Smart City Implementation and Aspects: The Case of St. Petersburg

Sergey I. Drozhzhin[1,2(✉)], Artem V. Shiyan[1], and Sergey A. Mityagin[1]

[1] ITMO University, Kronverkskiy pr. 49, Saint-Petersburg 197101, Russia
{sergey.drojjin, avshiyan, mityagin}@corp.ifmo.ru
[2] ETU "LETI", Professora Popova st. 5, Saint-Petersburg 197376, Russia

Abstract. Cities in the world face the problem of combining competitiveness and sustainable development at the same time. Urban space forms a much more subtle matter in terms of the simultaneous scale and point of processes spectrum. Certainly, the city is the primary source of generation fundamental anthropogenic factors within the framework of human activity (ecology, transport, society and security). However, on the other hand, in the current realities, it also becomes a structural tools mechanism for creating qualitatively new drivers of development (for example, intelligent infrastructure networks for urban mobility or closed-loop water supply).

The city as a dynamic system has a certain set of patterns. The basic ones regulate the system development, complexity of mechanisms and diversification of modules designed. The critical ones regulate system stability and the preservation of existing stable state. Providing modularity of urban management architecture will allow scaling the interaction chain within the socio-technical system (i.e. the city), which make it possible to minimize the risk of destructive strategic decisions.

Smart city as a platform provides transparency of the urban space processes and forms a two-level management (citizen-government). An effect indicator of high technology implementation is not so much a formal achievement of indicators values, but as the parameter of the complex infrastructure regime of a certain urban area in a given chronological period.

When we have such projects of this level, the citizens themselves act as the center of aggregation of new meanings, values, and needs. On the basis of their everyday life situations, a framework of knowledge is designed for further strategic urban space planning.

The authors of this article propose to revise the traditional understanding of the concept of "smart city" and consider the case of development of St. Petersburg as a "smart city", based on the value-oriented approach.

Keywords: Smart city · Value-oriented approach · Urban studies · Human-oriented approach

A. Chugunov et al. (Eds.): EGOSE 2018, CCIS 947, pp. 14–25, 2019.
https://doi.org/10.1007/978-3-030-13283-5_2

1 Introduction

Today, cities, within the trends of global economic development, are considered a kind of network nodes of world resources. They aggregate human, financial, scientific and technological, historical, cultural, commodity and civilizational (i.e., quality of life standards) flows. In addition, the modern city, as a complex infrastructure object, is an extremely complex system. And dynamically changing trends and threats are constantly expanding the list of critical parameters of this social engineering system.

The life-cycle of the city behind the paradigm of historical processes was transformed from a purely utilitarian direction of development (city-plant) into a mechanism of self-generation of new points of activity (city-functions) and meanings (city-people). In addition to the already formed framework of infrastructure, the urban area needs to be reorganized from the point of view of the impact of life situations of citizens [9]. Such fundamental decisions are pushed by numerous factors of resilience in the era of rethinking of everyday processes.

On the one hand, there is an increase in the population density of large cities due to over-urbanization and the chaotic use of adjacent areas, which leads to the risk of loss of the basics of strategic planning. But the redevelopment of former industrial areas leads to the revitalization of urban infrastructure. Engineering, transport and information infrastructures of the modern city are the arteries for the delivery of quality services. On the other hand, the role of every citizen, regardless of his or her activities, in ensuring the global competitiveness of cities is increased [5].

Because of continuous configuration changes, as the urban fabric covers various aspects of human scale, a priori there is an impact on a lot of other parameters, which in turn affect the socio-economic situation and, perhaps, even more worsen the situation than it was before. Thus, the smart city as a platform is aimed at monitoring and detailing the ongoing urban processes, regardless of the scale of the tasks.

2 Mechanisms of Smart City Design in the Context of Technological and Infrastructure Framework

«Smart city» suggests a rational strategy of advanced integration of innovative technologies with the urban infrastructure in order to improve the life quality [2]. All this is aimed at algorithmization of management of an effective service-oriented model of urban processes. The absolute organizational and economic condition for the design of this kind of ecosystem is the actual format of the technological and infrastructure base. The background of the emergence of a smart city as a kind of new formation of the territory is associated with the efficiency of resource use for a strictly limited cycle of services. Therefore, smart urban space provides the opportunity to use distributed entry points to the infrastructure guided by standardized regulations of interaction.

