

Investment potential of innovative development of "smart cities" in Russia

Natalia Buletova^{1,*}, *Mikhail Polozkov*² and *Ekaterina Stepanova*³

¹Moscow Polytechnic University, Department of Economics and Organization, Faculty of Economics and Management, 107023, Moscow, Bolshaya Semyonovskaya str., 38, Russia

²Russian Presidential Academy of National Economy and Public Administration, Department of Public Sector Economy and Finance, Faculty of State Audit, 11957, Prospect Vernadskogo, 82, Moscow, Russia

³Volgograd Institute of Management, branch of the Russian Presidential Academy of National Economy and Public Administration, Research and Organizational Department, 400066, Gagarin str. 8, Volgograd, Russia

Abstract. Russian government actively supports introduction of smart city technologies in large administrative entities in Russia. However, it is necessary to evaluate and maintain investment activity in the national market of innovative products which provides a competitive offer of such technologies to Russian and world consumers. Varying levels of regional social and economic development, different historical and cultural background of consumer behaviour affect not only the innovation in businesses and urban population in matters of purchasing and use of smart city technologies. These factors also determine attractiveness of relevant industries and start-ups, as well as sufficiency of human resources in high R&D intensive industries. The presented research outcomes reveal significant differences in innovative development level of "Smart Cities" in Russia. Russian government finances digitalization and introduction of "Smart City" technologies using public resources. It is concluded in the paper that incoherence in availability of territorial administrative resources among the constituent entities of the Russian Federation, different motivational and value orientations of Russian population and civil servants, in particular, traditional for various territories, leads to different results of the implementation and use of such innovations.

1 Introduction

One of the key features of successful implementation of investment policy, strategic planning system and management of territorial development is when investment resources are sufficient to form and develop the innovative sector of the regional economy.

The investment policy is further referred to as a set of measures attracting funding necessary to increase the GRP. The definition is applied at the federal government level,

* Corresponding author: buletovanata@gmail.com

using the executive power example of a constituent entity of the Russian Federation. Furthermore, it includes state support for investment activities with its interpretation enshrined in regional law, aimed at increasing investment activity in regions, by creating favourable conditions and protection of interests and rights of the subjects of investment activity. The vector of investment policy, its activity and attractiveness changes if we specify the sphere of attracting investment resources.

Namely, innovative applied science projects classified as “Smart City” technologies add investment appeal of the territory. The Ministerial Order No. 924 / pr of the Ministry of Construction of Russia dated December 31, 2019 "On approval of assessment methodology of progress and effectiveness of digital transformation of urban economy in the Russian Federation (IQ cities)", in clause 2.6. a “Smart City” is referred to in a very practical way as a city with population of more than 100 thousand people, functioning in accordance with the principles of the Departmental Project.

The Smart City is to conform to the three key features:

- a) The city is involved in the Departmental Project implementation;
- b) The city actively introduces initiatives of advanced digital and engineering solutions;
- c) Digitalization of urban economy is aimed at increasing efficiency of the urban management system, life quality and satisfaction level with stay in the city for current and future generations of urban residents.

In the research done by Russian and world scholars, the issue of digital technology investment attractiveness of the "Smart City" is relevant and actively discussed. For example, in articles [1], [2], [3], the authors present the results of “Smart Cities” creation in emerging economies. However, it might be interesting to compare the approaches to the topic of European and Asian countries; so in works [4] and [5], a unique experience of China is presented which takes into consideration cities creation and digitalization issues including and the public administration structure of the country. Of no less interest to the current research were the outcomes of studies by scholars from Russia and former soviet republics, including the following materials of articles [6] [7] [8] [9], including those reflecting disproportions in the level of social and economic development and investment attractiveness of Russian regions.

