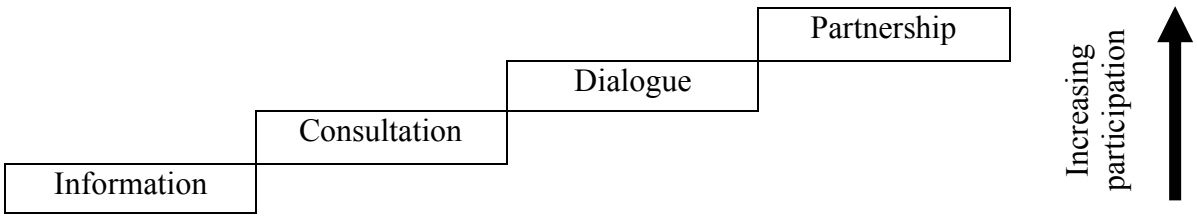

Figure 1 Scale of participation (biased on Council of Europe, 2009)

There are various forms through which consultations, dialogues and partnership may take place: focus group meetings, round tables, public forums and conferences. The first two methods fit for a smaller number and the next two – for a greater number of direct participants. The number of participating citizens is an important problem, since public participation should represent the needs of all social groups and at the same time be feasible (Verdegem, Verleye, 2015).

Therefore, the classic approaches to organization of participation have several limitations. The time, when, for example, round tables or public forums occur, can lead to bias in a study group. Although, these kinds of events often take place in evenings, it is still difficult for vast majority of people and their families to participate in them because they are usually occupied with work and other events throughout the week (looking after children, housework, shopping etc.). That is why these events are usually attended by the elderly, the retired and those who have a particular interest in the topic being under discussion.

Classical involvement tools demand people to spend their time to take part in participatory events. If people find the procedure too time-costly, they may opt out of taking part (Sutcliffe,

2017). This could be particularly true for the big group of "standby participants", citizens who are interested in politics and society but still prefer to remain largely inactive because of high time costs (Nabatchi at al, 2014).

The issue of an unrepresentative participation process can be solved by the introduction of new electronic tools for citizen involvement. Works by Stern, Gudes, and Svoray (2013) found that ages and occupational rates of participants vary between the classical participation methods and e-planning tools.

Government-to-citizen e-participation may be also categorized as classic one in terms of the degree or level of interaction between the authorities and people, distinguished among information, consultation, participation (Coleman, 2012). Three levels of participation can be defined depending on the depth of interaction.

- E-informing. At this level, authorities websites contain up-to-data information about policies and programs, laws and regulations, budgets, and other issues of public interests. Governments also provide software facilities, such as email subscription lists, online newsgroups, and web forums, for the distribution, and prompt access and use of public information and services;
- E-consultation. At this level, authorities provide online consultation means and tools, that enable people to vote (to choose) for a particular decisions that have already been formed by government for them. Also through these tools government may gather feedbacks or opinions of citizens, and then use this information for making decisions;
- E-participation. At this level, local authorities try to bring people into decision-making processes usually by participatory budgeting method. Government provide online participation platforms where people can suggest possible solutions, discuss them, give feedback, and vote for initiatives.

In this paper e-participation is considered as the combination of e-consultation and e-participation according the above categorization. E-informing is not examined in the current research, since it does not imply the real involvement of people in decision making process. Hence, based on the information above, the following definition is used in the paper: e-participation is a set of ICT-based tools that enables citizens to complain or comment on the work of public services online as well as to share ideas, discuss them, give feedback, and vote for initiatives.

Smyth (2008) combined the existing methods of e-participation into four categories: (1) online service delivery, (2) online discussion, (3) online opinion surveys (e.g., tools for choosing between alternatives), and (4) online decision support, such as tools for exploring different planning scenarios (Figure 2). He also placed these categories on the scale depending on the level of involvement.

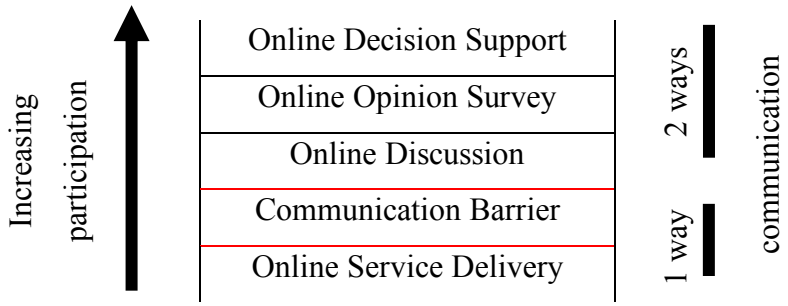

Figure 2 Scale of e-participation tools (based on Smyth, 2008)

E-participation is ICT-based in its essence. Thus, it is usually considered as a part of "smart" concepts. The cornerstone of "smartness" is the use of modern digital technologies. "Smartness" is an acquired trait: it means when ICT is begun to be widely used in any field of human activity, then this field is started to be considered as "smart" (Mejer, Bolivar, 2016). Therefore, if e-participation is examined in a relation to public transport, then it is more correct and precise to speak about smart public transport.

Citizens can be involved in almost any decision-making processes that relate to socially important issues. The city transport field is not an exception. A lot of authors highlight that the citizen participation topic in the development of city mobility is crucially important since it provides access to more information for planning transport flows in cities (Waters, 2005; Aldea, 2018). Modern transport systems differ in complexity in comparison to traditional transport systems. The traditional ones are relatively simple combination of a few transport modes that in turn consist of limited number of elements. This system can be optimized by using technical and engineering methods. As for modern mobility systems, they are characterize by variety forms of mobility and sub-systems including pedestrian networks and bicycle traffic, and many other factors (such as social and environmental effects) but more importantly that modern transport systems imply much more complex interactions between these factors. The organization of simple systems is largely based on the top-down planning approach, while the management of complex systems demands the creation of multiple feedback and self-regulation tools. In complex social and urban systems, centralized planning is inefficient if it does not use bottom-up approaches (Portugali, 2011; Moroni, 2015).

Most of city planners and scientists have come to conclusion that there is a proofed solution of urban traffic problems: the wide use of public transport, walking and cycling and less cars on the streets (Moroni, 2015; Pirannejad, Janssen, 2019). However, it is very difficult to implement this solution because it is necessary to find a balance between various traffic modes, acknowledging that pros and cons of each of these modes vary in different cities and neighborhoods. So the optimum, "ideal" combination of traffic modes (modal split), cannot be

found by using a pure top-down planning approach, because the optimum combination depends on local resident preferences (Moroni, 2015). Thus the modal split appropriate for the preferences of the urbanites from neighborhood X. differs from that of neighborhood Y. Without public participation providing information about the preferences of local residents and how they value the expected results, planners cannot identify the appropriate modal mix for each neighborhood and for the entire city. And after all, any plan, even the best one, and any modal mix, even the most efficient one, may not succeed if they are not supported by the people who are the key consumer of transport services. Involvement of citizens in transport planning may provide such support.

Yet it should be noticed, even with well-developed bottom-up tools, the governance of complex systems is at its core problematic (Slaev, 2017). Therefore, people are often skeptical doubts about their ability to effectively influence management processes. Bickerstaff and Walker (2001) said that, on the one hand, citizen participation is hampered by very limited mechanisms of involvement and, on the other, by the skepticism and reluctance of the people to take part.

The literature review has also shown that research about current topic offers only frameworks for e-participation, that are quite often purely theoretical (Islam, 2008; Lee & Kim, 2018), and does not have "empirical proof" (Holgersson, Karlsson, 2014; Wimmer, Strykowski, 2015). The literature on e-participation lacks proofs on the outcomes of collaboration between people and authorities (Auer, 2015; Meijer, Bolivar, 2016), that can be reached by implementation of smart cities projects (Feroz Khan, 2014; Scherer et al., 2015; Birkmeyer, 2015). Moreover most of the literature on citizens participation in urban mobility focuses more on the benefits of people engagement in the transportation development but it does not research if the citizen want to be engaged and if the active participation increases the attractiveness of public transport.

1.2. Theoretical background of "smart city" concept

To define smart public transport, firstly, it is necessary to understand what is "smart" in the urban context. The largest concept that study the application of "smart" ideas to urban life is a "smart city" concept. Having described the main characteristics of smart cities, deeper insights into "smartness" will be obtained.

Rapid urbanization, increasing population density, environmental and socio-economic challenges have caused the development of "smart city" concept to be at the forefront of the urban discourse. There are more and more smart city projects that implement around the world each year (Lee et al, 2014). The goal of these projects is to "provide more efficient services to citizens, to monitor and optimize existing infrastructure, to increase collaboration amongst different economic

actors and to encourage innovative business models in both private and public sectors" (Marsal-Llacuna et al, 2015).

Despite the fact that there are already plenty examples of smart city projects being implemented, there is still no universally accepted definition of the smart city. The literature review also showed that there is no single version of how the scientific discourse about smart city was born.

The table 1 presents approaches to the origin of the "smart city" concept.

Table 1 The roots of "smart city" concepts (based on the literature review)

The roots of "smart city" concepts	The main features of the concepts
The "smart community" concept.	The use of ICT to improve the communication between main stakeholders in order to improve the quality of life.
The "smart growth" concept.	To provide sustainable development of cities by the use of ICT?
The "intelligent city" concept.	The implementation ICT solution in urban infrastructure to improve the quality of life.

Some scientists are credited the historical connection of smart cities with the concept of "smart community", which appeared in Silicon Valley (Silicon Valley, California, USA) in 1993 (Vanolo, 2014). At that time the economy of the region were experiencing a severe crisis. The representors of big business, community members, government officials, educational professionals came together to set the momentum for the region development. Later, based on this successful integration, San Diego State University developed the first theoretical work: "Guide to smart communities". It refers to a "smart community" as a geographical area in which residents, organizations, and officials actively communicate or collaborate through ICT to improve the quality of life in their region.

The second probable prerequisite for the development of scientific discourse about smart cities is the emergence of "smart growth" concept developed within the framework of the "New urbanism" (Söderström, 2014). The "smart growth" concept was a response to the energy crisis in the middle of the 1970's. and to the harmful impact of the extensive economy on the environment. The main idea of the concept is to provide sustainable development of cities in order to avoid their sprawling and to reduce their consumption of energy recourse. The sustainable city is a place with harmony between nature, economy and society (Söderström, 2014).