During the popularization of the strategy of smart cities around the world, there is a different trend of approaches to the formation of smart infrastructure for a qualitative leap in the integrated development of the territory [3]. Based on the existing types of urban space, the following basic features can be identified in the formation of smart cities:

- Historically formed urban infrastructure (megacities New York, Moscow, London, Barcelona, Tokyo and St. Petersburg)
- Development of territories "from scratch" through the introduction of smart infrastructure (Songdo, Masdar, etc. new projects)
- Cities with underdeveloped infrastructure (for example, single-industry towns and small towns, for further preservation and development they need such a complex project-driver).

Most modern technological solutions are aimed at the installation of a single platform with a strictly built vertical modular architecture. This kind of boxed solutions are in demand in such standard projects as Masdar or Songdo. Of course the effect of ready-made and tested solutions in some cases justified. However, in the long term, a city without developing a platform for its specific management, territorial development strategy and infrastructure risk losing its competitiveness and digital independence in just five or ten years. Therefore, each city strives to choose a certain initiative and a key role of urban space for citizens in the future [16]:

- Moscow - unified information space;
- New York - city sustainable and resilient;
- Barcelona - technological sovereignty, increasing opportunities for citizens in the digital environment;
- Vienna - city of equal opportunities for all groups of citizens;
- Singapore - human-oriented approach and smart use of technology.

Due to the more transparent optimization processes in the urban infrastructure framework and the availability of flexibility in building tasks on life cycles, the most modern case is the approach to the phased implementation of a smart city. The specificity of the problems is due to the so-called "technological symptoms of scale", when the decisive feature of the quality of information is the creation of distributed information systems for each public service, and not the modularity of the architectural approach on the fundamental layers of a single platform.

As of 2017, St. Petersburg occupies a leading position among other Russian regions in regional information, development of the information society and the level of ICT penetration into urban process [14].

The city information infrastructure of St. Petersburg has a sufficiently developed, with great potential, but a complex structure, with an ever-growing volume of heterogeneous and fragmented data, services, systems, functions, which does not fully meet the modern requirements and needs of citizens, business and the city economy as a whole [15].

In this regard, the task was to restructure the existing complex of systems to create an intelligent network of interaction within the integration of various services. A smart city should transform the everyday life situations faced by different categories of citizens into personalized requests and a standard of urban service mobility [10].

For St. Petersburg, the priority goal is the fundamental deployment of technological and infrastructure base around the values of citizens, for a more flexible response to the current needs in the given conditions [11].

3 Methodological Support in the Development of the Concept Smart St. Petersburg

«Smart city» is considered as a system of urban resources management, designed for a new format of interdepartmental cooperation and the formation of a competitive economic space [16]. Due to the universal reasonable use of advanced intelligent information technologies, it is planned to gradually improve the quality of life of citizens starting from the first annual cycle of Smart City events.

Within the logic of integration processes, a structural and functional smart city model is proposed. Such a platform is an interconnected set of functional elements of the digital economy infrastructure of the city, consisting of four layers. The General scheme is shown in Fig. 1.