2 Public policy features regarding "smart" technologies development and implementation

The role of the Russian State in regulating, supporting and developing the area, and availability of the budget funding are crucial factors for investors. They determine the attractiveness level of investments in designing, development, and introduction of Smart City technologies. The adoption in 2019 of "Basic and additional requirements for Smart Cities (Smart City standard)" by the Ministry of Construction of the Russian Federation is a striking example of Smart City technologies rationing and regulation, affecting profitability of economic activity and its attractiveness for the investor. The document not systematizes the spheres of Smart City technologies and its application in urban life, but also identifies strategic directions and development measures with specific deadlines of implementation. For example, six types of activities in the area of "Smart Housing and Utilities Sector" were planned with deadline for implementation in 2024. They are aimed at saving energy resources and the introduction of modern systems of accounting, control and, in general, management of utility facilities. The authors analysed and systematized a group of risks, affecting expected economic benefits, that investors face or might face in Russia:

- the *risk of maintaining territorial inequality* in the availability of innovative smart city technologies for different age and social groups of population. This risk factor may affect

the overall attractiveness of such technologies for considerable consumers groups. If the cost marketability is insufficient and cheaper analogues produced by other countries are available, investment in such innovations will be marginal;

- the *risk of profit and planned income shortfall*, due to the negative impact of the economic crisis, international sanctions, COVID-19 pandemic on the population's ability to pay. Moreover, it comprises the situation in local labour markets, availability of the necessary components for production of innovative goods and services for the "Smart City" environment;

- the *risk of growing trend of freezing investment projects* in the field of innovative economic development project of "smart cities" outside government and national programs. The prospect generally reduces the innovation activity of all participants in the production and consumption of Smart City technologies and leads to additional losses for investors.

Using the Volgograd region as an example, we will present the financing structure of the regional project "Smart City" (in accordance with the decree of the Governor of the Volgograd region on May 20, 2019, "Digital Development Program and a Set of Measures for its Implementation"). The funding of the Project, apart from regional budget (75.8%), local budget (3.8%), extra-budgetary funds (14%), includes four more sources for "additional need" coverage (6.4%). The later may be considered both as the investment potential factor of the Project to raise funds and the one requiring additional funding from local budget. The point is that this ambiguity does not make a threat of underfunding of the Project, complicating the target indicators achievement.

2.1 Research Methods and Outcomes

Since a stable and safe investment environment of the territory's economy is of great importance for attracting investment resources, let us pay attention to the information on the IQ of "Smart Cities" in the Russian Federation. Thus, the authors apply ranking of Russian cities based on the results of assessing digital technologies introduction into the urban economy. This rating is based on the Methodology for assessing the progress and effectiveness of the digital transformation of urban economy in the Russian Federation (IQ of cities). The methodology is approved by the Order of the Ministry of Construction of the Russian Federation of December 31, 2019. No. 924 / pr.

In this study, this methodology is interesting from the point of view of determining the most complete set of Smart City technologies for efficiency assessment. According to the Expert and analytical report of the Center for Strategic Research 2018, the "Priority areas for introduction of Smart City technologies in Russian cities" included nine components: Smart Home, Smart Transport, Smart Energy, Smart City Management, Smart Education System, Smart Security System, Smart Management of Housing and Communal Services, Smart Health Care, Smart Waste Management.

However, in the "Basic and additional requirements for Smart Cities (Smart City standard)" which was approved by the Ministry of Construction of Russia on March 4, 2019, eight components have a slightly different definition: Urban Environment Innovations, City Management, Smart City Transport, Intelligent Environmental Safety Systems, Smart Housing and Communal Services Infrastructure, Communication Networks, Tourism and Services, Intelligent Public Security Systems.

Furthermore, in the Methodology for progress and effectiveness assessment of digital transformation of urban economy in the Russian Federation (IQ of cities), approved by the Order No. 924 / pr of the Ministry of Construction of the Russian Federation dated December 31, 2019, the composition of the components from the standard is taken as a basis, but it is supplemented by two more important elements:

- Intelligent Systems of Social Services;

- Economic Condition and Investment Climate.

And this is precisely what makes it possible to take into account the investment factor as an important condition for attainability of the goals set for the innovative development of Russian “Smart Cities”.

2.1.1 Main features of economic development of the Russian economy at the federal districts level

The factor of territorial inequality in availability and attractiveness of innovative Smart City technologies for business and population of certain Russian territories is also confirmed by statistical data on the main social and economic indicators of the development of Russian cities and regions. For instance, when comparing the investments volume in fixed assets and the value of GRP by federal districts, there is a noticeable advantage of the regions of the Central Federal District (CFD) in comparison with all other federal districts. It is associated with a number of social and economic factors, including a high share of the service sector, most attractive digitalization environment for modern investors, high level of qualified employment sufficiency and labour productivity and effective management system, including in the field of public and municipal administration.