The third point of view is based on the idea that the "smart city" concept has inherited a rich theoretical base from the "intelligent city" concept, which appaired in the late 80's (Cohen, 2018). The concept included issues such as the ability to generate innovation, the transition to e-government and the implementation of ICT infrastructures in urban space in order to improve the quality of life.

The different groups of the scientists associate the origins of the smart cities with the various concepts. This is the reason why the researchers highlight as the main features of smart cities different characteristics. The group of the scientists who believe that smart cities came from the "smart community" concept focus more on the participation or involvement citizens in decision making process and the development of local communication between authorities, business and residents via different ICT. Other scientists emphasize on the sustainable development aspect of smart cities because they associate smart cities with the "smart growth" concept. And the third group speaks more about ICT solutions that can be used in the cities for improving quality of life. The lack of consensus in the scientific community about the origin of the "smart city" concept is one of the reasons why there is still no generally accepted definition.

The second reason that leads to ambiguity in understanding of smart cities is that the adjective "smart" has several meanings. Regarding Oxford explanatory dictionary, the adjective "smart" refers to such meanings as intelligent, wise, knowledge, digital, ubiquitous, etc. (Online Oxford dictionary). Depending on the meaning the scientists attribute to this word, there are several related concepts that refer to smart city, such as intelligent city, knowledge city, wired city, digital city, and so on (O'Grady, O'Hare, 2012). In some cases, these words are used as equivalents to the smart cities phenomenon. An international research group led by Nim and Pardo studied the genealogy of the word "smart" in the concept of "smart city". Scientists have compiled a semantic series of terms related to the meaning of smart city: intelligent city, knowledge city, wired city, digital city and etc. The group came to the following conclusion: in relation to its related semantic equivalents, smart city is a more capacious concept that is organically linked to technological, human and institutional factors. Smart city in the process of conceptualization has combined all of the above concepts (Nam, Pardo, 2014).

The third reason, probably the main one, why there is still no general accepted definition, is that the concept of "smart city" has been applied to two different "domains". On the one hand, it has been used for "hard domain" such as, buildings, energy grids, natural resources, water management, waste management, mobility, and logistics, where ICT perform an important role in the functioning of the system. On the other hand, the concept has also been used for "soft domains" such as, education, culture, policy innovations, social inclusion, and government, where the use of ICT is not usually crucial (Neirotti et al, 2017; Yigitcanla et al, 2018).

The smart city differ from each other, mainly because the purpose of the smart city is often too large, that is, to improve the quality of urban life; depending on this goal, everything could be considered “smart” (Neirotti et al, 2017). Some of the approaches to the smart city understanding emphasize more on the specific domains such as, ICT, IoT, smart collaboration or sustainable development, while others have a more general understanding of the phenomenon.

The most quoted definitions of the smart city were collected in the table 2 and then compared to determine the most frequently used and common elements. It allowed to formulate the definition of a smart city that are used for the current research.

The first thing that all definitions have in common is that the technologies are the foundation for smart cities. The use of ICTs enhances and changes the way of life and work within cities. For example, innovated energy sensors provide more accurate data for the development of city energy network, while mobility sensors enables better traffic control.

The technologies of smart cities provide data collection, storage and processing, industry and cross-industry analytics. They also allow to predict the development of situations and behavior of individual physical infrastructure objects, as well as the city as a whole as a multi-level system. The use of ICT leads to the optimization of urban processes that is usually achieved by combining various elements and actors in an interactive intellectual system, the driver of which is the IoT technologies.

The technology dissemination is not the only one important dimension of the smart cities. People, human capital, creativity, and education are also a crucial part of the smart cities. Usually all things related to human capital are combined into the concept of “smart people” (Goldin, 2016). The “smart people” concept includes various elements like ability to lifelong learning, creativity, civil activity, open-mindedness, flexibility, diversity, involving in the life of community. From the perspective of this concept, creativity, stakeholders collaboration, and human capital can help to solve city problems.

The third most common feature of the smart cities is communication (collaboration). Technologies and applications, smart and creative people are prerequisites, but without real involvement and willingness to communicate, share ideas and collaborate between authorities, private sector, non-profit organizations, universities and citizens there is no smart city (Gil-Garcia, at al, 2015). According to many authors, modern challenges facing cities require new, unique and creative ideas that can only be born in the process of open and active communication between all interested parties(Gil-Garcia, at al, 2015).

Table 2 Definitions of smart cities (based on the literature review)

Source	Definition	The mentioned features of smart cities		
		The use of technologies	Human capital	Collaboration and communication
Washburn et al. (2010)	"The use of Smart Computing technologies to make the critical infrastructure components and services of a city—which include city administration, education, healthcare, public safety, real estate, transportation, and utilities—more intelligent, interconnected, and efficient".	+		
Nam and Pardo (2011)	"A smart city infuses information into its physical infrastructure to improve conveniences, facilitate mobility, add efficiencies, conserve energy, improve the quality of air and water, identify problems and fix them quickly, recover rapidly from disasters, collect data to make better decisions, deploy resources effectively, and share data to enable collaboration across entities and domains".	+		
Caragliu et al. (2011)	"A city is smart when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance".	+	+	
Kourtit and Nijkamp (2012)	"Smart cities are the result of knowledge-intensive and creative strategies aiming at enhancing the socio-economic, ecological, logistic and competitive performance of cities. Such smart cities are based on a promising mix of human capital (e.g. skilled labor force),	+	+	+

	infrastructural capital (e.g. high-tech communication facilities), social capital (e.g. intense and open network linkages) and entrepreneurial capital (e.g. creative and risk-taking business activities)".			
The European Commission (2014)	"A city seeking to address public issues via ICT-based solutions on the basis of multi-stakeholder, municipally based partnership".	+		+
Marsal-Llacuna et al. (2014)	"Smart Cities initiatives try to improve urban performance by using data, information and information technologies (IT) to provide more efficient services to citizens, to monitor and optimize existing infrastructure, to increase collaboration among different economic actors, and to encourage innovative business models in both the private and public sectors".	+		+
Cisco Systems, Inc. (2014)	"An integrated urban information and communication technology (ICT) overlay on a city that can support delivery of connected urban services and allow for efficient management of those services on a global scale".	+		+
Komninos (2016)	"(Smart) cities as territories with high capacity for learning and innovation, which is built-in the creativity of their population, their institutions of knowledge creation, and their digital infrastructure for communication and knowledge management".	+		+
Šiurytė et al., (2016)	"The ability of a city to be smart is the ability to meet the needs of its residents, and technology, in turn, is a means of communicating their needs and expectations".	+	+	+

All in all, the table above shows that the most popular and common fetchers of the smart cities are technologies, people and communication (collaboration). In other word, "smartness" in the urban contest means the combination of mentioned above features. Therefore, in the current paper smart cities are defined as a territory with high-capacity for learning and innovation, investments in human capital, and the high-quality life standard that are achieved through the widespread use of innovative technologies and active collaboration between stakeholders.

To sum up all the described features of smart cities above and clarify the current topic more, all the discussed points about smart cities were combined in the mind map (Figure 3). This mind map shows that the goals of smart cities are to improve the quality of life and find solutions to modern global challenges. Achieving these goals is possible with the active interaction of the three main components of smart cities (technologies, people and their active communication). Fields in which the "smart city" concept can be implemented combine mostly all areas of urban life such as health care, public transport (metro, buses, trams, etc.), education, security, energy grids and many others.

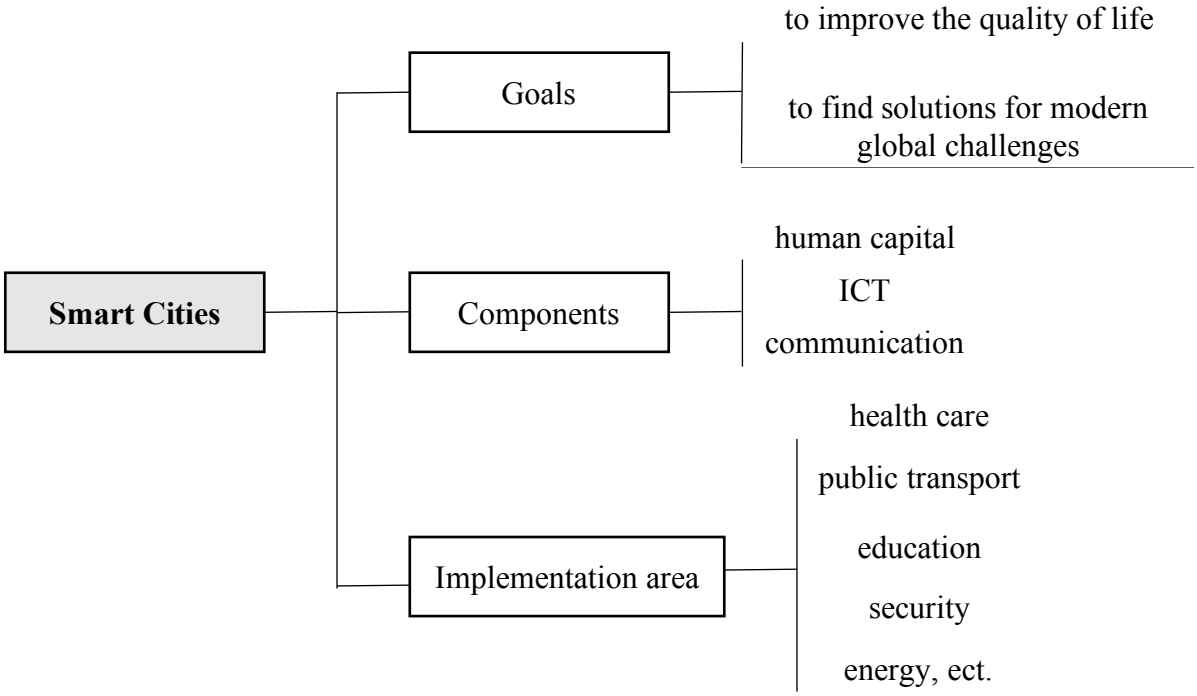

Figure 3 The mind map of the "smart city" concept (based on the literature review)

1.3. Smart transport: definition, objects and principles

In the first paragraph it was mentioned that the "smart" ideas can be implemented in the most of the urban life areas such as health care, public transport (metro, buses, trams, etc.), education, security, energy grids and many others. This research focuses on the applying the "smart" ideas to the urban mobility.