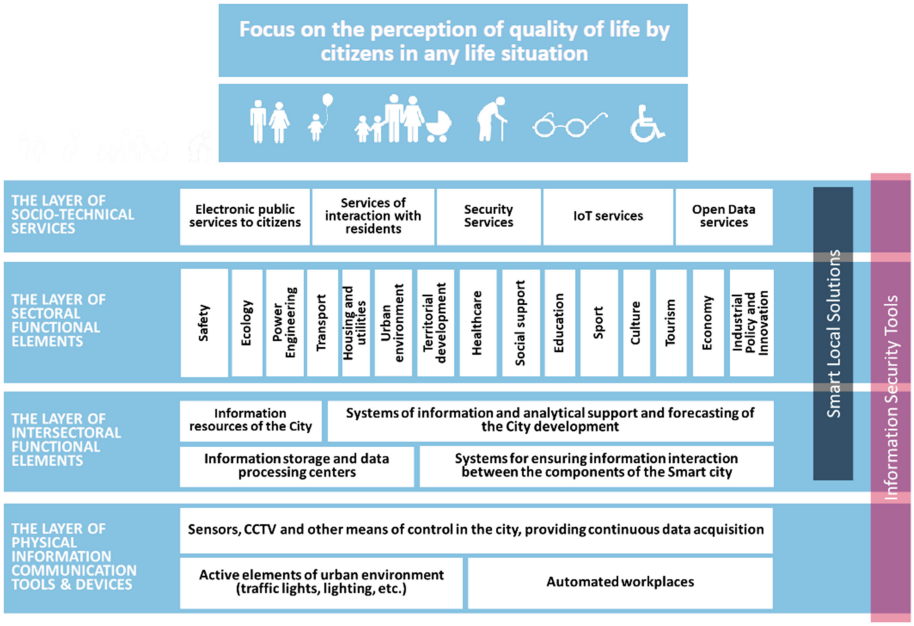


Fig. 1. The structure of the interacting elements of the City

Each functional element characterizes a group of functions of the city in relation to residents, businesses or authorities [4]. The development of elements of the basic layers (physical means of information interaction and inter-sectoral functional elements) is a necessary condition for the creation of the framework of the highest-level infrastructures. This kind of distribution of the smart city architecture into layers allows to prevent the emergence of unnecessary intermediaries of interaction and to streamline the phased implementation of modules to preserve the principles of the ecosystem [13].

1. Layer of physical information communication tools and devices:
   - hardware and software systems accompanying distributed urban processes;
   - seamless integration of digital technologies into the urban environment;
   - monitoring of automation objects.
2. Layer of intersectoral functional elements:
   - ensuring smooth interaction at the applied level of all subjects of urban information space;
   - aggregation of different data sources into a single urban repository;
   - organization of the required level of infrastructure performance for guaranteed access to urban data.
3. Layer of sectoral functional elements:
   - transparent coordination of urban development within the framework of the activities of the Executive authorities;
   - optimization of e-government information resources;
   - component implementation of modules for day-to-day management tasks.
4. Layer of socio-technical functional elements:
   - mobility of public and municipal services;
   - formation of conditions for the expansion of services in the digital profile of citizens;
   - infrastructure entry points to the unified information space of the city.

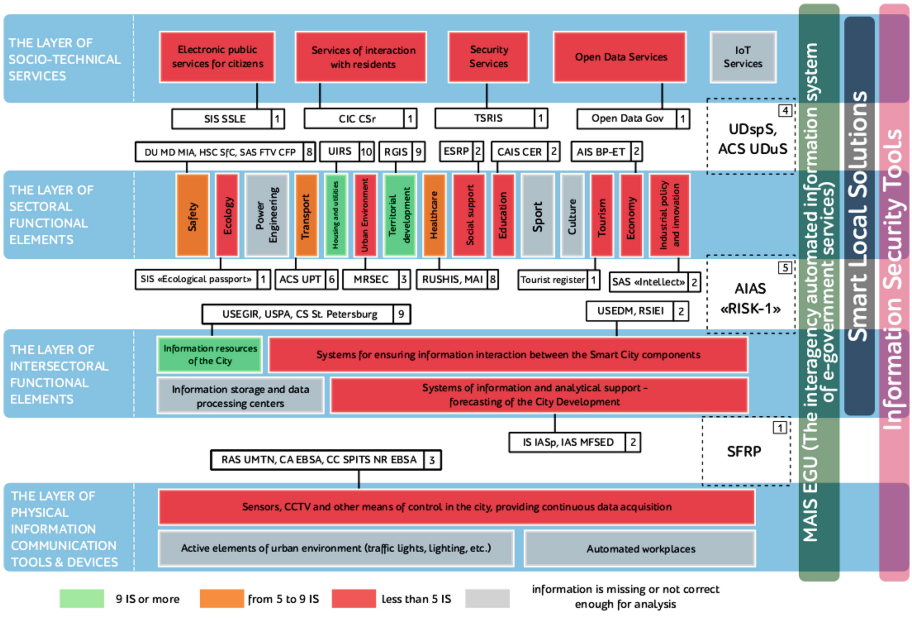


Fig. 2. Current situational scheme about IT infrastructure status of St. Petersburg