Figure 1 reveals the result of comparing the contribution of each federal district to the volume of investments in fixed assets of the country (the largest contribution of 29 per cent can be attributed to the Central Federal District, the smallest one of 3 per cent belongs to the North Caucasus Federal District. If we take into account national GDP formation, the leaders with 35 per cent belongs to the Central Federal District and the lowest value of 2 per cent is attributed to the North Caucasus Federal District; the same situation is with the number of employees involved in the area. In the presented graph, the following dependencies and features of economic development are traced:

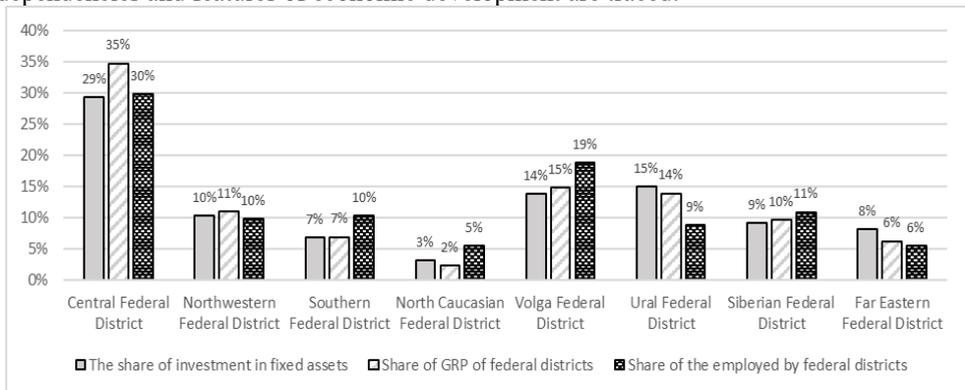


Fig. 1. Investments, GDP and Employed population Distribution of Russian federal districts as of 2019 data.

Source: Compiled by the authors on the basis of Federal State Statistics Service data.

- Russian federal districts can be divided into several types:

1) those with the highest investment attractiveness, in which investments and labor resources involved make a greater contribution to the national GDP (for instance, the Central Federal District and Northwestern Federal District) indicating a higher productivity and investment appeal;

2) Those with high efficiency of the resources used (Ural Federal District, Far East Federal District), which also possess high labor productivity and excess of the attracted investments share when compared to the GDP share;

3) Those with the least investment attractiveness and the smallest contribution to the national GDP, such federal districts represent 50 per cent of the total (Southern Federal District, Volga Federal District and Siberian Federal District) with the lowest labor productivity against the background of an excess of the share of the employed compared to that of investment and GDP.

At the same time, the outcome of comparing the contribution of federal districts to the volume of innovative goods, works, services (Fig. 2) using the example of 2019 suggests that the VFD has the highest return on investment in the economy of the regions of federal districts which indicates a high return on scientifically intensive activities in the regions. of this federal district and great potential in the development and actual trends implementation in digitalization as well as attracting new investments.

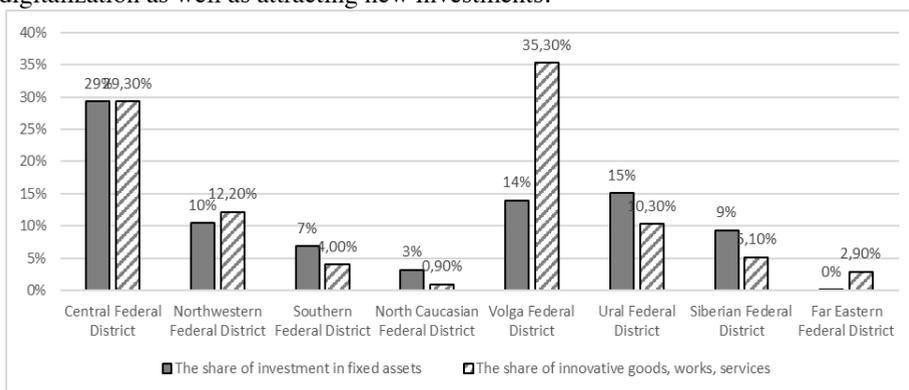


Fig. 2. Federal districts distribution by contribution to investments volume and innovative goods, works, services production in the national economy structure, 2019.

