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Research Article

International and Russian Experience Of Smart City Concept Implementation

Natalia Vasilievna Gorodnova, Alexey Vladimirovich Krupkin and Anastasiya Alekseevna Peshkova

Ural Federal University, Ekaterinburg, Russia

Correspondence should be addressed to: Anastasiya Alekseevna Peshkova; np91@list.ru

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Abstract

Purpose: Smart city concept implementation is one of the prioritized goals for economically developed countries. This concept is based on the use of information technology in the design and construction of infrastructure facilities. This approach leads to the development of investment and construction sphere and allows using an effective system of urban space and resource consumption management. The main purpose of this article is to systematize foreign and Russian experience in smart city concept implementation, including analyzing the current position and future prospects of the industry development. **Design/methodology/approach:** Basing on the analysis and synthesis methods, the authors considered some significant investment projects of creating "smart cities" in Singapore, China, Portugal, the United Arab Emirates and Russia; determined the social and economic effects from the projects implementation. Besides, the authors used investment modeling and SWOT analysis to access efficiency of implementation of smart technology concept elements in the everyday environment of Russia on the example of project of creating a "smart mini coffee shop/bakery". **Findings:** The research shows some large smart city projects are being realized according to international and Russian experience (e.g. the Smart Nation Singapore, the Sino-Singapore Tianjin Eco-city, the PlanIT Valley in Portugal, the Masdar City in the United Arab Emirates, the Southern Satellite City in Russia). Besides, some elements of the concept are implemented in the existing urban space. In the future, smart cities will be one of the main sources of social and the economic well-being of developed and developing countries. The smart city concept implementation depends on the amount of state support, the interest of private sector entities in project participation as well as the reduction of various risks associated with the widespread use of information technologies (cyberattacks and pollution of the information space). **Research/practical implications:** This study may be useful for scientific community members and experts of analytical centers who are professionally interested in smart city concept implementation as well as experts of big companies, small and medium businesses in the investments and construction sphere.

Keywords: digital economy, smart technologies, smart city, smart coffee shop/bakery.

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Introduction

Application of the SMART system principles offers new opportunities for urban planning. This system is applied to develop all infrastructure sectors: traffic, power industry, housing and utilities sector, communications, land improvements, safety, environment parameters monitoring, and others (Mostafavi et al., 2014). In the investments and construction sphere, the SMART system includes two main components:

- application of the SMART technology that means a modern approach to the setting of certain goals and parameters of a project. It enables summarizing all available information starting from the first stage of a project life cycle, defining acceptable work schedule, and determining the resources needed;

- implementation of the smart technologies that are the basis of building the digital economy. Today, all big companies and transnational structures actively invest in the development of those technologies. At the same time, the investments payback period in the sphere of innovations is decreasing and the process of returning invested money is getting simpler.

In some foreign countries, including those in the European Union, Gulf and Asia countries, the concept of a smart city became widely spread which includes the creation of basic and intellectual infrastructure. Implementation of this concept element starts in Russia, too. According to the latest report published by Persistence Market Research, the 622 B US dollars smart cities market is anticipated to surpass 1 T US dollars in 2019 and take a leap to 3.48 T US dollars by 2026 end. Over a 10-year assessment period 2016-2026, the market will showcase staggering growth at a CAGR of 18.8% (Persistence Market Research, 2017).

The implementation of smart technologies is an integral part of improving the comfort level and life quality of population; also, it increases the competitive ability and economic potential of cities by means of processes automation and resource saving. Each community develops its own strategy of implementing smart technologies basing on current history, cultural values and subject to local issues.

Global Experience of Smart City Concept Implementation

The British Standard Institution defines the smart city concept as “effective integration of physical, digital and human systems into in artificially created environment in order to ensure sustainable, successful and comprehensive future for citizens“ (The British Standard Institution, 2014).