Table 1. Terminology explanation of urban information systems in St. Petersburg

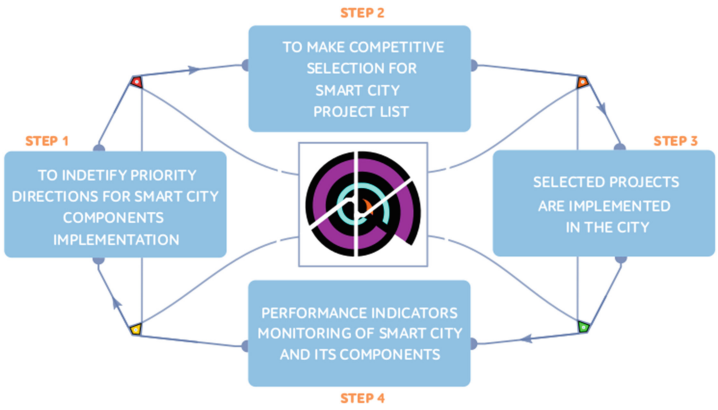
№	Abbreviation	Full meaning
1	SIS	State information system
2	SAS	State automated system
3	CS	Classifier system
4	ACS	Automated control system
5	AIS	Automated information system
6	CAIS	Complex automated information system
7	IS	Information system
8	RAS	Resource accounting system
9	HSC	Hardware and software complex
10	IAS	Informational and analytical system
11	CA	Certification authority
12	CC	Control center
13	AIAS	Automated information and analytical system
14	TSRIS	Territorial and sector-based regional information system
15	RSIEI	Regional system of interdepartmental electronic interaction
16	UDspS	Unified dispatch service
17	FTV CFP	Fixing traffic violations and control fines payment
18	MAI	Management of ambulance infrastructure St. Petersburg
19	ESRP	Electronic social register of St. Petersburg population
20	ClC CSr	Call centre of citizens service
21	IASp	Information and analytical support
22	SFRP	System of the formation and projects registration

Figure 2 shows a comparison with a model of smart city architecture by overlaying the current set of resources with a planned information platform. Table 1 provides brief reference for technical names of urban systems.

4 Formation of an Integration Platform for Effective Implementation of Smart Driver-Projects

The implementation of the Smart St. Petersburg is made in the logic of the project approach, in which each project occupies a certain place in the overall structure according to its functional purpose [16]. Thus, the «smart city» is structurally a set of interacting projects, jointly ensuring the achievement of their own local goals and common goals of «Smart St. Petersburg». The concept implementation in St. Petersburg assumes the use of the existing potential of the city due to the active and initiative participation of business and citizens as participants of the city development process [12].

The process of implementing projects within the «Smart St. Petersburg» involves an annual cycle of activities. The project platform is described in Fig. 3.



MORE DETAILED STRUCTURE OF CYCLE

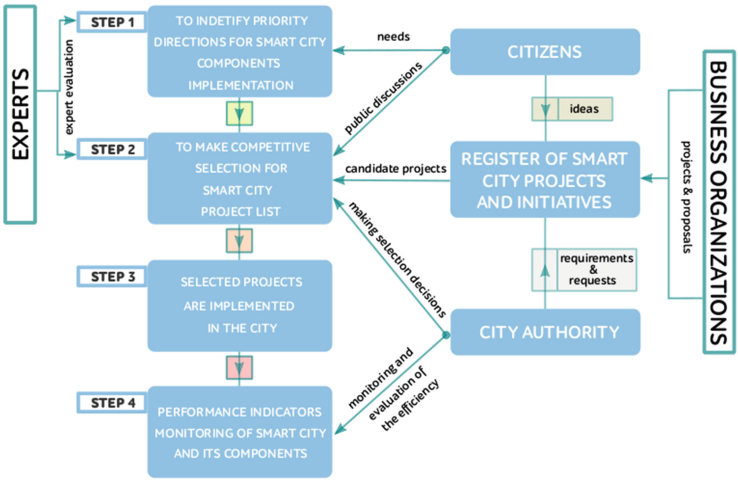


Fig. 3. Annual cycle of selection and ranking of projects

The purpose of the first stage is to determine the priority directions for the development of the city. The directions are determined by following factors: expected effect in terms of improving people's quality of life; advance development of the city; necessary elements of infrastructure [6]. At the first stage, the most popular areas of development should be identified, according to current problems and the needs of the population, as well as the formation of an infrastructure for the introduction of "smart" solutions. There must be a balance between these areas.