Source: Compiled by the authors on the basis of Federal State Statistics Service data.

Figure 3 presents the calculation of labor productivity outcomes by federal districts as a result of the regional GRP ratio of each district to the average annual number of employees. The highest indicator is observed in the Ural Federal District with a highly developed industrial complex, a high level of automation of economic activity.

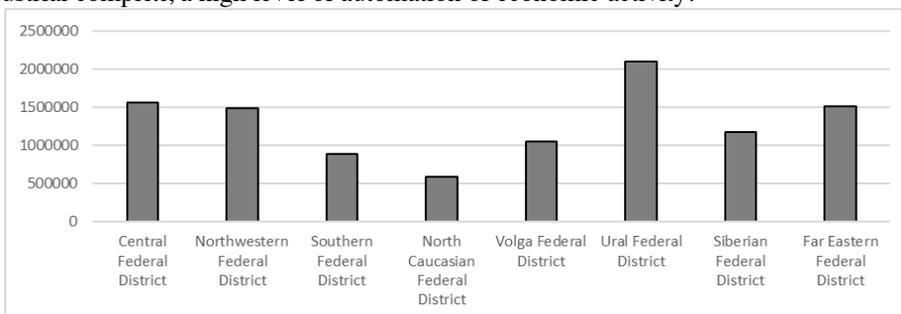


Fig. 3. Labor productivity of those employed in the regional economy of Russian federal districts according to 2019 data, thousand rubles / person.

Source: Compiled by the authors on the basis of Federal State Statistics Service data.

There is an uneven distribution of personnel between the Central Federal District and other federal districts of Russia. It is associated with, among other things, concentration of

large scientific centres in the Central Federal District, and a higher demand for R&D results among entrepreneurs.

Having calculated labour productivity based on the macroeconomic indicators of GRP and the population employed in the regional economy, the authors received confirmation of the investment attractiveness of the Ural Federal District as most industrially developed one. More than that, it was in this federal district that the highest labour productivity was revealed, which significantly differs from the Central Federal District and other territories of the country.

2.1.2 Analysis outcomes of the of "Smart Cities" role in Russian federal districts innovative development

The ABC analysis was another research method used which resulted in the following outcomes:

- 10 key Russian regions which bring 49% of investments into national economy have been identified (Fig. 4); on the one hand, these are the cities of federal significance such as Moscow and St. Petersburg with adjacent regions, as well as the largest regions in terms of mineral resources extraction as the Tyumen region and the Republic of Sakha (Yakutia), and industrial production level (Sverdlovsk region, Republic of Tatarstan);

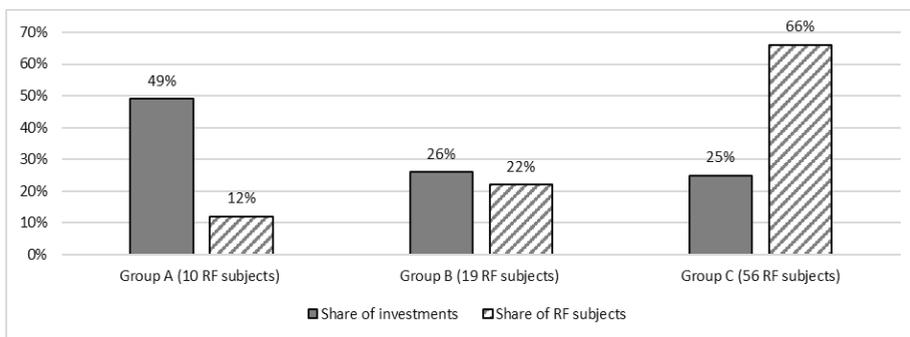


Fig. 4. ABC analysis outcomes of Russian regions by volume of capital expenditures in capital investments according to 2019 data.

Source: Compiled by the authors on the basis of Federal State Statistics Service data.