Today, the concept of Smart City is successfully implemented (Soldatov, 2015) and is used by such countries as Singapore, the USA, Canada, Japan, Spain, France, Morocco, the Netherlands, Finland, China, the UAE, South Korea, and Kazakhstan.

Singapore is the leader in the sphere of building the digital economy where the innovative project involving preparation of the city to the future (“Smart Nation”) has been implemented since 2014 (Hoe, 2016). According to the recent assessments, Singapore government will give 1.68 B US dollars for the development of digital economy in the next four years. Authorities plan to spend 56.43 M US dollars on the extension of digital solutions for small and medium business.

In Singapore, more than 80% of the population (about 3.2 M humans) lives in affordable apartments and construction of such apartments is initiated by authorities of the city-state (Legislative Council Secretariat, 2013). Smart technologies are widely used in the sphere of urban planning. For example, the smart sensors project was launched in

the Yuhua quarter in 2014 where such sensors monitor electric power, water consumption and other parameters online. They enable optimizing costs on resource consumption (Teo, 2015).

Also, the smart sensors are used in Singapore traffic infrastructure, including the monitoring of public transport moving and immediate response to any problem occurred. According to authorities, at this moment, the system enables reducing average time of waiting for public transport at bus stops up to 3–5 minutes. By 2020, they plan to impose an obligation to equip private cars with special navigation systems that will facilitate the redistribution of road networks load and enable payment of parking and toll roads charge automatically.

Besides, the smart system for seniors' surveillance was launched in Singapore that involves special detectors installed on house doors that monitor movements. If the system detects irregular movement or no movement during a long period of time, relatives or medical staff will be informed of that (Teo, 2015).

In the nearest future, it is planned to create the Unified Information System in Singapore that will enable absolute monitoring of information on the city as well as living conditions of its population. It should be noted that the mentioned information will be controlled by the state that is approved by population in order to ensure efficient city management.

Basing on „smart" and „green" technologies, an experimental eco city, the Sino-Singapore Tianjin Eco City, is under construction in China that will continue during the next 10–15 years (Li et al., 2015). The project is a product of bilateral cooperation of China and Singapore; it encompasses the area over 30 square kilometers and is designed for 350,000 dwellers. Today, the core infrastructure is completed, and some dwellers have lived in the city since the beginning of 2012. As at the end of 2017, the volume of investments made by Singaporean companies in the project comprised about 231.2 M US dollars (that is about 46% of the total capital investments volume) (Global Entrepreneurship Monitor, 2016). One of the important conditions of normalizing the environmental situation in the city is prioritized use of public transport by its residents as well as the sorting of household wastes for their further recycling. Singapore government comprehensively supports this project. Thus, the Tianjin Eco-city Assistance Programme was launched in 2011 that includes subsidies granted to companies involved in construction.

In Portugal, the concept of the "city computer" is planned to be used in the course of implementing the PlanIT Valley, a unique project in the municipality of Paredes (Carvalho, Campos, 2013). The area of building includes 1,700 ha with the total investments amount of 19 B US dollars; residential buildings are designed for the maximum capacity of 225,000 humans; the city construction is to be completed by 2022 (Madakam, Ramaswamy, 2015). The project involves the developing of the modular software-platform, called Urban Operating System (UOS). This system will be able to collect data from smartphones, tablet PCs, desktop computers, laptops, and "smart houses" in order to analyze living conditions and needs of dwellers. All utility processes will be regulated using sensory devices for measuring water temperature, level of lighting, humidity, and other parameters. For example, if weather conditions deteriorate, the system will automatically increase heating temperature in houses as well as brightness of street lanterns.

Another prominent example of implementing the smart cities concept is Masdar project in Abu Dhabi, United Arab Emirates. The project is based on applying solar power and other renewable energy sources; it is designed for 50,000 dwellers, 40,000 passengers and 1,500 enterprises that primarily specialize in "clean technologies". It is planned that the financial support of city design construction

will be provided by Mubadala, an investment company from Abu Dhabi, in the amount of 22 B US dollars (Goldenberg, 2016). Construction of the city started in 2008, and its completion is expected in 2030.

