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Tools of quality economics: sustainable development of a 'smart city' under conditions of digital transformation of the economy

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Abstract. The article covers the issues of ensuring sustainable city development based on the achievements of digitalization. Attention is also paid to the use of quality economy tools in managing 'smart' cities under conditions of the digital transformation of the national economy. The current state of 'smart' cities and the main factors contributing to their sustainable development, including the digitalization requirements is analyzed. Based on the analysis of statistical material, the main prospects to form the 'smart city' concept, the possibility to assess such parameters as 'life quality', 'comfort', 'rational organization', 'opportunities', 'sustainable development', 'city environment accessibility', 'use of communication technologies'. The role of tools for quality economics is revealed in ensuring the big city life under conditions of digital economy. The concept of 'life quality' is considered, which currently is becoming one of the fundamental vectors of the human civilization development, a criterion that is increasingly used to compare countries and territories. Special attention is paid to such tools and methods of quality economics as standardization, metrology and quality management. It is proposed to consider these tools as a mechanism for solving the most important problems in the national economy development under conditions of digital transformation.

1. Introduction

A characteristic feature of modern human civilization is the rapid growth of the urban population. This is an objective and unavoidable process associated with the ever-increasing share of industry in the global economy, where an ever-greater part of economic activity is concentrated.

Today, more than half of the world population lives in cities, and according to the UN forecasts, this figure will reach 60% by 2030. In addition to a total number of citizens, a number of big cities is increasing. If in 1950 there were only two such cities in the world — Tokyo and New York, then in 2014 there were already 28 cities, and their number will reach 41 by 2030 [1, 2].

The city as a place of residence provides a person (in general) with more comfortable conditions than rural areas. The city dweller has more opportunities for job search, improved access to education, medicine, and social services. However, the increase in a number of cities brings a lot of problems.



The environmental impact increases (increase in landfills, air pollution). Road congestion has become common occurrence in big cities, housing and utility payments are increasing. In addition, the information technologies development leads to an increase in social instability, popular movements are arranged through the World Wide Web. The result of all this is the instability of urban development.

Therefore, it is no coincidence that today in the world there is an increasing interest in the concept of a 'smart city', the implementation of which will help to overcome the problems facing cities currently.

Experts point out that the 'smart city' feature is the rational organization and use of resources. Due to this, for example, cities will be out of road congestions, citizens will pay less for housing and utilities services (HUS) and urban nature will be less affected.

2. Theory or experimental methods

It should be noted that the concept of the 'smart city' grew out of the concept of 'smart community', formulated in 1993 in the famous Silicon Valley of the United States of America. This community meant any goal-oriented cooperation between the business and residents to improve living and working conditions using available information technologies [3–5]. The current understanding of the 'smart city' does not focus on technologies. According to the modern interpretation, the 'smart city' is a place where conditions are created for the development of human capital. Numerous researchers write about this, presenting integrated concepts for creating the 'smart city' [6], assessing the 'smart cities' development strategies based on the analysis of such criteria as the 'smart city index' [7], other parameters such as the city model in motion, conceptual framework, definitions and indicators [8].

It can be said that a degree of city or territory development is determined by human capabilities. From this point of view, today 240 cities in Europe can be called 'smart' to one degree or another. According to the consulting company McKinsey, there will be about 600 'smart' cities in the world by 2020. In another five years, these cities will generate almost two-thirds of world GDP [9].

Moscow, Sochi, Copenhagen, Singapore, Stockholm, and Zurich are among the 'smart' cities. As an example of the 'smart city', we should mention the eco-city Tianjin — the joint project of China and Singapore designed to live up to 350 thousand people. To construct the city, a heavily polluted area without access to fresh water was specially selected. Many of the most modern technologies have been implemented in the city. Alternative energy supply, circulating water supply (almost like at space stations), seawater desalination, waste recycling, transport network creation without participation of motorized transport, video surveillance systems, air quality control and much more. Now more than 70 thousand people live in the city (it is calculated for a population of up to 350 thousand), 4500 companies with a total authorized capital of 200 billion yuan (a little more than \$30 billion) are registered. The project is planned to be fully completed by 2020 [10, 11].

Another example of such a city is Masdar settlement under construction within the UAE. According to plans, about 100 thousand people should live in Masdara by 2020. The city will become fully autonomous. It will be powered from renewable sources; unmanned electric cars will run its streets. Citizens will work mainly in the field of IT technologies and at waste treatment facilities [12].

Saint Petersburg can also be included in a number of 'smart cities' by rights. The 'Smart City Saint Petersburg' project is designed for three years and involves the introduction of a unified system of strategic and operational control of various spheres of life using the most modern information technologies until 2020, as well as the further development of the practice of the public government. The primary objective is to improve the city citizens' life quality and ensure the sustainable development of the economy. The widespread use of advanced information and communication technologies is also intended to provide intensive and high-quality interaction of citizens, business representatives and government authorities [9]. Many separate elements of the 'Smart City' system in Saint Petersburg have already been implemented or are being implemented now. For example, the implementation of a system for monitoring the street cleaners work across the Petrogradsky city district has increased the cleaning efficiency by more than 30% [9].