- the second group B includes 19 Russian constituent entities forming 23% of the total volume of investment resources of the country, in which the share of investments in the total volume of attracted investment resources varied within 1.0% -1.9%;
- Group C includes 56 regions, which are characterized by the minimum value of the share of investments which is less than 1% in the total volume of investments in the national economy.

The following conclusions can be drawn on the basis of the Russian constituent entities distribution into groups A, B and C in terms of the volume of innovative goods, works and services production (Fig. 5):

- 13 regions of the country provide 72% of innovative goods, works, services to the national economy, while 10 out of 15 million-plus cities, participating in the implementation of the Smart City project, about 67%, are located in these regions. Their distribution by federal districts will be as follows (Table 1);
- 8 regions provided their contribution in the amount of 12% of the total volume of innovative goods, works, services in the national economy according to 2019 data while there are only 2 million-plus cities in this group being Voronezh and Rostov-on-Don;

- the largest group C of Russian regions includes 60 constituent entities with the share of less than one per cent in innovative goods, works and services production in the total bulk and around 16 per cent total contribution into innovations; group C included 3 million-plus cities such as Volgograd, Omsk and Novosibirsk.

Thus, we have identified the leaders and outsiders in the implementation of innovative products in the field of Smart City technologies, using the example of million-plus cities, which is relevant to various investment attractiveness, R&D performance and the innovative efficiency of the economy.

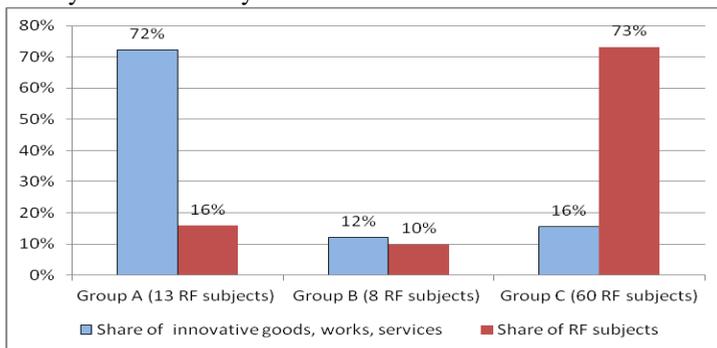


Fig. 5. ABC analysis outcomes of Russian regions by volume of distribution of innovative goods, works, and services according to 2019 data.

Source: Compiled by the authors on the basis of Federal State Statistics Service data.

Table 1. Million-plus city-participants of the "Smart City" project distribution by ABC-analysis according to the share of innovative goods, works and services criterion.

	Distribution of million-plus cities	Distribution by Federal Districtы	The share of innovative goods, works and services in the total volume produced in the Russian Federation
Group A (13 RF subjects)	10 million-plus cities (67%)	1 city of Central Federal District (Moscow) 1 city in the Northwestern Federal District (St. Petersburg) 5 cities of the Volga Federal District (Nizhny Novgorod, Kazan, Samara, Ufa, Perm) 2 cities of the Urals Federal District (Yekaterinburg, Chelyabinsk) 1 city of the Siberian Federal District (Krasnoyarsk)	72%
Group B (8 RF subjects)	2 million-plus cities (13%)	1 city of the Central Federal District (Voronezh) 1 city of the Southern Federal District (Rostov-on-Don)	12%
Group C (60 RF subjects)	3 million-plus cities (20%)	1 city of the Southern Federal District (Volgograd) 2 cities of the Siberian Federal District (Omsk, Novosibirsk)	16%

Continuation of table 1.

Total	15 million-plus cities (100%)	100%
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Source: Compiled by the authors on the basis of Federal State Statistics Service data.

Figure 6 reveals the outcome of Russian federal subjects distribution by employed individuals in the economy; it can be observed that there are 13 regions with the maximum share of the employed individuals, and the highest number of 29% of the employed involved in the economy can be attributed to 55 Russian federal subjects.