At the second stage, projects are selected based on methodology and regulations.

At the third stage, the projects of "Smart St. Petersburg" are being implemented. The implementation of projects is carried out in compliance with the standards adopted

in the industry of the implemented project, while respecting the principles and objectives of Smart St. Petersburg. Control over the implementation process is carried out by the relevant state authority of St. Petersburg [8].

At the last stage of the cycle, the dynamics of the target indicators of "Smart St. Petersburg" and the performance indicators of the implemented projects are analyzed. Based on the monitoring results of the target indicators of Smart St. Petersburg, the results of the first and second steps can be slightly adjusted, and the cycle can be continued from the third stage. In the case of a significant deviation in the values of indicators or inability to achieve the target values - the cycle of activities is repeated from the first stage.

5 The Strategy of Human-Oriented Design to Improve Citizens Life Quality

There are three options for identifying priority areas and areas for introducing smart city technologies.

The first option assumes an orientation toward successful global and Russian practices of building "smart cities". Focusing on specific solutions and positioning the city in subject ratings are the advantages of this option. Possible immature of the city to implement a set of technologies due to lack of infrastructure (or serious problems in it) is disadvantage of this option. Current problems of the city can also be a difficult obstacle to the introduction of technology.

The second option involves focusing on current urban problems and their consistent solution. This allows to achieve the desired effect of improving quality and standard of living. Advantages of this approach are the initial social orientation and ensuring the maximum social effect at each iteration. The disadvantage of the approach is that strategic goals and intensive development of the city are not achieved.

The third option involves the identification of areas for the city development, based on its personal characteristics and capabilities and orientation to them. Advantages of the approach are: certain determination of development and the possibility of achieving significant results by focusing efforts. The obvious disadvantage is the lack of consideration of current problems in the city.

As part of the preparation of the "Smart St. Petersburg" concept, a combination of the second and third approaches was considered as a basis [1].

First of all, it is necessary to understand the position regarding the smart city of those stakeholders that are in St. Petersburg. The first component is a survey of active residents of the city, the second is a survey of employees of the authorities in St. Petersburg. It is important to determine how the concept of "smart city" is perceived now and how ready the two groups are to actively use smart city technologies today. The detailed survey and extended statistics are presented in Fig. 4.