At this moment, the most of the above mentioned projects are at the implementation stage. In our opinion, the given examples are related to the most significant of them and allows for the conclusion that implementation of such projects requires significant capital investments and, as a rule, their volume is achieved through the state support as well as private sector participation.

Russian Experience of Smart City Concept Implementation

The creation of necessary conditions for development of the digital economy is one of the prioritized goals of Russian state politics. It should be noted that, at the moment, there is no single definition of the term "Smart City" either abroad or in Russia. Therefore, in this study, the authors give their definition as follows: the Smart City project means a global system of city space management that is based on informational approach and innovation technologies, application of new nanotechnology-based materials, that implements principles of power saving and power efficiency and enables forming the environment and infrastructure that are comfortable for residents, increasing efficiency of the city functioning in general, significantly improving environmental situation, increasing efficiency of public and private transport, forecasting and minimizing unfavorable consequences of risk events, and significantly saving resources that will increase investment attractiveness and competitive ability of the city.

In Russia, the concept of the Smart City was implemented, first of all, in such projects as Greenfield (Republic of Tatarstan: Innopolis, SmartCityKazan — construction of a new district in Kazan), Skolkovo project (Moscow Region), a new city of Ust-Luga (Leningrad Region), Olympic items clusters (Sochi, Krasnodar Krai), a residential neighborhood of Smart City (Ulyanovsk), that became a basis for making efficient managerial decisions on creating comfortable environment for residents of large Russian cities.

Certain goals, trends and measures in this sphere are fixed in many strategic documents, including the Strategies of the Information Community Development in the Russian Federation for 2017–2030, the Concept of Long-term Social and Economic Development of the Russian Federation for the Period Until 2020, the Strategy of Scientific and Technological Development of the Russian Federation, the Strategy of the Information Technologies Sector Development in the Russian Federation for 2014–2020 and for the Future Period Until 2025, the Programme of the Russian Federation Digital Economy, etc.

In the mentioned documents, formation of smart cities is stated as a prioritized trend among other promising trends of Russian economy development. In order to implement this trend, the Russian Federation Ministry of Communications and Mass Media as well as representatives of a number of Russian state corporations and universities signed the memorandum on establishment of the National Consortium of Digital Technologies Development and Implementation in the Sphere of City Management in October 2017. The Consortium activities will be focused on the development of 50 large Russian cities in the interests of about 50 M dwellers. It is planned that the core emphasis will be made on the creation of digital platforms for managing smart cities, delivery of projects on implementation of unmanned transport, and projects in the sphere of improving transparency and efficiency of housing and utilities sector, creation of favorable environment to develop hi-tech companies.

At this moment, big urban planning projects based on the smart city concept are

implemented in a number of Russian regions. In particular construction of Ilyinskoe-Usovo neighborhood unit is launched near Moscow where the intellectual system of city lighting control and climate monitoring will be created; also, the first in the country telpher railway with traffic capacity for 10,000 humans per hour will be built (each kilometer costs 12-15 M rubles and expected payback period for investments is 3-5 years). Also, the smart house concept will be implemented that involves lighting, heating, climate, and electric appliances control. Having interviewed potential clients, the project developer found that the respondents expressed the strongest interest for available Wi-Fi networks, services with data on parameters of climate, air, local retail businesses load, outdoor surveillance cameras video, parking lots, and a child's location (Content Review, 2016).

In the Leningrad Region, there is the project on construction of Yuzhny, a satellite city of Saint Petersburg, at the financial planning stage; its total investments volume amounts to 176 B rubles, project delivery time comprises 19 years, and the building area is of 2,012 ha (START Development, 2016). There will be 4.3 M square meters of housing constructed in the city territory; also, intellectual systems of road networks and passenger transport control will be created, power efficient city lighting will be implemented, smart meter readings will be installed, etc. SmartCityKazan, a similar innovative project of constructing a new district of Kazan, is at the implementation stage now.