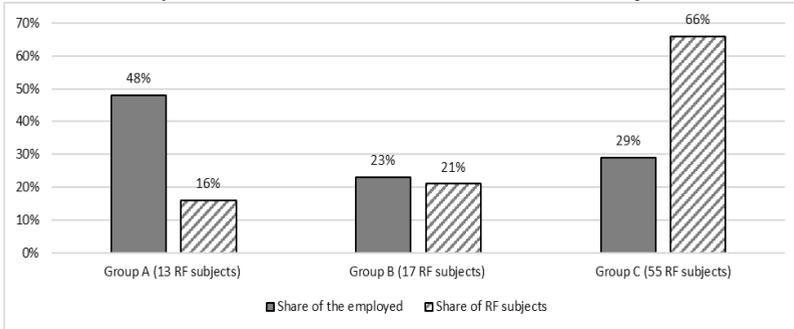


Fig. 6. ABC analysis outcomes of Russian regions by employment in the economy according to 2019 data.

Source: Compiled by the authors on the basis of Federal State Statistics Service data.

Table 2 summarizes the given characteristics of Russian federal districts and regions specifying how many of the 15 million-plus cities belong to the corresponding federal districts. It can be seen from the results obtained that for large federal districts with well-developed infrastructure, high population density, availability of automation and digital technologies, high efficiency of the innovative goods, works and services is typical. The economy of scale is also implemented in case of small federal districts, the example of the North Caucasus Federal District testifies to the weak involvement of the participant in the innovativer regional economy.

The example of the Volga Federal District, in which 5 million-plus cities are located, reveals a high positive result of 35.3% of the "Smart City" project participant in terms of its contribution in innovative goods, works and services into the economy.

The authors previously investigated the prospects for the implementation of Smart City technologies in Russia using the example of comparing the development trends of the Sharing economy and achieving the goals of sustainable development of Russian cities and regions [10], [11], the scale of activities within the Sharing economy; and the alignment of regional indicators of sustainable development with national indicators and UN goals. These studies correlate with the conclusions in the works of worlc researchers on this topic [12], [13] and [14].

The concurrent positive economic, social and environmental effects of Smart Cities technologies should promote expanding their application scope to the other Russian regions.

Table 2. Russian Federal districts distribution regarding their contribution to national economy and its innovative component.

Federal District	Indicators				
	The share of investment in fixed assets	The share of innovative goods, works, services	Share of GRP of federal districts	Share of the employed by federal districts	Labor Productivity, thousand rubles / person
Central Federal District (2 million-plus city-participants in the "Smart City" Project)	29% (max)	29,30%	35% (max)	30% (max)	1 555 778
Volga Federal District (5 million-plus city-participants in the "Smart City" Project)	14%	35,30% (max)	15%	19%	1 049 366
Ural Federal District (2 million-plus city-participants in the "Smart City" Project)	15%	10,30%	14%	9%	2 092 294 (max)
Northwestern Federal District (1 million-plus city-participant in the "Smart City" Project)	10%	12,20%	11%	10%	1 489 331
Siberian Federal District (3 million-plus city-participants in the "Smart City" Project)	9%	5,10%	10%	11%	1 177 460
Southern Federal District (2 million-plus city-participants in the "Smart City" Project)	7%	4,00%	7%	10%	889 633
Far Eastern Federal District (нет городов-миллионеров)	8%	2,90%	6%	6%	1 509 972
North Caucasian Federal District (no million-plus city-participants)	3% (min)	0,90% (min)	2% (min)	5% (min)	588 268 (min)

Source: Compiled by the authors on the basis of Federal State Statistics Service data.

The Public investment policy implemented in the region is of great importance for a potential or current investors. It is assessed from standard points of complexity, transparency, accessibility for implemented measures, and the results obtained. The reason is that even in neighbouring regions with similar climatic, social and-economic development conditions, different results of innovative and investment development have been observed. In close-by regions with noticeable differences in the structure of the economy associated, among other things, with varying qualified personnel availability for relevant industries, different innovativeness and science intensity of the industry, the differences are even more significant.

3 Discussion

The way the administrative resource of the executive power of a particular territory is applied not only forms the level of public confidence in the government. It also determines economic stability or instability in the development of a city or a region. Moreover, it makes it possible to obtain competitive advantages including from budget for resources or fail to do so. Finally, it determines quality and standard of living of population with its values and development priorities. This is the investment potential of the innovative development of modern Russian "Smart Cities". On the one hand, it strongly depend on the involvement in implementation of public programs and projects, and, on the other hand, on the available management resources, including those represented by senior officials and executive power.