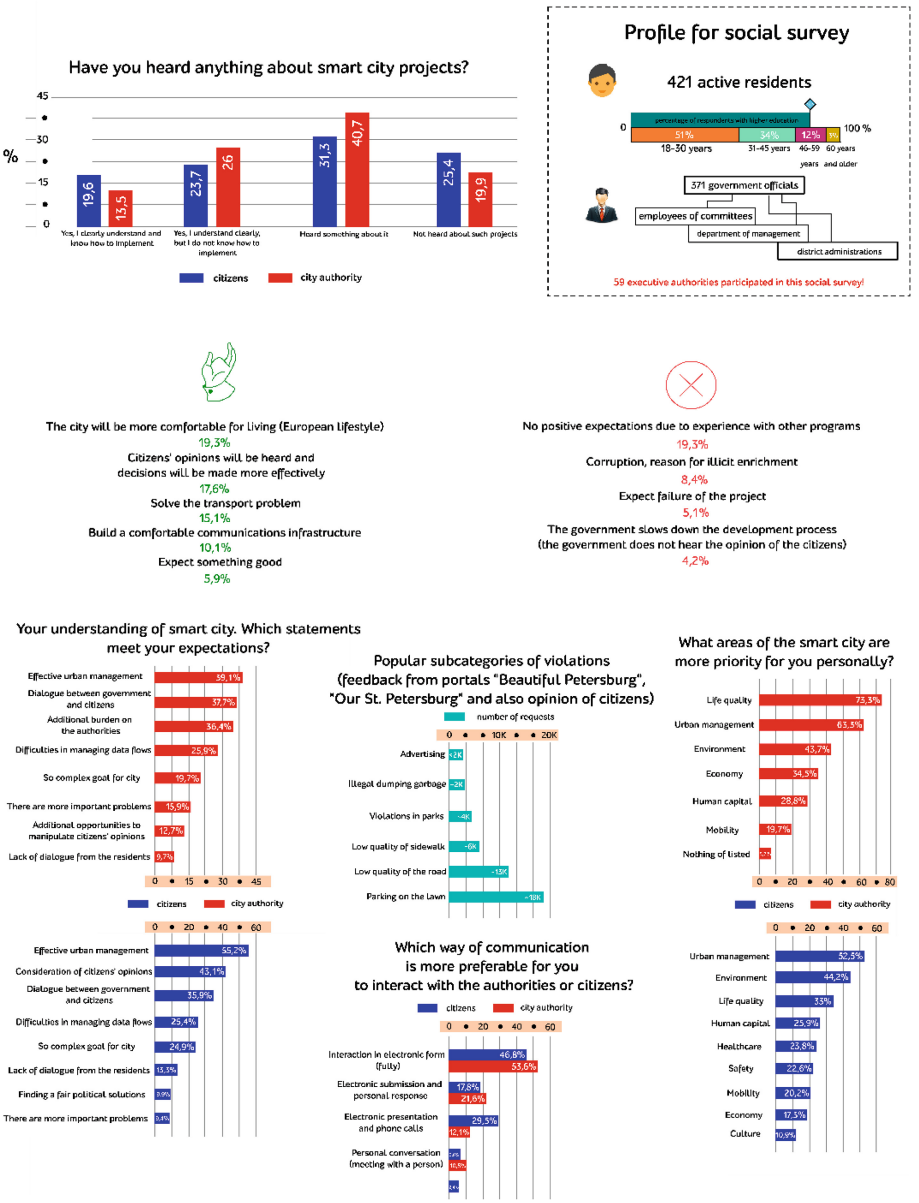


Fig. 4. Stages and statistics of the sociological survey Smart St. Petersburg

In general, according to the results of the research, it can be noted that the representations of St. Petersburg authorities on the priority areas of the city's development focused on the management of the city and the prospects for its development. Citizens focus mainly on current problems.

For this reason, when composing the final priority ranking of the directions for introducing the «smart city», both components are considered. Figure 5 shows the final rating of directions in the abstract format according to the structural and functional model of «Smart Petersburg».

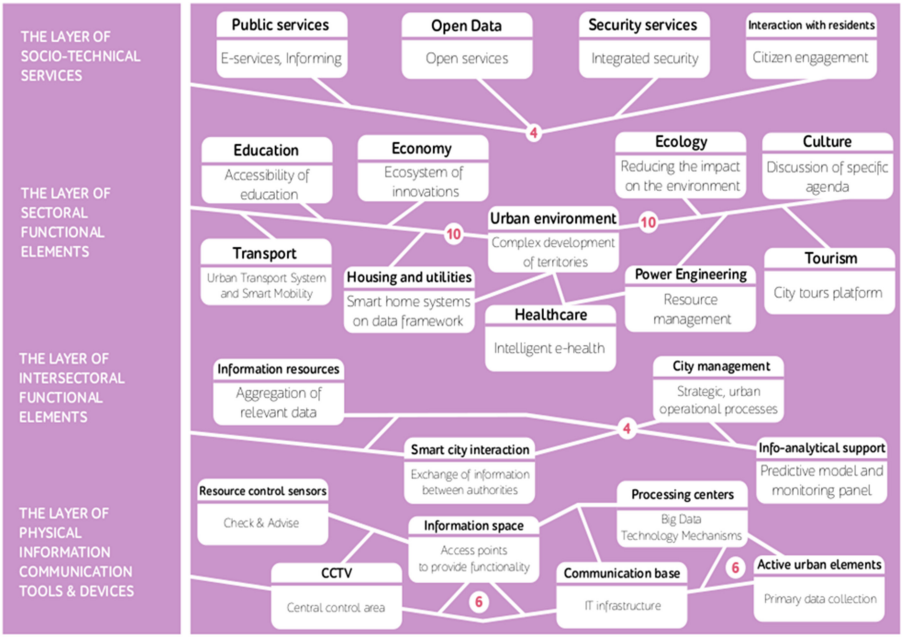


Fig. 5. Priority directions and areas for introducing smart city technologies in St. Petersburg based on needs and proposals of citizens and city authorities.