Special vehicle priority travel system is being introduced based on the achievements of digital technologies. According to calculations, by means of traffic lights operation optimization, it is possible to reduce a buses traffic time on some routes down to 15%. And this will reduce a number of buses without prejudice to passengers that, naturally, will lead to a decrease in a volume of exhaust gases and fuel consumption. The system was tested during the 2018 World Cup. Thanks to it, or rather the ‘green corridor’ being created, the shuttle can move along Moskovsky Prospect without stopping with minimum impact on the rest of the transport: the traffic light delay for traffic flows crossing the intersection will be only a few seconds.

Thus, the basis for sustainable development of the ‘smart city’ is information. The second required condition is the high control quality. Specialists working in city and municipal authorities must select and develop the most effective innovative solutions that provide the maximum effect for urban environment modernization and allow optimizing the use of urban resources. Such a specialist should, regardless of his/her field of work, be able to use modern information and communication technologies. In addition, he/she should be able to analyze and summarize information from various sources to create and update databases, be able to provide the necessary data [13–15].

3. Results section

The application of the quality economics elements will facilitate the observance of these conditions.

As is known, the quality economics is composed of three parts. With respect to the ‘smart’ city development, this means the following.

The standardization determines the possibility of normalization and evaluation of sustainable development indicators, as well as management methods. In other words, it facilitates the creation of a single information space.

The metrology provides uniform measurement methods, therefore, it facilitates obtaining accurate, objective and timely information, on the basis of which management decisions will be made.

The way with which these decisions will be made is under the responsibility of quality management. It offers a systematic approach to management, which allows choosing the most effective innovative solutions (Figure 1).

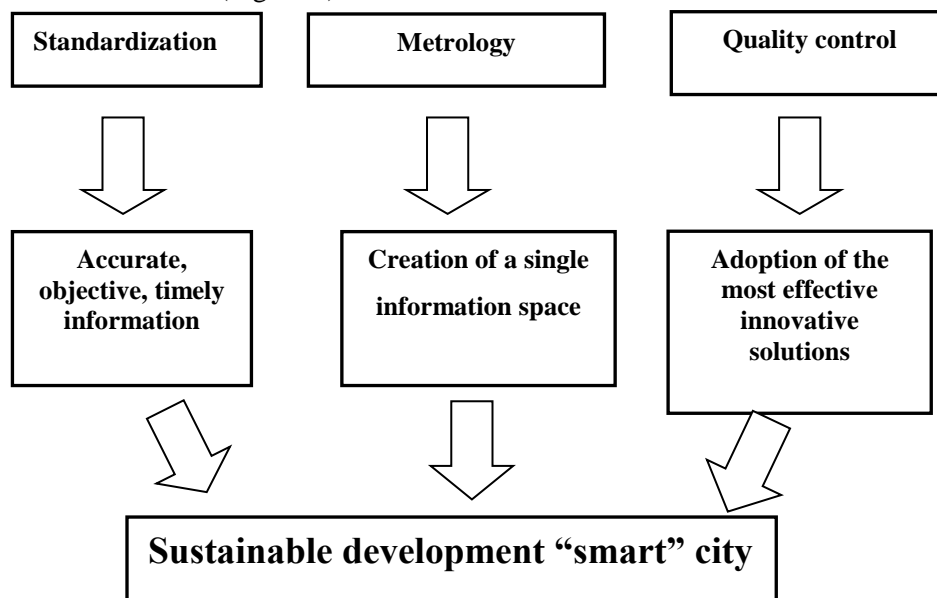


Figure 1. The influence of quality economics elements on the sustainable development of the ‘smart’ city under conditions of digitalization.

Based on the previously performed both domestic research, and foreign, it can be said that the use of quality economics tools in managing the smart city development facilitates more complete and

adequate definition of its development objectives, since the quality factor is taken into account. In addition, their use is possible in identifying possible development problems. They can also be used to universalize and standardize indicators of the 'smart' city development and when developing uniform methods that allow comparing different 'smart' cities among themselves.

Among the quality economics tools, the standardization should be highlighted. The reasons for this are clear. In fact, to achieve the specified objectives, it is necessary that all interested parties uniformly understand the development meaning and objectives. This can not be achieved without standardization development.

In addition, currently, the 'smart' cities development faces serious problems that cannot be solved with no application and development of appropriate standards. The first of them is related to the absence of unified data collection and analysis system. This leads to the fact that the information is delivered from many different sources and has many formats, which significantly complicates its analysis. Moreover, information exchange between various city services is also difficult today. The experts note that uniform standards are extremely necessary. It is not a mere coincidence that the concept of 'smart' Saint Petersburg proposes the introduction of uniform standards for collecting and transmitting information, and, consequently, the creation of a single information space [10].

And the second problem is the information security. Threats in virtual or cyberspace are growing extremely fast. Having hacked networks, cyber-terrorists can disrupt the operation of heating, water supply, lighting systems, and financial settlements. According to experts, today about 15% of all investments in IT technologies are works in the field of information security. Therefore, the standards development in this direction is justified and in demand.