In conformity with the "Main Directions of Budget, Tax and Customs Tariff Policy for 2021 and for the Planning Period of 2022 and 2023" (approved by the Ministry of Finance of Russia), the main parameters of the basic forecast of the social and-economic development of the Russian Federation include an increase in investments in fixed assets in 2021 by 3.9%, in 2022 - by 5.3% and in 2023 - by 5.1%. The reason for this is a gradual transition to an investment growth model based on increasing private sector investments.

We would like to stress that all innovative technologies of the "Smart City", being advanced demanded digital technologies supported by government policies and measures, are promising and attractive investment areas, primarily with the aim of generating long-term income.

In 2020, a federal law No. 69-FZ of April 01, 2020 "On the Protection and Encouragement of Investment in the Russian Federation" (as amended on December 30, 2020) was adopted in order to stimulate investment activity. The law legalizes and prescribes the procedure for concluding and implementing an agreement on the protection and encouragement of investment. The procedure for monitoring the stages of implementation of an investment project, in respect of which an agreement on the protection and encouragement of investment has been concluded, is also prescribed, as well as the procedure for maintaining:

- the Agreements Register;
- the Register of Public and Municipal Support Measures.

4 Conclusion

In conclusion we would like to state that Global and Russian experience of developing and implementing investment policy measures indicates an increase in the demand of economic entities for state support. It includes such relevant for the investor issue as attracted financial resources and, in turn, measures of public protection, guarantees and insurance of financial and investment risks. All these factors increase the attractiveness and profitability of such investments at the level of both national and regional economy.

Quality of life alignment among the urban and rural area residents through state support and the attractiveness of smart technologies for investors will contribute, inter alia, to a change in internal migration flows due to the equal availability of modern technologies for comfortable and safe million-plus cities functioning and of other settlements. In such cases we can talk about the possibility of:

- New jobs creation including maintenance of operation of these technologies in the field of housing and communal services, road safety, etc;
- Increase in investment potential of million-plus cities with greater efficiency of innovative goods, works and services, since it is on the example of large agglomerations that one can ensure economic and social efficiency of testing the "Smart" technologies introduction;

- Implementation of best practices in other region, territories and settlements, subject to investment activity and innovation of population and business.

References

1. N. Afzalan, T. W. Sanchez, J. Evans-Cowley, *Cities*, **67**, 21-30 (2017)
2. V. Albino, U. Berardi, R. M. Dangelico, *Journal of urban technology*, **22(1)**, 3-21 (2015)
3. M. Gascó-Hernandez, *Communications of the ACM*, **61(4)**, 50-57 (2018)
4. P. Liu, Z. Peng, *Computer*, **47(10)**, 72-81 (2014)
5. B. Qin, S. Qi, *Digital Law Journal*, **2**, 29-47 (2021)
6. G. G. Aralbaeva, U.D. Berikbolova, *International Research Journal*, **9-2**, 138-142 (2021)
7. N. A. Vukovic, V.A. Larionova, P. Morganti, *Economy of Region*, **17**, 1004-1013 (2021)
8. L. V. Zubareva, A.V. Kuramshina, *Russian Economic Bulletin*, **2**, 177-183 (2019)
9. O. I. Yakushina, *Theory and practice of social development*, **4**, 33-42 (2021)
10. N. E. Buletova, E. V. Stepanova, *Smart Innovation, Systems and Technologies*, **172**, 975-986 (2020). Access mode: doi: 10.1007/978-981-15-2244-4_93
11. N. E. Buletova, E. V. Stepanova, Y. M. M. Atwa, *International journal of ecological economics & statistics*, **41**, 14-28 (2020)
12. A. D'Auria, M. Tregua, M. Vallejo-Martos, *Sustainability*, **10(8)**, 2642 (2018)
13. J. M. Barrionuevo, P. Berrone, J. E. Ricart, *IESE Insight*, **14**, 50-57 (2012)
14. B. N. Silva, M. Khan, K. Han, *Sustainable Cities and Society*, **38**, 697-713 (2018)