There are three main concepts that describe the application of the modern technologies to the urban mobility: “smart transport”, “smart mobility”, and “intelligent transport” concepts (IRMA, 2018; Bodhani, 2012; Murgante, 2015).

There are not any standard definitions of these three terms because the idea of applying “smart” approach to the transportation systems are relatively new (Zhang, 2017). However, the difference between them is not as significant as the difference between the smart cities definitions (Olaverri-Monreal, 2016). The table 3 represents the most quoted definitions of the terms. From each term its main characteristics were extracted in order to compare them with each other.

It can be seen from the table that the researchers and practitioners highlight the implementation and utilization of ICT as the main characteristic of the terms. According to current scientific opinion the adjective “smart” in the context of transportation systems means the usage of digital solutions to optimize the existing city transport infrastructure. In other words, the keystone characteristic of the smart or intelligent transport is a wide use of the ICT for the innovation of urban mobility. Since these concepts are similar to each other, they are used as synonymous in the current paper.

However, it is important to mention one small difference between these approaches. The “intelligent transport” concept is broader than the “smart transport/mobility” approach because the second ones focuses only on the urban transport systems while the first one also includes transportation systems between cities and countries such as air transport, marine transport, and rail transport systems (Stawasz, Sikora-Fernandez, 2015). An Euler diagram can be used for a better understanding of the relationship between these tree concepts (Figure 4).

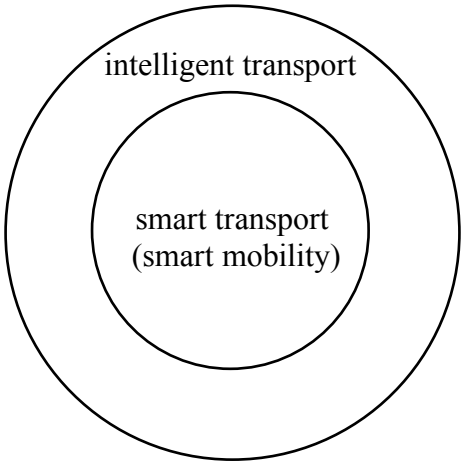

Figure 4 The relationship between “smart transport”, “smart mobility”, and “intelligent transport” concepts

Table 3 Definitions of smart transport (based on the literature review)

Source	Definition	The main characteristics	Applying field
The European Commission (2016)	Intelligent transport is a systems that helps to optimize the use of existing infrastructure through a variety of technical means such as traffic signals, journey planners, smart ticketing or cooperative systems (including vehicle-to-vehicle and vehicle-to-infrastructure communication systems).	To optimize the use of existing infrastructure through a variety of technical means.	Urban mobility.
Clara Benevolo et al. (2016)	Smart transport could be seen as a set of coordinated actions addressed at improving the efficiency, the effectiveness and the environmental sustainability of cities. In other words, Smart Mobility could consist of a hypothetically infinite number of initiatives often (but not always) characterized by the use of ICT. By not ICT initiatives of the smart mobility the research group means such initiatives as paid parking, congestion pricing, bans on the use of low-quality fuel for cars and many others.	Initiatives that often (but not always) characterized by the use of ICT.	Urban mobility.
Williams B. (2018)	Intelligent transport is a system where vehicles interact with the environment, and with each other, to provide an enhanced driving experience, and where intelligent infrastructure improves the safety and capacity of road systems	Interaction between vehicles and the environment (implies the use of ICT).	Urban mobility and long-distance transport systems.
Chun and Lee (2018)	Smart Mobility is a concept of comprehensive and smarter future traffic service in combination with smart technology. A Smart Mobility is realized by means of the current intelligent traffic systems.	Realized by means of the current intelligent traffic systems.	Urban mobility.

Vast majority of the researchers (Giuffrè, Di-Dio, 2017) refers smart transport to the "hard" (techno-centric) domain of the smart cities and does not try to apply, for example, the ideas of the "smart people" or "smart communication" concepts to the urban mobility. Mentioned above Bob Williams in his book remarks that there is a joke in the intelligent transport standards development sector: "we have given up trying to make drivers intelligent (by making drivers intelligent, he means the improvement of driver trainings, and driving exams), so now we are making the vehicles and roads intelligent!"(Williams B. 2018). It seems reasonable to say that today this joke is the essence of "smart transport" concept.

Almost the same opinion was expressed by Lefevre, executive director of the New Cities Foundation. In one of his interview he said: "The smart city (and in particular the smart mobility) seems to have lost its contact with humans. If you type smart city on your image search engine, the first human being appears on the page number eight. The first hundred or so images are sci-fi renditions of cities that will probably never exist. The same happens by searching "smart mobility" or "smart transport" (Papa, 2015). In the literature and in practice there is a gap between the "smart transport" approach and citizens. This gap is formed because "top-down" approach biased on master planning currently dominates in the implementation of the smart transport solutions (Papa, 2015).

In the first paragraph was mentioned that there are three main features of "smartness" in the city context: technologies, people and communication (collaboration). Only combination of them can make a city truly "smart". However, when the scientists speak about smart transport they consider only on technology feature and ignore other two.

Certainly, the use of ICT in the urban transport system includes the communication domain. ICT solutions give travelers new opportunities to interact with a public transport or each other. For example, there are plenty of different mobile applications or websites that provide real-time data about congestion level on the roads, arrival time of public transport, online ticket purchase support and many others (Benevolo, 2018). However, this kind of communication is not the communication in the sense implied by the "smart city" concept that assume active two-way interaction (Gil-Garcia, at al, 2015). In the case of the smart transport this communication type would be more accurately called informing because it does not assume the active participation of citizens in the interaction process. Citizens are only recipients of the information.

It has been said already that the smart transport is only one of the areas concerning the smart city implementation. However it is a critically important topic, that affects numerous aspects of the urban life quality (Neirotti, 2018). Transport flows pull a city together into a coherent whole but the constant rising of the population numbers and density increases the load on the transport network which in turn can lead to the transport collapse and the complete disintegration of the city.

Implementation of the smart transport ideas may prevent this pessimistic prediction but it is also not the only one objective of the smart transport. From the literature review were gather and group together into seven categories the key smart transport objectives:

- to reduce air and noise pollution;
- to relieve traffic congestion;
- to increase affordability and accessibility of public transport;
- to improve transport safety;
- to increase transfer speed;
- to reduce transfer costs;
- to increase effectiveness and efficiency of public transport.

The implementation of the smart transport projects provides the great opportunities for both urbanites and city officials. It improves the quality of life in the cities and facilitates the economic development but in order to achieve the objectives the realization of smart transport ideas must be built on the following principles (Benevolo, D'Auria 2016):

- flexibility: smart mobility must provide the multiple modes of transportation that allow the urbanites to choose the most appropriate ones depending on the situations;
- efficiency: the traveling around a city must strive to minimum time, energy and finance costs;
- integration: the urbanites must be able to achieve any point in the city from "door-to-door";
- clean technology: transport in the cities must be eco-friendly and aim to zero-emission;
- safety: new transport technologies must provide better saltines on the roads.

To summarize all the information above and clarify the current topic more, all the discussed points about smart urban mobility were combined in the mind map (Figure 5).

In the modern scientific literature there are three main concepts that describe the use of ICT for urban mobility: "smart transport", "smart mobility", and "intelligent transport". The concepts do not differ from each other and most of the time are used as synonyms. According to the literature, the main feature (component) that makes transport "smart" is a wide use of ICT solutions for transport infrastructure on the biased of five principles: flexibility, efficiency, integration, clean technology and safety. The researcher do not consider other features of "smart" concept such as communication and human capital when they refer to the smart transport. Moreover, the implementation of smart transport projects is aimed at achieving the following objectives: reducing air and noise pollution, relieving traffic congestion, increasing transfer speed and etc.

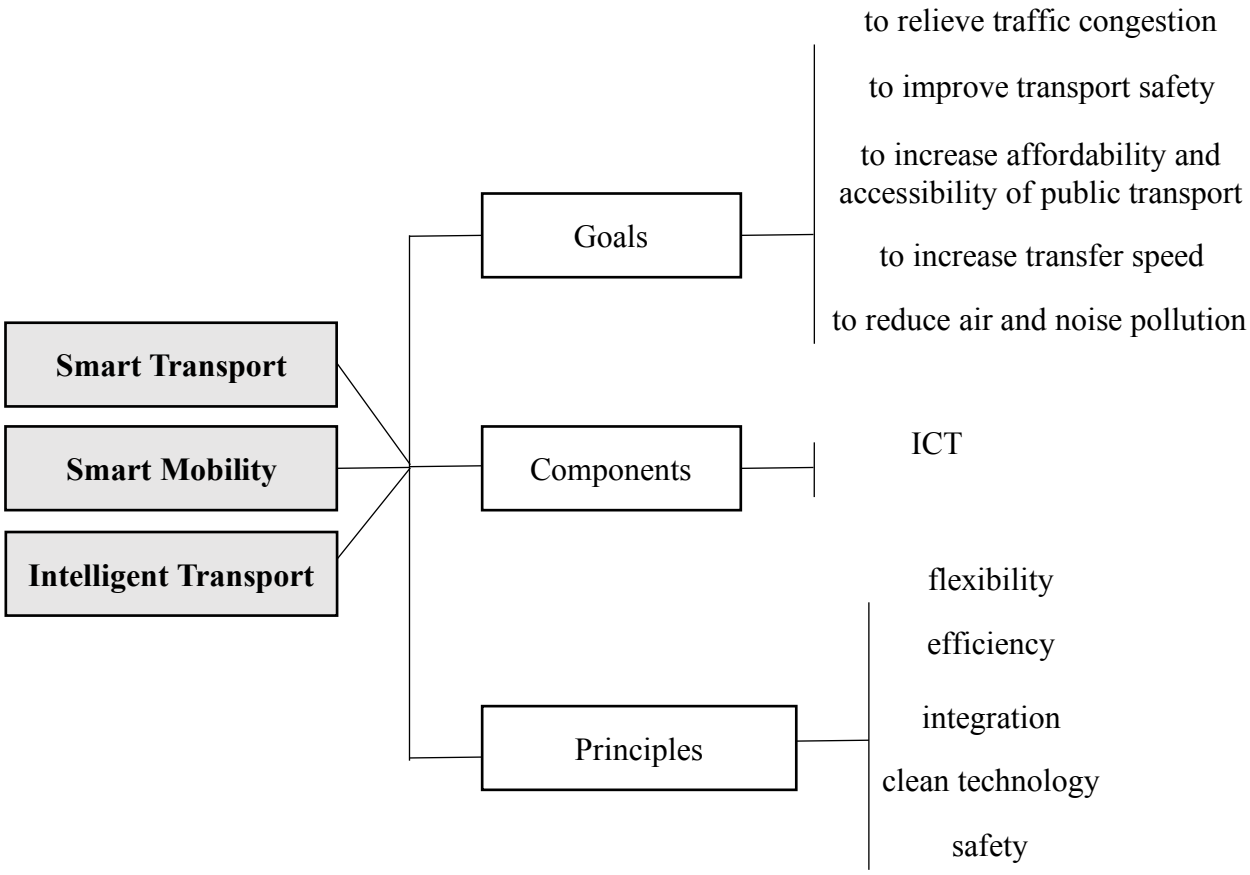

Figure 5 The mind map of the "smart city" concept (based on the literature review)

This research paper focuses more on the particular part of the smart transport – smart public transport. Therefore, it is necessary to define what smart public transport is. The literature review has shown that there is no the specific definition of the smart public transport because the researchers and the practitioners consider it as a part of the "smart transport" concepts (Zanella at al, 2014; Lacinak 2016) . They define smart public transport through the characteristics of intelligent transport. As it was found above the main feature of intelligent transport is the use of the different ICT-biased solutions in the vehicles and the road infrastructure. Hence, smart public transport is transport system in which technical means are widely used in order to optimize the existing public transport infrastructure.