In Novosibirsk, it is planned to create the intellectual transport system aimed at efficient control of traffic streams, including increase in traffic capacity of road network due to optimization of color light signaling control algorithms, notification of road users of current road and traffic situation and options to optimize their route, notification of dwellers of available parking lots, etc. Besides, in order to ensure security of underground infrastructural systems, 3D geo system is launched in Novosibirsk that will determine the location of utility systems by means of placing a smartphone with a relevant app installed against a certain piece of land.

Also, it is planned to implement smart technologies in the sphere of designing industrial and commercial construction projects using the Building Information Model system that enables making the 3D imaging of any elements and systems of a building as well as collecting and processing any data on it: sketches, engineering calculations, materials used, etc. The Russian Federation Ministry of Construction, Housing and Utilities started to implement these technologies in 2015. It is expected that BIM technologies application will reduce costs of project construction in average by 30%. In many countries, application of such information models is mandatory. For example, they have been used in Great Britain since 2015 to design projects constructed at the state expense.

Significant achievements are made in the sphere of digital production arrangement, including that resulted from the implementation of up-to-date integrated information systems and advance technologies, digital factories. Due to the implementation of smart technologies, companies succeed in ensuring economic efficiency growth, reduced period of creation and launch of production of new products, and optimizing business processes.

Prospects of Smart Technologies Development in Russia: Smart Coffee Shop/Bakery Construction

In Russia, smart technologies are mostly used in the implementation of innovative projects by large integrated structures that are partially owned by the state. These technologies are applied in the sphere of industrial products manufacturing organization, residential buildings design, power supply, color signaling control, street lighting, and heating supply. We believe that

in the mid-term perspective these technologies will have more extensive application in small and medium business activities. The sphere of smart coffee shops/bakeries may become one of the development trends for such business. Therefore, the authors of this article developed an innovative project of creating a smart coffee shop/bakery that bakes eco bakery products. According to the project, over the long term, establishment of a chain of such coffee shops/bakeries across the country is planned. Short-term goals of the project include gaining stable position in the market of coffee shops/bakeries in Ekaterinburg and development of this service.

Bakery Products Market

Presently, Russia shows the growing consumers 'interest for bakeries' products because bakery products represent traditional national food included in the daily menu of most people living in the country. According to the Federal State Statistics Service of Russia (http://www.gks.ru/), average bread consumption volume in our country at this moment comprises 136.9 gram in relation to population per day that in average comprises about 50 kg a year per each person living in Russia (http://www.gks.ru/).

Historically, the market of bread, bakery and confectionary products is one of the biggest markets of Ekaterinburg food industry. In 2017, the population is 1,455,904. Available market capacity is about 70,990,348 kg per year. Presently, Ekaterinburg baking industry produces about 600 types of various bakery products. Among the main trends of bakery production in Ekaterinburg, the following may be mentioned:

- consumption share of socially significant bread is about 50%;
- the market mainly develops due to non-conventional product varieties. It is forecast that within the next five years so called traditional bread varieties will remain in the lower price segment while there will be growth in the premium segment representing bread of special recipe as well as bread made of natural ingredients only;
- producers searching for new assortment lines;
- tendency to increasing production profitability due to small piece products;
- growth of consuming products of new types;
- active building the culture of consumption of freshly-baked smart bread;
- growth of bread volume purchased by households.

Sharp increase in the number of coffee shops/bakeries in Ekaterinburg is observed after overcoming the economic instability in the whole country in 2009. Also, it should be noted that the share of coffee shops/bakeries in the market in the total volume of bakery products sales is not large because bread production is initiated by big bakeries as well as bakeries owned by big retail chains. It is notable that establishment of smart coffee shops/bakeries producing eco bakery products, where visitors may peacefully have a rest of city rush and stresses, is a free sector.