Currently, the International Technical Committee (TC) — ISO/TC 268 'Sustainable Cities and Communities' engages in standards development in the field of sustainable development.

The main task of the TC is to develop the requirements, structures, guidelines and supporting methods and tools related to the achievement of sustainable development, taking into account intelligence and adaptability. These documents facilitate the development and implementation of integral and integrated approaches to sustainable development and sustainability. Currently, 29 countries are a number of permanent members of the committee and 23 countries and organizations are members of the committee as observers.

The technical regulation is a regulatory legal act that will regulate safety issues at any stage of a product's life cycle. One of the types of security established by law is to ensure the uniformity of measurements, since one of the goals of metrology is to protect society from unreliable measurement results. Technical regulations will establish methods for testing, measuring, evaluating the conformity of products with the formed parameters or standardized requirements. These measurement methods will be directly provided in technical regulations, or technical regulations will be accompanied by a set of standards containing these methods as an evidence base.

But the presence of the base itself is not yet sufficient; you must have the technical means to ensure this evidence. Herewith, it shall be measuring instruments and methods that have passed the relevant recognition (legalization) procedures.

Another important principle of technical regulation is the unity of 'rules and methods of research (tests) and measurements during performance of procedures for mandatory conformity assessment'. The basis for obtaining objective results of research and tests are reliable measurement results. The legislation stipulates that all technical regulations must establish the minimum necessary requirements to ensure the uniformity of measurements, taking into account a level of risk of harm.

The most general requirements are associated with the mandatory use of the International System (SI) units, the mandatory 'reference' of measurement results to the relevant state standards and establishment of confidence intervals, within which the true values of the measured values are presented. The quantities themselves that should be measured are derived from the requirements ensuring mechanical, electrical, nuclear and radiation, chemical, thermal, industrial, fire and biological safety, as well as explosion safety, electromagnetic compatibility of devices and equipment, and

radiation safety, which is important to develop digital measurements and ensure the quality of population life.

4. Discussion section

In Russia, for these purposes, a national TC 115 has been created, which is ‘mirror-like’ in relation to TC ISO 268, thus, its tasks are similar. In addition, in 2016, the international TC 546 ‘Sustainable development of administrative and territorial entities’ was created, the members of which are the Russian Federation, Belarus, Kazakhstan, and the observers are Moldova, Kyrgyzstan, Azerbaijan.

The purpose of the TC 115 activity is to create an expert platform, which allows to unite efforts to improve the work in the field of standardization for sustainable scientific-technological and socio — economic development

TC 115 includes two subcommittees: Subcommittee 1 ‘Development of methodology for system-based approach to quality management in administrative and territorial entities’ and Subcommittee 2 ‘Performance indicators and methods of assessment evaluation’, as well as a special working group ‘Intellectual (smart) technologies’.

The TCs perform works to assess metrics for smart community infrastructure. In particular, in such areas as the principles and requirements for metrics, general framework for the development and management of infrastructure, maturity model for assessment and improvement, opportunities and problems of interaction, a guide to best practices in the field of transport, information within communities, smart transport for compact cities.

Among the developed standards, it is necessary to note the following standard ISO 37120:2014 ‘Sustainable development and adaptability of communities. Indicators of urban services and quality of life’ [16]. The standard establishes the methods for applying a set of indicators to manage and measure the effectiveness of urban services and quality of life.

The standard applies to any city, municipal district or local government that undertakes to measure its effectiveness in a comparable and controllable way, regardless of size or location.

The standard establishes the methods for applying a set of indicators (100 indicators distributed into 17 groups) to manage and measure the effectiveness of urban services and quality of life. Further standard development will include the addition of indicator groups reflecting the assessment for such groups as biodiversity, risk management, planting, disaster prevention and readiness in emergency situations.

Figuratively speaking, the standard contributes to the creation of a city digital model, as it creates a city image through the indicator values.

Peculiar development of this standard was standard ISOTR 37121:2017 ‘Sustainable development of communities. The list of current guidelines and principles for sustainable cities development and their resistance to negative external influences’ [17]. Currently, it contains compilation of 105 indicator systems for monitoring (self-assessment) of cities used throughout the world.

5. Conclusions

Thus, considering the peculiarities of applying the tools of quality economics, namely standardization, metrology and quality management to provide for sustainable cities development, it should be noted that under conditions of the digital economy and growth of globalization and digitalization processes, certain efforts of the global community in this activity frameworks should be noted [15, 16].

This allows uniting countries for joint organization of work in the field of standardization and quality management in ensuring sustainable development of territories and cities. Despite the fact that there are the certain developed mechanisms, the work is still in progress and requires the constant attention and participation of all countries of the world community.

Finally, it is worth noting that, according to experts, urbanization in the world, taking into account digitalization processes, will only increase.

Therefore, a number of cities and their sizes will increase. Along with a certain comfort, urban life creates new problems for people and humanity as a whole, affecting issues of life activity, employment, and choice of profession [18].

Now it is necessary to develop ways to overcome them, eliminating all the bottlenecks in advance. This will help to minimize the risks and hazards that may arise in the very near future in case of digitalization processes increasing.

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