The implementation of smart public transport solutions has mostly the same objectives as the smart transport: increase accessibility, affordability, safety, and speed of the public transport etc. All these objectives have one larger general goal: to increase the attractiveness of public transport for passengers (Murgante, 2015). The bad experience of American cities, for example, such as California and San-Francesco, has shown that the only one right strategy for the development of urban mobility is the improvement of public transport system rather than the

expansion of road network (Borieko, at al., 2019). Congestions, CO2 emissions and noise pollutions problems can be solved only if vast majority of the citizens use the public transport. Smart technologies have a large potential to provide better public transport services, thereby increasing its attractiveness for urbanites.

The literature analyses also showed that the most of the researchers equate the smart public transport with sustainable transport. The usage of new technology allows to find the balance between current and future needs and decrees the impact on the environment. The smart public transport can support sustainability in the following fields (Marsal-Llacuna, 2018; Cohen, 2018):

- Environmental sustainability:
  - the reduction of the direct CO2 emissions from the public transport by optimizing schedule, routes, traffic and demand prediction, etc.;
  - the indirect CO2 emission (i.e., the CO2 emissions from the private vehicles) can be also decreased by raising the appeal of public transport that also leads to improvement land use in the cities (e.g., reduction of car parking spaces).
- Social sustainability:
  - the increase of a personal safety by improving public transport safety;
  - the improvement of the social justice by providing more accessible mobility for vulnerable groups (e.g., elderly, disabled, etc.);
  - the increase of social integration by expanding the coverage of public transport services;
- Economical sustainability:
  - the reduction of budget expenditures by optimizing the use of resources in public transport;
  - he increase human productivity by reducing daily travel time.

All in all, smart public transport is a system in which different technological means are widely used in order to increase the attractiveness of it and support city sustainability. “Smart” in this context means filled with modern technologies. This approach is very techno-centric because it ignores other two domains of “smart”. Hence, it is reasonable to ask if communication domain are added to smart public transport, would it help to increase the attractiveness of it. In other words, if citizens get the opportunity to e-participate, will it influence on their chose between public transport and a private car?

1.4. Smart transport solutions for a public transport

Smart transport solutions are essentially a practical and physical manifestation of the smart transport ideas. Therefore, it is important to look at the current market of the smart solutions to determine how the theoretical ideas are implemented in the practice.

Nowadays there are plenty of different smart transport solutions for public transport on the market. MarketsandMarkets forecasted that this market increases from USD 55.0 billion in 2017 to USD 149.2 billion by 2023, at a Compound Annual Growth Rate of 14.7% during the forecast period. Key market players are IBM (US), Siemens (Germany), Huawei (China), TomTom (Netherlands), Cisco Systems (US) and Toshiba (Japan) (MarketsandMarkets, 2019). The existing smart solutions for public transport can be grouped into five categories:

1. Traffic management and vehicle operation control systems. This category is divided into three subgroups (Debnath, 2019):

- vehicle operation management system is designed to systematize and regulate the process of releasing the vehicles to the route. It also keeps records of each driver work and each vehicles operation and provides effective communication between different operators in the system. The main part of the system is GPS traffic control display: it informs the main traffic control operator about the situation in the control zone of the vehicle dispatching system;
- intersection control system automatically regulates traffic lights so as to privilege vehicles while they are crossing the intersections. Intersection control system is a multilevel system of high complexity. It consists of four levels: the first one has different traffic flow sensors (cameras, microwave radars etc); the second is responsible for controlling traffic lights and information panels, collecting information about the volume of traffic, crowding at the intersection; the third level of the system manages data transmission to the traffic control center and receiving it back; the fourth level consists of the central server node and traffic control center which are responsible for providing the information to other systems.
- Closed-circuit television (CCTV): CCTV monitors public transport traffic and ensures safety movement on the lines.

2. Payment control systems. They procure entrance to stations, automatic fare gathering on the lines, access monitoring to stations, administration and test of passenger flow. Also, they manage the tariff policies. As a means of payment, systems often use smart tokens, contactless payment cards, barcode tickets and bank cards. The system consists of workstations that allow you to control the operation of the system and obtain the necessary data. Central server node is core of

the system. The processing center (central server node) has a set of server equipment with the appropriate software that ensures the operation of the system.

3. Passenger information systems. They are a means that provides citizens with necessary information connected with public transport such us bus timetable, train arrival and departure time, current time and date, different help information. Passenger information systems can be provided via different technologies such as mobile applications, websites or information screen inside vehicles and at stops.

4. Shared mobility. Shared mobility solutions enable citizens to share cars, bicycles, or other modes of transport. The main trait of shared mobility is that it is built on the principle of "as needed". Shared mobility includes different type of transportation such as peer-to-peer ridesharing, on-demand ride services, bikesharing, and other modes (Caragliu, 2018).

5. Systems of data collection. This category consists of various types of sensors and applications that collect real-time data. The sensors provide the data ranging from the individual trip behavior to the infrastructure usage (including the technical conditions of the vehicles). IoT technology can be used in different ways to collect data for traveler services. For instance, delay information can be obtained from recognition or positioning sensors on-board vehicles and at stops, information about the actual destinations of travels (used to provide efficient transport alternatives) can be collected from smart card tickets, and micro-navigation information can be attained using IoT-based recognition systems that are located on-board vehicles and across stations (Caragliu, 2018).

To sum up, market analysis has shown that there is a large number of technological means that can provide better control over the transport flows. They also allow to collect big amount of data to improve the network of public transport. However, in the practice as in the theory there is no any widespread ICT solution that could engage citizens in active two-ways communication. Most of the solutions offer passive communication that comes in form of informing passengers about transport schedule.

Although there are no widespread ICT solutions that would provide opportunity of citizen e-participation, the authorities of some cities in the world try to develop its own solutions. For instance, when the city authorities of Helsinki (Finland) were developing new transport master plan in 2016, the online map-based questionnaire was created to involve the residents in the development process. The residents of the city could go to the special web-site, in which the city map was placed, then they could leave any comments on the map about the problems that they faced using public transport. The collected information was used to improve the new transport master plan (ENDURANCE, 2018).

Another example of e-participation practice is QR-codes that were placed in public buses in Shenyang (China). Each bus in the city has a unique QR-code. Having scanned it, the passengers get access to a special from, where they can complain or comment on the working of the bus (S.U.M.P, 2017).

The instance of higher degree of citizen engagement is Mobilnagdynia portal. The portal is launched in the city of Gdynia (Poiland). It contains the all information related to public city transport. Through the app citizens can share their ideas about the development of city mobility, participate in planning process and vote for decisions. Almost the same app works in Palma (Spain), but the app has an extra feature. The users can allow the app to track them in order to provide more information for transport planners (ENDURANCE, 2018)..

Despite that there are the examples of e-participation solutions, these solution remain quite rare. It can be called experimental attempts by certain city authorities to introduce participation in the transport field.

The outlined above smart solutions enable new opportunities for the all stakeholders (ERTRAC, 2015):

- Opportunities for public transport operators (public or private companies that provide transport services);
- Opportunities for city departments that are responsible for transport planning;
- Opportunities for passengers.

Opportunities for public transport operators

Various sensors located in the vehicles create new management opportunities for public transport operators. Sensors, geolocation systems and ticket validators provide a real-time data about the location of vehicles, its travel speed, deviations from the schedule, crowding aboard vehicles, technical condition of it, etc. Since most of the transport services are scheduled, it is crucially important for operators of public transport to get the real-time information to deal with disturbances from the schedule. (ERTRAC, 2015).

For example, if there is a failure in the operation of trams, decisions are needed be taken regarding re-allocation or re-scheduling of other vehicles. Sensors and ticketing data provides relevant information for such decisions. The instance of the relevant information providing by sensors are the number of passengers who are currently on the trams and what are their point of destination (Debnath, 2019).

The sensors also create economic opportunity because they help to deal with maintenance problems of vehicle fleet. Sensor data about technical condition of the vehicle allows to make more accurate decisions about its maintenance and repair which in turn leads to fewer planned and

unplanned breaks for maintenance and repair, and potentially less maintenance time in total that allow to reduce financial costs (ERTRAC, 2015).

Opportunities for city departments

One of the most crucial task for the city authorities is to find the most optimal public transport routes. On the one hand, the optimal routes mean that the transport resources are distributed in the way that any point of destination in the city can be reached comfortably using public transport, and, on the other hand, it means that public vehicles are allocated in the way that minimized its negative impact on the environment such as CO2 emissions and noise (ERTRAC, 2015).

The lack of information is the biggest barrier of the planners to find the optimal roads for the public transport. The wide use of the ICT in the transport allows to overcome this barrier. The ICT-based services give the access to a large amount of real-time data ranging from the individual movement patterns of the each urbanites to the infrastructure usage. This data contribute to more accurate design of routes.