Consumers' Choices

The main criterion of a consumer in choosing a bakery product is its freshness. The second significant position is taken by taste, look of the product, and its price. Therefore, a smart coffee shop/bakery can be a real competitor because products are baked of freshly made dough with ingredients that are fresh and good for health.

Strengths and Weaknesses of a Business. Opportunities and Threats in the External Environment

Table 1 represents SWOT analysis matrix.

Table 1: SWOT analysis matrices

Strengths of a business	**Opportunities in the external environment**
1. High quality of eco bakery products made at automated lines under supervision of qualified personnel using eco recipes that are kept in secret. 2. Freshness of eco products. 3. Producing eco bakery of natural ingredients only without any additives that are bad to health. 4. Wide range of products offered. 5. Prompt response to any change in consumers' choices by means of an automatic analysis of the Internet search requests statistics, internal database including data on purchases, and feedback from clients received via electronic means of communication. 6. Opportunity to prepare individual orders received through a mobile app. 7. Up-to-date eco design with decoration and furniture made of natural materials (bamboo, wood, linen, hopsacking, stone, natural texture imitation, cork, living green plants, stabilized moss, and coarse pebbles) as well as unique content of the interior, including built-in lighting, small decoration items (wicker baskets, wooden shelve stands), and other details. 8. Work shops.	1. Growth of consumer demand due to brand recognition. 2. Winning regular clients by holding various PR campaigns, presentations, tasting sessions, as well as due to attractive qualities of eco products. 3. Reduction of working capital costs due to import substitution. 4. Creation of strong and stable supplies system. 6. Useful experience of running a business. 7. Production expansion, range diversification.
Weaknesses of a business	**Threats of external environment to a business**
1. Brand unfamiliarity, weak market coverage. 2. Lack of regular clients due to short history in the market. 3. Products prices are comparable with competitors' prices though they must be lower. 4. Lack of stable working capital supplies. 5. Lack of experience in running business by an owner of a coffee shop/bakery.	1. Increased competition between existing players in the market or the coming of new competitors. 2. Extension of substitute goods offered at low prices. 3. High growth rate of prices for ingredients and electric power. 4. Lack of qualified personnel in the market. 5. Decrease in the culture of consuming freshly baked bread.

Investment Plan

From the point of view of the highest efficiency for the smart coffee shop/bakery design, we chose a business legal structure of a business without incorporation (sole trader). There is no license required. Total number of personnel includes 7 employees.

At the initial stage of a coffee shop/bakery operation, the clients are offered for choosing 34 types of eco bakery products as well as workshops services. All bakery products

belong to the middle price segment. The required amount of capital investments in operation of a mini coffee shop/bakery and its maintenance during the first 3 months is indicated in table 2. The working capital includes raw materials costs, costs of other disposables, and lease.

Table 2: Capital investments required to open a coffee shop/bakery

No.	Capital investments allocation	Amount (RUB)	Amount (US dollars)
1	Registration of a business	800	14
2	Procurement of authorizations and approvals	2 400	41
3	Purchase and installation of capital equipment	554 362	9 502
4	Other costs on purchasing capital equipment	39 984	685
5	Costs on interior decoration	21 798	374
7	Working capital, disposable materials purchase (for 3 months)	855 509	14 664
	Total:	1 474 852	25 280

It is suggested that a simplified taxation system (STS) will be applied at 15% imposed on a positive balance of income and expense. If STS is applied, sole traders are exempted from VAT and personal income tax as well as personal property tax in relation to the property used in operation.

The planned sales volume in 3.5 years of a business operation will be 90% of the maximum possible revenue at the given scale of a smart coffee shop/bakery.

Determination of a payback period is made graphically; the graph of the project financial profile is presented in fig. 1.