The conducted sociological survey has demonstrated a kind of snapshot of the development ideas about smart city in the specific context of the space transformation needs. This kind of dynamic tracking of the «urban pulse» will help to avoid misinterpretation of the basic values of citizens and the principles of technological progress [7].

Many cities are trying to gain a rating score by implementing various "smart projects" chaotically without feedback and overloading the fundamental infrastructure. Thus, the agenda of complex development of the territory is formed subjectively and without a full-scale discussion. The trend of over-urbanization obliges the government to use predictive modeling to understand the needs of citizens in a balanced and long-term Smart City strategy.

6 Conclusions

This article considers the vision and main features of smart city in St. Petersburg: structural and functional model of the "smart city"; main steps of selection and ranking of projects for their implementation in the urban environment; results of sociological survey. Results of the survey confirmed necessity of considering opinion of citizens and other stakeholders in processes of city development. Even though there are common expectations of smart city projects, it is important to make priorities to achieve certain effect.

References

1. Minelli, A., Ruffini, R.: Citizen feedback as a tool for continuous improvement in local bodies. Int. J. Public Sect. Manag. **31**(1), 46–64 (2018)
2. Fernandez-Anez, V., Fernández-Güell, J.M., Giffinger, R.: Smart city implementation and discourses: an integrated conceptual model. The case of Vienna. Cities **78**, 4–16 (2018)
3. Sikora-Fernandez, D.: Smarter cities in post-socialist country: example of Poland. Cities **78**, 52–59 (2018)
4. Kumar, H., Singh, M.K., Gupta, M.P., Madaan, J.: Moving towards smart cities: solutions that lead to the smart city transformation framework. Technol. Forecast. Soc. Chang., 1–16 (2018)
5. Kummitha, R.K.R., Crutzen, N.: How do we understand smart cities? An evolutionary perspective. Cities **67**, 43–52 (2017)
6. Borsekova, K., Korény, S., Vaňová, A., Vitálišová, K.: Functionality between the size and indicators of smart cities: a research challenge with policy implications. Cities **78**, 17–26 (2018)
7. Bakıcı, T., Almirall, E., Wareham, J.: A smart city initiative: the case of Barcelona. J. Knowl. Econ. **4**(2), 135–148 (2013)
8. Mora, L., Deakin, M., Reid, A.: Strategic principles for smart city development: a multiple case study analysis of European best practices. Technol. Forecast. Soc. Chang., 1–28 (2018)
9. Alawadhi, S., et al.: Building understanding of smart city initiatives. In: Scholl, H.J., Janssen, M., Wimmer, M.A., Moe, C.E., Flak, L.S. (eds.) EGOV 2012. LNCS, vol. 7443, pp. 40–53. Springer, Heidelberg (2012). https://doi.org/10.1007/978-3-642-33489-4_4
10. Fernandez-Anez, V.: Stakeholders approach to smart cities: a survey on smart city definitions. In: Alba, E., Chicano, F., Luque, G. (eds.) Smart-CT 2016. LNCS, vol. 9704, pp. 157–167. Springer, Cham (2016). https://doi.org/10.1007/978-3-319-39595-1_16
11. Haarstad, H.: Who is driving the 'smart city' agenda? Assessing smartness as a governance strategy for cities in Europe. In: Jones, A., Ström, P., Hermelin, B., Rusten, G. (eds.) Services and the Green Economy, pp. 199–218. Palgrave Macmillan UK, London (2016)
12. Monzon, A.: Smart cities concept and challenges: bases for the assessment of smart city projects. In: International Conference Smart Cities And Green ICT Systems 2015, pp. 1–11. IEEE (2015)
13. Braude-Zolotarev, M., Grebnev, G., Yermakov, R., Rubanov, G., Serbina, E.: Interoperability of information systems. Compendium INFO-FOSS. RU, Moscow, pp. 100–108 (2008)

14. Level of IT development in Russian subjects. http://minsvyaz.ru/uploaded/files/vopros-2-prezentatsiya.pdf. Accessed 21 Mar 2018
15. Disposal of Government of St. Petersburg № 21-rp, 14 April 2017. http://base.garant.ru/43424628/. Accessed 13 Mar 2018
16. Concept of Smart St. Petersburg. http://petersburgsmartcity.ru. Accessed 30 Apr 2017