Opportunities for passengers

The lack of information is the problem not only for transport planners but also for the passengers. In order to choose the most appropriate transport mode, the urbanites must have the access to the up-to-date information. Such information may concern what travel options are actually available in a given situation, where tickets can be bought, and what support a specific transport service offers to elderly or disabled persons. For example, the real-time delay information enables the urbanites to make informed decisions about which transport modes are best suited for them during the time of disturbance. Moreover, the services that provide the kind information can be personalized for each passenger which reduces the time spent on searching for information (Debnath, 2019).

2. METHODOLOGY AND RESEARCH FINDINGS

2.1. The research method

In the first chapter of the research the comprehensive literature review was conducted. It showed that the "smart transport" concept deals only with one domain of "smart": widespread use of ICT for city transport infrastructure. Therefore, it is reasonable to ask if the communication domain of "smartness" is added to the concept, does it help to achieve the goal of the smart transport: increase the attractiveness of public transport? In other words, if citizens get the opportunity to e-participate would it influence on their choice in a favor of public transport? In the current research, e-participation means the possibility of citizens to complain or comment on the work of public transport online as well as to share and vote for ideas about its development. A survey experiment is used in the paper as the method of research to find the answer to this question

Population-based or survey experiments is becoming an increasingly widely used research method. It is actively used in such science as: sociology, psychology, management, economics, public police, law, and etc. (Mutz, 2011).

Mutz in his guide "Population-Based Survey Experiments" gives the following definition of survey experiment: "survey experiment is studies in which the researcher controls the random assignment of participants to variations of the independent variable in order to observe their effects on a dependent variable" (Mutz, 2011). Independent variable is manipulated and causes the subsequent change in the dependent variable.

In other words, survey experiments involve changing some aspects of the survey experience for some respondents. One respondent might get a question or text that use one phrase or sentence, for example, another might get a text that uses a slightly different word order or content. The researcher manipulates with a text or question order according his or her researching goals. The manipulation within a text is independent variable and the outcomes of the manipulation is depended variable. For better understanding the process of the method is represented below (Figure 6).

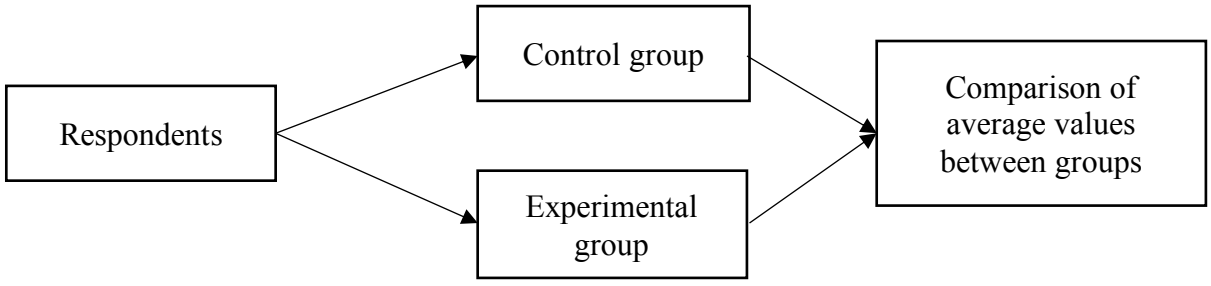

Figure 6 the process of the experiment (based on Mutz)

The figure 3 illustrates the process of the experiment: the respondents are randomly assigned to one of the groups, each group has slightly different questionnaire (the difference, which is independent variable, determines according to the goal of research), then the averages of two groups are compared. If there is the difference in averages, it gives a right to make a conclusion that there is a causal relationship between dependent and independent variables.

The main requirement for survey experiments is that respondents must be randomly assigned to different variations of a survey. It allows to make a conclusion that any differences in answers across the groups of participants occur not because of the specific attributes of each groups (Mutz, 2011). Moreover, if respondents are randomly assigned to control or experimental group, then the scientist has a right to eliminate (within statistical limits) external influences that can distort the effects that the scientist expects to observe, such as gender, education, respondents income and so on.

Therefore, survey experiments can overcome the main limitation of observational studies, that usually use regression models to find the causal relationship between dependent and independent variables. When the scientist conducts the regression analysis, he or she has to accept the untestable assumption that there are no unobservable variables that distort the causal relationship that the scientist is trying to measure. The assumption quite often can lead to inaccurate results because actually there are a lot of factors that may have influence on the casual relationship, and it is impossible to take into account all of them. The experiment can deal with this problem because the experimenter intervenes in the data-generation process that gives him or her an opportunity to focus respondent on the particular causal relationship while randomization of assignment provides the uniform present of all unobserved factors in both groups. In other words, because of the randomization, the all influence factors are equally represented in the groups. Hence, the researcher does not need to consider them at all.

This method is perfectly suitable for the current research because of the following reasons:

- E-participation opportunity obviously is not the main factor that influences on the choice of citizens. There more important ones such as affordability, accessibility, time spent and etc. That is why, if the observational study with regression analysis is conducted for the current paper, the participation factor will be “lost” among other more important factors. The experiment allows to focus the research on the particular causal relationship.
- Using the regression model for finding the exact percentage of how much attractiveness increases, it is necessary to collect all the factors which influence the attractiveness of public transport. There are a lot of different factors that influence on it. It is impossible to collect all of them to make reliable conclusions. As it was

written above the experiment can deal with this problem because it balances all unobservable factors.

2.2. The design of the survey experiment

The experiment was conducted using e-survey tools. E-survey is perfectly suitable for this kind of research design because it can provide the random assignment of respondents. Other advantage is that it requires significantly less time than offline survey. It also allows automatically encode the findings, which simplifies the data processing process and reduces the number of errors that occur during manual processing.

In this research the dependent variable is the attractiveness of public transport and independent variable is the opportunity of e-participation for citizens. To study the relationship between the variables, two short texts were developed (table 4). The original version of the texts are placed in appendix 1.

Table 4 Examples of the texts

The control group	The experimental group
In 2020, the city administration of St. Petersburg starts transport reform. It is planned that public transport will become predictable, socially oriented and comfortable. It is expected that traffic intervals during peak times will be significantly reduced, and buses will follow the schedule accurately. 2 662 new comfortable buses with air conditioning, low floors and smooth running will be purchased for passengers. Passengers will be able to pay with bank-cards and unified electronic travel tickets, including preferential ones, in any kind of public transport.	In 2020, the city administration of St. Petersburg starts transport reform. It is planned that public transport will become predictable, socially oriented and comfortable. It is expected that traffic intervals during peak times will be significantly reduced, and buses will follow the schedule accurately. 2 662 new comfortable buses with air conditioning, low floors and smooth running will be purchased for passengers. Passengers will be able to pay with bank-cards and unified electronic travel tickets, including preferential ones, in any kind of public transport. Moreover, citizens will be able to complain or comment on the work of public transport via the mobile app as well as to share and vote for ideas about its development

The text for experimental group had one extra sentence about opportunity of e-participation for citizens (independent variable). The participants were randomly assigned to one of the groups, then they had to read the given text and answer the following question that was the same for the both groups. The question reflects the dependent variable.

"Evaluate on a six-point scale how much the new reform increases the attractiveness of public transport in comparison with a private car (6 – the attractiveness of public transport will increase significantly, 1 – the reform will not affect the attractiveness of public transport in any way)."

Then it needs to calculate the average of the answers to this question for each group and compare it. If there is a positive or negative difference in averages between the control group and the experimental group, than e-participation increases or decreases the attractiveness of public transport respectively. If there is no difference in averages then the opportunity of e-participation does not influence on the attractiveness.

Moreover, there were extra questions about the level of e-participation and socio-economic status of the respondents in the questionnaire. The information about the level of e-participation allows to figure out at what degree citizens want e-participate while the data about socio-economic status let to check the randomization of the experiment.

Saint Petersburg is a research area for the current study. It was chosen because of two reason: the first one, the city experiences the problems with transport traffic (hence, it crucially important to encourage people to use public transport), the second one, the government of the city plans a transport reform (the findings of the research potentially may be used for the reform). Qualitrics platform was used to conduct the survey. The platform allows to randomly assign respondents to one of the groups. The survey was shared on the public pages of the districts of St. Petersburg on "Vkontakte". The analysis of the data was conducted in package "R studio".

2.3. Descriptive statistic of the data

The survey was conducted from the 1st of May to the 20th of May 2020. During this time 1694 respondents participated in the experiment: 847 respondents are in the control group and 847 ones are in experimental group. According to The Oxford Handbook of Political Methodology the minimum size of each group must be at least 150 respondent to get relevant result (Box-Steffensmeier at a, 2008). The sample of the research meets the requirement.

Another important requirement is that the both groups must be almost similar by their main sociodemographic parameters. This requirement is met automatically if the respondents were

randomly assigned to the groups. The table 5 represents two groups by their main socio-demographic parameters.

Table 5 The sample for survey experiment

Parameters	Control Group	Experimental Group
Gender:		
Male	373 (44%)	377 (45%)
Female	474 (56%)	470 (55%)
Age:		
18-30	285 (34%)	280 (33%)
31-45	379 (45%)	381 (45%)
46+	183 (21%)	186 (22%)
Education		
Secondary	69 (8%)	77 (9%)
Post-secondary	147 (17%)	141 (17%)
Not finished higher	119 (14%)	116 (13%)
Higher	405 (48%)	401 (47%)
2 or more higher or PHD	107 (13%)	112 (14%)
Income		
Very low	81 (9%)	79 (9%)
Low	144 (17%)	140 (16%)
Medium	404 (48%)	407 (48%)
High	159 (19%)	160 (19%)
Very high	59 (7%)	61 (8%)
Transport mode		
Only PT	301 (35%)	302 (34%)
More PT than PC	147 (17%)	151 (19%)
Half PT and half PC	136 (16%)	135 (16%)
More PC than PT	139 (17%)	138 (17%)
Only PC	124 (15%)	121 (14%)

From the table 5 it is seen that the both groups have almost the same socio-demographic characteristic. To be completely sure that the groups are similar to each other, two formal tests were run. T-test checks if two samples have equal means while F-test checks if the groups have the same variances. If means and variances are equal for the groups then the conclusion can be drawn that there is a balance in the main socio-demographic characteristics.