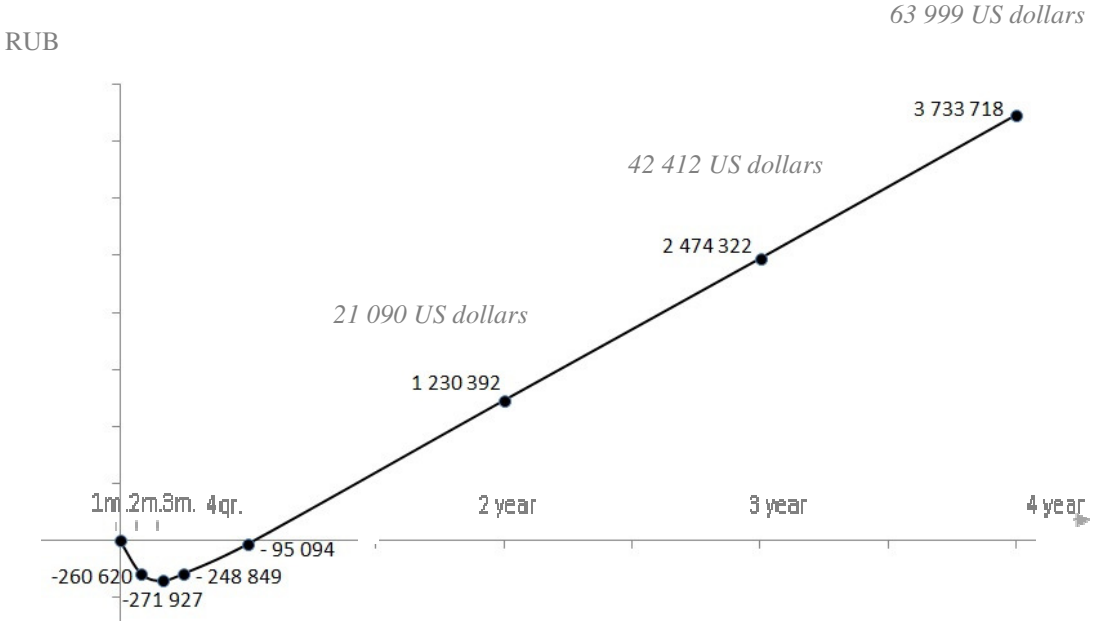

Fig. 1: Project financial profile

Basing on the graph presented, we can see that the payback period of the project is less than the investments lifetime.

In order to assess efficiency of the project, the summary table of integrating efficiency indicators is prepared (table 3).

Table 3: Summary table of integrating efficiency indicators

Indicator	**Value**	**Attractiveness of an indicator to an investor**
Investments lifetime	3.5 years	Acceptable
Net discounted income	3 733 718 rubles (63 999 US dollars)	+
Investments payback period	6 months	+
Profitability index	3.53	+
Discount rate	20.25%	Acceptable
Internal rate of return	46%	+

Conclusion: all integrating indicators of the project satisfy with criteria-based value that allows us to conclude that the business project developed is economically feasible.

Conclusion

one of the global trends in the modern world is building the digital economy. According to the Boston Consulting Group, a share of the digital economy in GDP comprises 5.5% in developed countries and 4.9% in developing countries at the end of 2016. According to the results of research held by the Russian Association for Electronic Communications, in Russia, this indicator comprises 2.8% of GDP at the end of 2017 that demonstrates small growth to compare with the similar period of 2015 (2.3%).

Building the digital economy is based on the implementation of smart technologies that open a variety of opportunities to develop the investments and construction sphere, including that by means of creating smart cities that, in future, will be one of the sources of growing social and economic welfare. A mandatory condition of development of this industry is the implementation of a broad range of measures that will allow overcoming various risks related to the wide expansion of information technologies, including cyber attacks, information pollution, and unemployment growth in conventional economy industries. Speaking of such measures, specific attention should be paid to increase in digital literacy of population and development of careful attitude to personal data.

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