Table 6 The results of t-test and F-test

Parameters	p-value of t-test	p-value of F-test
Age	0.893 *	0.3008 *
Education	0.1211 *	0.2243 *
Income	0.9273 *	0.4848 *
Transport mode	0.8153 *	0.7369 *
		* 5% significance level

The null hypothesis for t-test is that there is a difference in means of two samples; the null hypothesis for F-test is that there is a difference in variances of two samples. For the current research the significance level is 0.05 (5%). Hence, if p-value is less or equal to 0.05 then the null hypothesis is not rejected. The table N shows that for the all parameters p-value are not less or equal to 0.05. Therefore, the null hypothesis is rejected which means that the parameters of two groups have the same variances and means. In other words, two groups are similar according to their socio-demographic characteristics. This conclusion confirms that the samples were collected randomly which also gives the right to consider the results of the experiment are relevant and externally valid.

2.4 The results of survey experiment

As it was written above the respondents randomly got one of two texts that were slightly different from each other, then they were asked to assess how much the transport reform increases the attractiveness of public transport. The positive difference in mean values between the answers to this question shows if the opportunity of e-participation increases the attractiveness of public transport. T-test was used to check if the difference in mean values is statistically significant. The table 7 shows the result of experiments.

Table 7 the result of experiments

exp. group avg.	con. group avg.	difference	difference in %	p-value(t-test)
General results				
3.54	3.52	0.02	0.003%	0.8451*
Results on age group 18-30 years old				
4.14	3.55	0.59	9.8%	0.0001467
Results on age group 31+ years old				
3.46	3.5	-0.04	-0.006%	0.7499*
Results on groups that use only PC or more PC than PT				
3.87	3.38	0.49	8.2%	0.005038
Results on groups that use only PT or more PT cars than PC				
3.74	3.6	0.14	0.02%	0.2854*
Results on groups with high and very high income				
3.78	3.34	0.44	7.3%	0.001219
Results on groups with low and very low income				
3.49	3.46	0.03	0.005%	0.4401*
Results on groups with low and very low income				
3.61	3.56	0.06	0.01%	0.3198*

The T-test showed that the difference in the average values of the two groups is not statistically significant (p-value > 0.05, then the null hypothesis of equality of averages is not rejected). It means that the opportunity of e-participation does not increase the attractiveness of the public transport in comparison with a private car.

However, there is a statistically significant difference in averages (p-value < 0.05) if considered in relation to the 18-30 years old age groups. It means that the attractiveness of the public transport increases for the young people if they have the opportunity to e-participate in its managing. To be more precise, the e-participation rises attractiveness by 9.8%. As for the 31+ years old groups, there is no significant difference in averages between them. The possibility of e-participation has no influence on their choice between the public transport and private car. Since there are more respondents from the 31+ years old group in the sample, it led to the overall result that e-participation has no effect on attractiveness of public transport.

The same result can be found if measured in relation to the groups of respondents who use only public transport or more public transport than private cars and the groups that use only private cars or more private cars than public transport. For the second group the possibility of e-

participation increases the attractiveness of public transport by 8.2% while for the first one it is not the factor that influences on the attractiveness.

If the sample is split into the groups by incomes of the respondents, then the groups of the respondents with high and very high income have the statistically significant difference in averages. The opportunity of e-participation increases the attractiveness of public transport for people with higher income by 7.3% while the respondents with lower income do not consider e-participation as the factor that can effect on the attractiveness.

3.5. Modeling the factors of participation

In the first part of the paper was described three levels of e-participation: e-informing, e-consultation and e-participation. E-informing is well researched field. There are a lot articles in which are proofed that citizens are ready to participate in e-informing because they receive obvious benefits. Moreover, this process is not too time costly for urbanites because it is actually not assumed the active participation of them (Debnath, 2019). The current research is focused on the e-consultation and e-participation. It is obvious that citizens of St. Petersburg are ready to participate in e-informing, but it is not clear if they are ready for e-consultation and e-participation.

To study if St. Petersburg residents are ready for e-consultation and e-participation, two extra questions were added to the questionnaire of the survey experiment:

"Imagine that you have the possibility to leave complaints and comments about public transport through a mobile app, would you use this feature if necessary"

"Imagine that You have the opportunity to share, discuss and vote for ideas about the development of public transport network through a mobile app, would you use such a function?"

The results of the answers to this question are presented in Figure 7. 66% of respondents are ready for e-consultation (citizens to complain or comment on the work of public transport online) and 57% are ready for e-participation (*to share, discuss and vote for ideas about the development of public transport*) . It gives a right to assume that St. Petersburg residents in general are ready for e-consultation and e-participation.

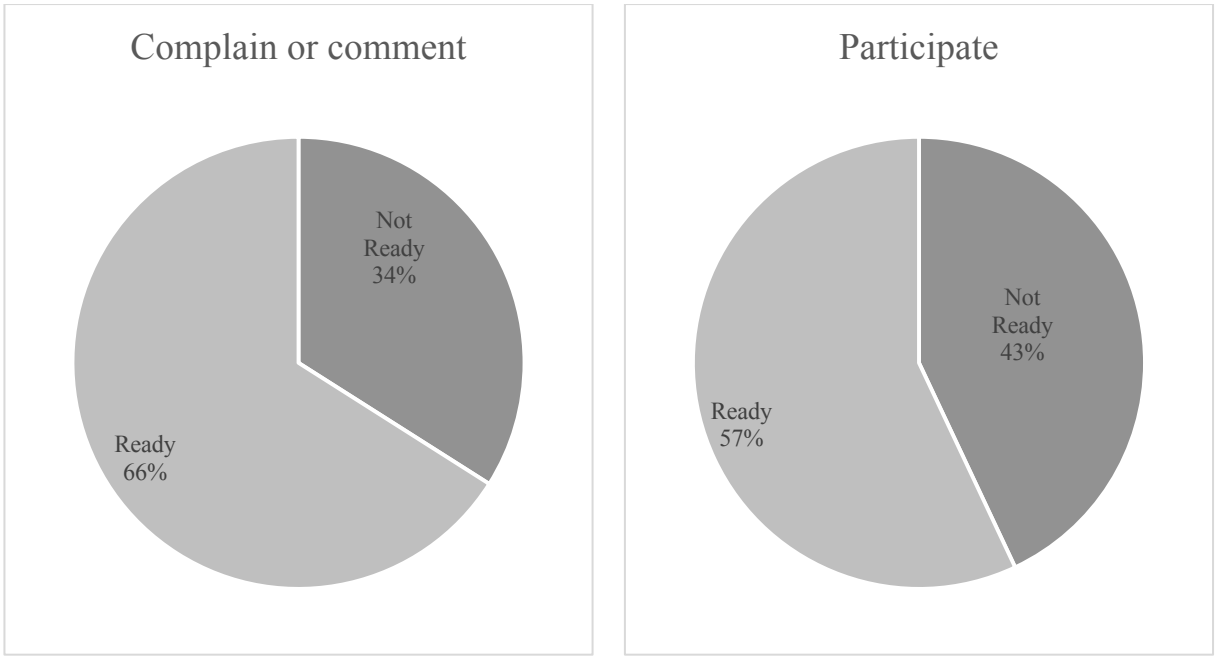

Figure 7 the readiness to e-participate

The survey also contained the question about preferred channels of interaction. Results of answers to the question represent in figure 8.

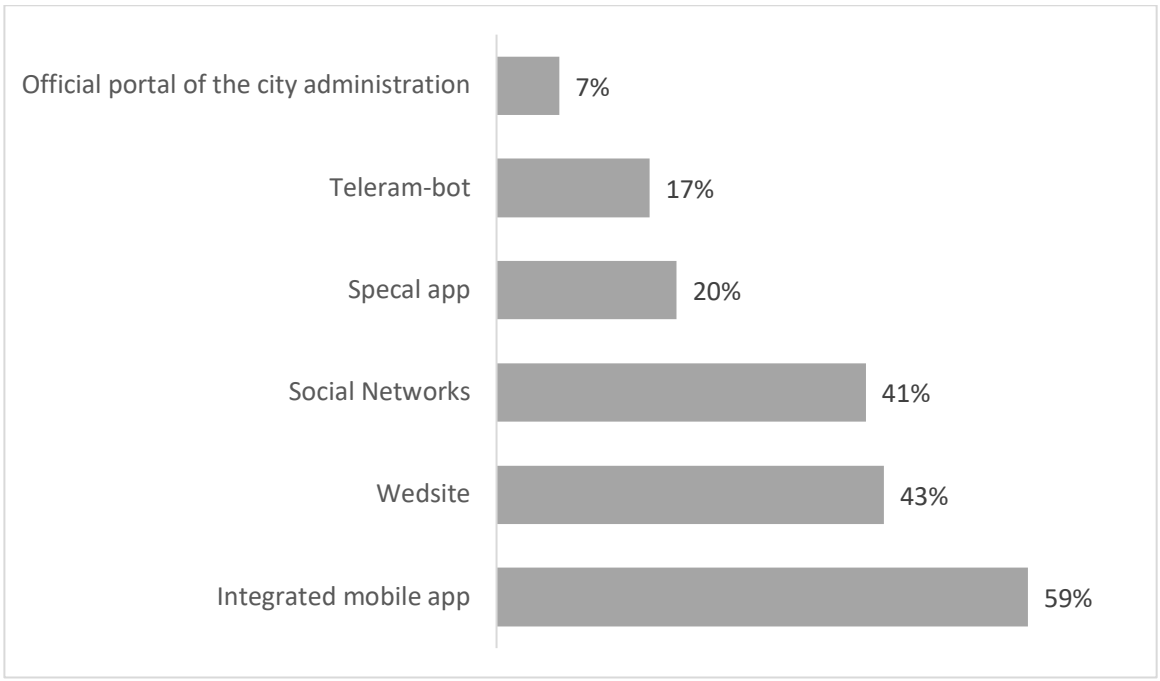

Figure 8 The preferred channels of participation

The most preferred channel of e-participation is mobile app that has the information about public transport (schedule, arrival time) and extra features that provide the possibility to e-participate. Only 20% of respondent prefer the specially separate mobile app for e-participation. The results are quite evident because the integrated mobile app is convenient tool. Today citizens are surrounded by large amount of different websites and apps, thus, they prefer integrated apps that contain all necessary information in one place.

To get more insights into the readiness of the citizens to e-participate, two logit models were developed. The first model studies the causal relationship between the readiness of St. Petersburg residents to e-consult and their main sociodemographic characteristics. The second one describes the relationship between the readiness to e-participate and also main sociodemographic characteristics of respondents. The both model has the following general structure:

$$P(Change_i = 1\ |X_1, X_2, \dots, X_n|) = F(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ \dots + \ \beta_n X_n)$$

$$P(Change_i = 1\ |X_1, X_2, \dots, X_n|) = \frac{1}{1 + \ e^{-(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ \dots + \ \beta_n X_n)}}$$

where:

$Change_i$ is depended variable

X1,X2,…Xn are model parameters

$(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ \dots + \ \beta_n X_n)$ is binding function

The variables are described in Table 8.

Table 8 The variable description

Dependent variable	
readiness to complain or comment	turns 1 if the respondent is ready for e-consulting, turns 0 if not
readiness to participate	turns 1 if the respondent is ready for e-consulting, turns 0 if not
Descriptions of the variables	
gender	turns 1 if the respondent is mail, turns 0 if not
education	turns 1, 2, 3, 4 or 5 if respondent has secondary education, post-secondary education, not finished higher education, higher education, 2 or more higher education (including PHD) respectively.
age	turns 1, 2, 3, 4, 5 or 6 if the respondent is 18-25, 26-35, 36-45, 46-55, 56-65, 65+ years old respectively.

income	turns 1, 2, 3, 4 or 5 if the respondent has very low, low, medium, high or very high income respectively.
transport mode	turns 1, 2, 3, 4 or 5 if the respondent use only PT, more PT than PC, half PR and half PC, more PC than PT, only PC respectively.

"R Studio" was used to develop the models. Estimates of the model parameters are represented in Table 9 and Table 10. The variables used in the model are measured in nominal scales. Hence, the obtained estimates cannot be quantified, but sign of the obtained estimates can be interpreted to define the direction of influence of independent variables on the readiness to e-consult or e-participate.

Table 9. Readiness to e-consult

Independent variables	Coefficients
gender	-0.38901*
education	0.08446
age	-0.10612*
income	0.65019*
transport mode	0.14455*

The sing * indicates the statistically significant coefficients. Signs of the obtained parameter estimates indicate the following:

- Women are more likely to e-consult than man;
- The older a resident, the less likely he or she e-consults;
- The higher income of a citizen, the more likely he or she e-consults;
- The more often a resident use car, the more likely he or she e-consults.

Table 10 Readiness to e-participate

Variables	Coefficients
gender	-0.33326*
education	0.06485
age	-0.18758**
income	0.54853 **
transport mode	0.07518

The sing * indicates the statistically significant coefficients. Signs of the obtained parameter estimates indicate the following:

- Women are more likely to e-participate than man;
- The older a resident, the less likely he or she e-participate;
- The higher income of a citizen, the more likely he or she e-participate;

2.6. Desiccation and policy implication

The survey experiment showed that the possibility of e-participation does not increases the attractiveness of public transport for all categories of citizens. If the results of the experiment are considered in relation to the 18-30 years old age groups, then there is a statistically significant positive difference in averages between the experimental and control groups. It means that the opportunity of e-participation makes public transport more attractive for young people. To be more precise, the e-participation rises attractiveness by 9.8%. It is probably due to the several facts: firstly, a young generation got used to modern technologies. They are open to them and utilize them without hesitation. Secondly, young people have been brought up in an environment of personalized goods and services (Dumitrescu, 2016). Thus, they expect something the same from the public services. The possibility of e-participation provides the opportunity to personalize public transport. Public transport, in this case, becomes closer to consumers, that is appreciated by young people.

As for the 31+ years old groups, the experiment showed that for these respondents the possibility of e-participation has no influence on their choice between the public transport and privet cars. It can be explained by the fact that this group of people has less free time rather than younger people. They are usually occupied with work and other events throughout the week (looking after children, housework, shopping etc.). Hence, they just want to get ready-made service without spending extra time on improving it. Another possible explanation of the result is that with age people become more skeptical about modern technologies and also about participation practices in general (Moroni, 2015). Probably they believe that all decisions are made exclusively by the authorities while the participation is fiction that actually do not affect anything. Moreover, political environment inside the country perhaps has also influenced their attitude to democratic procedures.

The difference in attitudes to e-participation among different age groups explains why the general result of experiment showed that the possibility of e-participation does not increase the attractiveness of public transport. Since there are more respondents from the 31+ years old group

in the sample, it led to reduction of the difference in mean values between the experimental and control groups

The experiment also showed that for the group of respondents that use only private cars or use private cars more than public transport the possibility of e-participation increases the attractiveness of public transport by 8.2% while for the group that uses use only public transport or more public transport than private cars, it is not the factor that influences on the attractiveness. The reason for this result is probably that car users have full control over their vehicle, thus, they expect the same from public transport. E-participation enables passengers to control the quality of services as well as influence on the public transport network in order to make it more comfortable for them.

Another result of the experiment demonstrated that the opportunity of e-participation increases the attractiveness of public transport for people with higher income by 7.3% while the respondents with lower income do not consider e-participation as the factor that can affect the attractiveness. It might be explained when income of citizens increases, they expect to receive better services. Thus, they think that if they have, for example, the possibility to complain or comment on the work of public transport online, it may influence on the quality of public transport services.

The extra questions that were added to survey showed that 66% of respondents are ready for e-consultation and 57% – are ready for e-participation. Hence, it gives a right to assume that St. Petersburg residents in general are ready for e-consultation and e-participation.

The logit regression model revealed that age of the resident effects his or her readiness to e-consult and e-participate. The older a resident, the less likely he or she e-consults or e-participates. It can be explained by the same arguments as the fact that e-participation rises attractiveness of public transport for young generation. Young people usually have more democratic values. They believe that they can change the world into better place (Dumitrescu, 2016). Moreover, as it was said above, they are open to modern technologies and actively use them. One more possible explanation is that older people have less free time in comparison with to youth because they are burdened with children, mortgage and etc.

Another finding obtained from the model is that the citizens with the higher income are more likely to e-consult and e-participate in comparison with citizens with lower income. As it was mentioned above, one of the possible reason is that citizens with higher income expect to get better services. Another reason is, when people become wealthier, they start to have more active citizenship because now they have less problems with their basic needs and ready to spend their free time on civil activisms (Jasna t al, 2017).

To sum up everything above, e-participation increases the attractiveness of public transport for the such groups as: the 18-30 years old age group (by 9.8%), the group of respondents that use only private cars or use privet cars more than public transport (by 8.2%) and people with higher or very high income by (by 7.3%).

Based on these results, it can be concluded that the city administration should develop the e-participation tools, since it increases the attractiveness of public transport for such important categories of citizens as youth, people with growing incomes and car owners.

While developing public transport, it is important to address these groups of residents because of the following reasons:

- Young people are the category of citizens who are still forming their transport habits. Moreover, in the near future they will be able to afford a car purchase. Therefore, it is crucially important to create public transport that would be as attractive as possible for young people to encourage them to use public transport instead of a private car.
- The same applies to people with higher or very high income. Citizens with a growing income in the near future will face the choice to continue using public transport or buy a private car. If public transport is a more attractive alternative for them, they will continue to use it.
- City administration should also pay attention to car owners when they develop public transport. By meeting their expectations of urban mobility, the authorities will be able to encourage car users to use public transport.

In the upcoming transport reform in St. Petersburg, the city authorities do not pay attention to the development of e-participation tools. Although, the result of the study showed that e-participation increase the attractiveness of public transport. Thus, it is highly recommended to provides the city residences with opportunity to complain or comment on the work of public transport online as well as to share and vote for ideas about its development. Moreover, the survey showed that the residents of St. Petersburg are generally ready to complain, comment and share their ideas regarding the operation of public transport if it is necessary. It means that e-participation can become a really working institution in St. Petersburg.

The development of participation will not only increase the attractiveness of public transport, but also provide the city authorities with more information about the city transport problems. Taking into account the comments, complaints and ideas of citizens, the city authorities will be able to make more effective decisions. In this case, “efficiency” means, on the one hand, reducing the cost of finding an optimal solution to complex transport problems that affect the

interests of a significant number of citizens, and, on the other, preparing a solution that takes into account the interests of all affected parties to the maximum extent possible.

Moreover, while developing e-participation, city authorities should take into account which channel of e-participation is most preferable for citizens. The survey showed that for the residents of St. Petersburg the most preferred channel of e-participation is mobile app that has the information about public transport (schedule, arrival time and ect.) and extra features that provide the possibility of e-participate. Thus, implementing e-participation tools, city authorities should focus on this channel of participation.

CONCLUSION

Today, cities are characterized by a high level of motorization. Despite the fact that large cities have developed transport infrastructure, still the increase of cars leads to serious transport problems, which are manifested in congestion of transport networks, reduced economic activity, air pollution, reduced road safety and mobility of the population. Modern experience shows that the transport policy pursued by the city authorities should be aimed to develop public transport.

Modern urban mobility is characterized by its complexity, since it has a large number of integrated sub-systems, including networks of pedestrian and bicycle traffic, and many other factors (such as social and environmental effects). The development of such complex systems requires the establishment of multiple feedback and self-regulation mechanisms that can be provided by e-participation tools.

E-participation is a scale that varies from just informing to real engagement citizens in decision making process. It consists of three levels: e-informing, e-consulting and e-participation. On the first level citizens get an access to up-to-data information about policies and programs, laws and regulations, budgets, and other issues of public interest. The next level assumes that citizens are enabled to complain and comment on the work of public services. Finally, on the last level government provide online participation platforms where people can suggest possible solutions, discuss them, give feedback, and vote for initiatives. E-informing was not examined in the current research, since it does not imply the real involvement of people in decision making process.

E-participation is usually considered as a part of "smart" concepts because it is biased on ICT. Therefore, if e-participation is examined in a relation to public transport, then it is more correct and precise to speak about smart public transport.

To understand what is "smart" in the urban context, the "smart city" concept was examined. Based on the analysis of different approaches and common components of the smart cities, three main domains of "smartness" in urban context were defined: wide use of ICT, development of human capital and communication between stockholders. It was also shown that only the combination of all these domains makes a smart city really "smart".

The ideas of "smartness" concept can be applied in any field of urban life including transportation. However, the literature review showed that the practitioners use only one dimension (ICT dimension) of "smartness" when they speak about smart transport. They do not try to apply other two domains to smart transport systems. The analysis of existing smart transport solutions also showed that there are no special ICT-biased solutions on the current market that would promote greater participation of citizens in the planning of the transport system.

To cover the found research gap, the survey experiment was conducted. The goal of the experiment was to define if the opportunity to complain or comment on the work of public transport online as well as to share and vote for ideas about its development increases the attractiveness of public transport for citizens.

The experiment showed that the opportunity of e-participation increases the attractiveness of public transport for such groups as: the 18-30 years old age group (by 9.8%), the group of respondents that use only private cars or use privet cars more than public transport (by 8.2%) and people with higher or very high income by (by 7.3%). Thus, it can be concluded that e-participation must be considered as smart transport solution. From the practical point of view, the result means that city authorities should spend money on introduction of e-participation in public transport filed.

Moreover, the study determined the readiness of St. Petersburg residents to e-participate and the preferable channels of it. Two logistic regression models were also developed to find which socio-demographic factors affect the readiness of citizens to e-participate.

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APPENDICES

Appendix 1

The questionnaire for survey experiment

For control group

Уважаемый респондент, прочитайте, пожалуйста, текст и ответьте на вопросы.

В 2020 году в Санкт-Петербурге стартует транспортная реформа. Общественный транспорт после нее должен стать предсказуемым, социально ориентированным и комфортным. Ожидается, что интервалы движения в пиковое время значительно сократятся, а автобусы будут точно соблюдать расписание. На дорогах города появятся 2662 новых комфортных автобуса с кондиционерами, низким полом и плавным ходом. Везде будут принимать к оплате банковские карты и единые электронные проездные билеты, в том числе льготные.

Оцените по шестибалльной шкале, насколько новая реформа увеличивает привлекательность общественного транспорта в сравнении с личным автомобилем (6 – привлекательность общественного транспорта значительно увеличится, 1 – реформа никак не отразится на привлекательности общественного транспорта).

For experimental group

Уважаемый респондент, прочитайте, пожалуйста, текст и ответьте на вопросы.

В 2020 году в Санкт-Петербурге стартует транспортная реформа. Общественный транспорт после нее должен стать предсказуемым, социально ориентированным и комфортным. Ожидается, что интервалы движения в пиковое время значительно сократятся, а автобусы будут точно соблюдать расписание. На дорогах города появятся 2662 новых комфортных автобуса с кондиционерами, низким полом и плавным ходом. Везде будут принимать к оплате банковские карты и единые электронные проездные билеты, в том числе льготные. Помимо этого граждане смогут оставлять жалобы и комментарии в режиме реального времени с помощью мобильного приложения, а также принимать онлайн-участие в планировании транспортной сетки города.

Оцените по шестибалльной шкале, насколько новая реформа увеличивает привлекательность общественного транспорта в сравнении с личным автомобилем (6 – привлекательность общественного транспорта значительно увеличится, 1 – реформа никак не отразится на привлекательности общественного транспорта).

Extra questions for both groups

1. Представьте, что у Вас есть возможность оставлять жалобы и комментарии относительно работы общественного транспорта через мобильное приложение, стали бы Вы пользоваться такой функцией при необходимости?

- Да, стал(а) бы;
- Нет, не стала бы;

2. Представьте, что у Вас есть возможность участвовать в планировании маршрутной сетки общественного транспорта города (делиться идеями о его развитии, обсуждать их с другими жителями и представителями городской администрации, а также голосовать за понравившиеся идеи) через мобильное приложение, стали бы Вы пользоваться такой функцией?

- Да, стал(а) бы;
- Нет, не стала бы;

3. Выберите наиболее удобные для вас способы оставлять жалобы и комментарии относительно работы общественного, а также участвовать в обсуждениях планирования маршрутной сетки общественного транспорта.

- Официальные порталы органов государственной власти;
- Паблики и группы в социальных сетях;
- Интернет сайты/порталы;
- Telegram-боты;
- Специальное мобильное приложение;
- Интегрированное мобильное приложение, которое бы содержало информацию о работе общественного транспорта и возможности, указанные в вопросе.

4. Какой транспорт Вы используете?

- Личный автомобиль (100% поездок);
- Общественный транспорт (100 % поездок);
- 50 % личный автомобиль и 50% общественный транспорт;
- Больше личный автомобиль, чем общественный транспорт;
- Больше общественный транспорт, чем личный автомобиль.

5. Укажите, пожалуйста, Ваш пол.

- Мужской;
- Женский;

6. Укажите, пожалуйста, Ваш возраст.

- 18-20;
- 21-25;
- 26-30;
- 31-35;
- 36-40;
- 41-45;
- 46-50;
- 51-55;
- 56-60;
- Старше 60.

7. Ваше образование.
    - Среднее;
    - Среднее-специальное;
    - Неоконченное высшее;
    - Высшее;
    - Два и более высших, учёная степень.
8. Какое высказывание точнее всего описывает материальное положение Вашей семьи?
    - Очень тяжелое, так как хватает только на еду;
    - Тяжелое, так как хватает на еду и одежду;
    - Умеренное, так как хватает на еду, одежду, ежедневные нужды и отпуск раз в году;
    - Хорошее, так как хватает на еду, одежду, ежедневные нужды, покупку автомобиля и отпуск раз в году;
    - Очень хорошее, так как хватает на всё, вплоть до покупки одежды и автомобилей; класса “премиум” и дорогостоящего отдыха на престижных курортах несколько раз в году.
9. К какой категории граждан Вы относитесь?
    - Учащийся / студент;
    - Военнослужащий;
    - Наёмный работник;
    - Предприниматель;
    - Пенсионер;
    - Безработный.

Appendix 2

T-test and F-test for checking if two samples have equal means and the same variances.

T-test and F-test for variable age

```
        F test to compare two variances

data:  con_gr$age and exp_gr$age
F = 0.91824, num df = 604, denom df = 573, p-value = 0.3008
alternative hypothesis: true ratio of variances is not equal to 1
95 percent confidence interval:
 0.7809264 1.0793127
sample estimates:
ratio of variances
         0.9182365
```

```
        Welch Two Sample t-test

data:  con_gr$age and exp_gr$age
t = 0.1346, df = 1166.4, p-value = 0.893
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.2162315  0.2480857
sample estimates:
mean of x mean of y
 4.543802  4.527875
```

T-test and F-test for variable education

```
        F test to compare two variances

data:  con_gr$educ and exp_gr$educ
F = 1.1056, num df = 604, denom df = 573, p-value = 0.2243
alternative hypothesis: true ratio of variances is not equal to 1
95 percent confidence interval:
 0.9402696 1.2995396
sample estimates:
ratio of variances
          1.105597
```

```
        Welch Two Sample t-test

data:  con_gr$educ and exp_gr$educ
t = -1.5512, df = 1177, p-value = 0.1211
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.19844133  0.02320016
sample estimates:
mean of x mean of y
  3.52562   3.61324
```

T-test and F-test for variable income

```
        F test to compare two variances

data:  con_gr$income and exp_gr$income
F = 1.153, num df = 604, denom df = 573, p-value = 0.08482
alternative hypothesis: true ratio of variances is not equal to 1
95 percent confidence interval:
 0.9806169 1.3553035
sample estimates:
ratio of variances
          1.153039
```

```
        Welch Two Sample t-test

data:  con_gr$income and exp_gr$income
t = 0.091205, df = 1176.6, p-value = 0.9273
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.08334162  0.09146786
sample estimates:
mean of x mean of y
 2.957025  2.952962
```

T-test and F-test for variable transport mode

```
        F test to compare two variances

data:  con_gr$trmode and exp_gr$trmode
F = 1.0282, num df = 604, denom df = 573, p-value = 0.7369
alternative hypothesis: true ratio of variances is not equal to 1
95 percent confidence interval:
 0.8744215 1.2085316
sample estimates:
ratio of variances
          1.028171
```

```
        Welch Two Sample t-test

data:  con_gr$trmode and exp_gr$trmode
t = -0.23361, df = 1175.2, p-value = 0.8153
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.1862557  0.1466208
sample estimates:
mean of x mean of y
 2.366942  2.386760
```

T-test for testing if two groups have difference in averages

T-test for general results

```
        Welch Two Sample t-test

data:  totaly$exp1 and totaly$exp2
t = -3.8344, df = 391.1, p-value = 0.0001467
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.8909063 -0.2869648
sample estimates:
mean of x mean of y
 3.553922  4.142857
```

T-test for the group 18-30 years old

```
        Welch Two Sample t-test

data:  totaly$exp1 and totaly$exp2
t = -3.8344, df = 391.1, p-value = 0.0001467
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.8909063 -0.2869648
sample estimates:
mean of x mean of y
 3.553922  4.142857
```

T-test for the group 35+ years old

```
        Welch Two Sample t-test

data:  totalo$exp1 and totalo$exp2
t = 0.31885, df = 783.42, p-value = 0.7499
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.2073141  0.2877219
sample estimates:
mean of x mean of y
 3.498753  3.458549
```

T-test for the group that uses only PC or PC more than PT

```
        Welch Two Sample t-test

data:  total_a$exp1 and total_a$exp2
t = -2.8232, df = 336.73, p-value = 0.005038
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.8355938 -0.1493459
sample estimates:
mean of x mean of y
  3.37500   3.86747
```

T-test for the group that uses only PT or PT more than PC

```
        Welch Two Sample t-test

data:  total_a$exp1 and total_a$exp2
t = -2.8232, df = 336.73, p-value = 0.005038
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.8355938 -0.1493459
sample estimates:
mean of x mean of y
  3.37500   3.86747
```

Logit model for factors of e-consultation

```
Deviance Residuals:
    Min       1Q   Median       3Q      Max
-2.6337   0.3603   0.5649   0.6835   1.4219

Coefficients:
            Estimate Std. Error z value Pr(>|z|)
(Intercept) -0.49653    0.37625  -1.320  0.18694
trmode       0.14455    0.05191   2.785  0.00536 **
gender      -0.38901    0.15978  -2.435  0.01491 *
age         -0.10612    0.03535  -3.002  0.00268 **
educ         0.08446    0.06569   1.286  0.19852
income       0.65019    0.08627   7.537 4.81e-14 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Logit model for factors of e-participation

```
Deviance Residuals:
    Min       1Q   Median       3Q      Max
-2.4345   0.3964   0.5831   0.7227   1.4718

Coefficients:
            Estimate Std. Error z value Pr(>|z|)
(Intercept)  0.24773    0.36220   0.684   0.4940
trmode       0.07518    0.04914   1.530   0.1261
gender      -0.33326    0.15590  -2.138   0.0326 *
age         -0.18758    0.03412  -5.497 3.87e-08 ***
educ         0.06485    0.06388   1.015   0.3100
income       0.54853    0.08328   6.587 4.49e-11 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```