

Prospects for the development and use of innovative technologies in the housing and communal services sector

Alina Korovkina^{1,*}, Alexander Kolosov¹, Inna Pereslavl'tseva¹, and Kirill Sklyarov¹

¹Voronezh State Technical University, 394006, 84, 20-letiya Oktyabrya st., Voronezh, Russia

Abstract. In the modern world, the process of innovative transformation of the housing and communal services (HCS) sector is taking place with active steps. The latest technical developments are used to improve the quality of life of the population, which are aimed at a comprehensive modernization of the entire structure of HCS and reducing the wear of systems. One of the most important stages is the introduction of innovative technologies through the use of the Internet of Things, big data processing. The objects of innovative development are smart platforms, the Internet of Things, artificial intelligence, and a quantum computer. Investors can help these innovations. Therefore, the importance of the issue of integrating modern technological innovations has great prospects for the maintenance and development of housing and communal services. The paper studies the current perspective of using the latest developments in the field of HCS, mainly aimed at improving the quality of life of the country's population. The possibility of attracting investors as the main assistants for the successful implementation of innovative projects was also considered. The sphere of HCS is a promising platform for creating profitability of innovative projects, achieving an improvement in the quality of life of the population. It is of high importance for many sectors of the economy of the Russian Federation.

1 Introduction

Housing and communal services (HCS) includes a set of industries, which, in turn, are aimed at improving the quality of life of consumers, necessary for the comfortable implementation of important needs. In addition, the HCS sector acts not only as a platform for providing a range of services that contribute to improving the quality of living, but also as an assistant in maintaining the lifestyle of the population, having a significant impact on the growth of the socio-economic potential of all regions of Russia, their investment attractiveness. It also creates favorable conditions for introduction of innovations [1] and the development of private entrepreneurship.

The housing infrastructure is large-scale not only on the territory of the Russian Federation, but all over the world. The total length of the external and underground water

* Corresponding author: alinko199@mail.ru

supply pipelines reaches 800 thousand kilometers, heat supply networks - 172 thousand kilometers.

To date, the HCS sector is undergoing a significant number of changes, the result of which is an improvement in the quality of life of citizens, especially relevant during a pandemic. Noting the insufficient level of living of residents, attention is focused on the following indicators: work on preparing for the replacement or repair of engineering systems should be carried out annually, while in large cities, about 50% of heating networks require replacement, the share of repaired ones is about 5%; repair of water supply networks carried out within 2%, but about 40% of networks require replacement. As a result, the level of accidents on the routes increases and, consequently, economic costs increase. Equipment with metering devices in apartment buildings also remains at low rates: 10% with heat supply meters, 5% with water supply meters, which shows a low level of resource conservation. In the entire HCS sector, attention is focused on a high number of unprofitable organizations: it reaches 55% in the utilities structure, and in the housing structure - 52%. It is obvious that a high percentage of network wear and untimely elimination of the problem of improving them is reflected in a significant number of accidents at network sections. Replacing unusable networks and technical equipment can achieve lower production costs, generating significant savings in financial resources. At the same time, the view is focused on the main complex problems: the low level of attracted private investors, the slow modernization of technological objects of HCS. To solve them and reform the sector, the promising introduction of new technologies, attracting investors, joining the efforts of HCS entities, homeowners, state and regional management structures are required. At the same time, an important factor in reforming the HCS sector today is the creation of conditions for attracting private business and the formation of the institution of effective homeowners. Nowadays, in the Russian economy, the HCS sector is one of the leading industries in which demand is stable and high. Based on the foregoing, we can say that the potential interest of private investors in the HCS sector is progressively increasing, since it is a lucrative market with great potential for additional profit on investment.

In the multitasking environment that developed during the coronavirus pandemic, housing and communal services include a set of industries. There are important problems in the HCS sector. When the timing of the negative impact of the sanctions and restrictions remains undetermined, and our country cannot lift them on its own, an important impetus for the growth of the Russian economy can be provided by the provision of advanced development of industries that have sufficient potential to become drivers of sustainable growth of the domestic economy. Do not forget that the country has long entered the era of introducing new innovations in various fields, as well as their modernization and reform. For the subjects of the housing and communal sector, innovative development will be combined into a single sequence, which is aimed at ensuring high-quality comprehensive services to consumers [2]. The sphere of HCS predetermines the profitability of innovative projects and high importance for many sectors of the economy of the Russian Federation.

2 Materials and Methods

The analysis of the implementation of innovative platforms, which allows improving the functioning of the HCS sector, carried out by the researchers, notes the expediency of investor support, as well as rapid implementation, which would subsequently guarantee an improvement in the quality of life of consumers.

The main approach to solving the problem in the field of wear of HCS systems, improving the quality of services, innovative development is a comprehensive modernization of the sphere, the introduction of new innovative projects, as well as increasing energy efficiency (Fig. 1).

Drawing attention to the experience of foreign countries, such as Germany, there is a visible positive diametrical opposite, since such difficulties have been overcome thanks to a timely and competent approach to the management system, which includes: improving technologies and bringing them to an advanced level, eliminating losses, reducing costs, attracting and support of investors at the stage of implementation and development. In the United States, Boston, Seattle and other cities, 311 applications have been developed for non-profit organizations, such as reporting accidents, potholes, etc. [5].

The sphere of innovative activity is key in the economy of our country. Nowadays, technologies are being introduced directly into people's lives [4], and the mechanism of their work is designed on the development of market processes. Innovation in its understanding implies the introduction of the latest products in the technological field, and is also a set of measures simultaneously aiming at bringing improved innovations and new industrial processes to the market.

The main criteria for innovation include: scientific novelty, use in practice, ability to meet market demand. Based on the foregoing, innovation is an object of intellectual property, which is the end result of scientific and technical human activity generated for use in the service sector by the consumer.

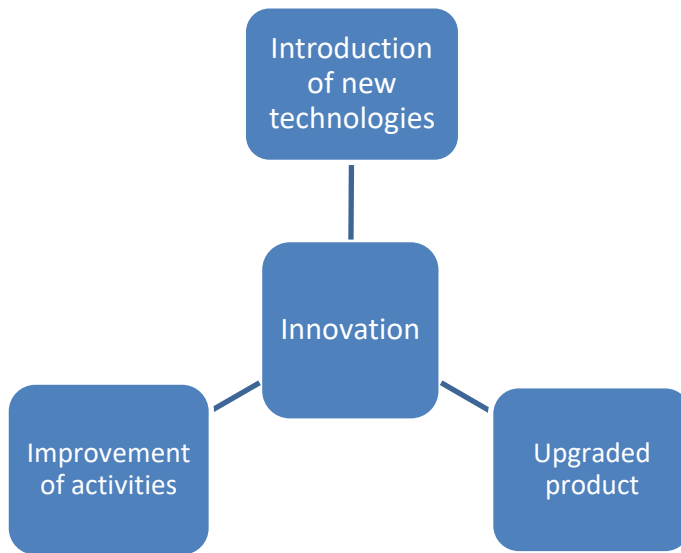


Fig. 1. Components of innovation

Nowadays, almost 90% of information is created through the Internet of Things (IoT), where the concept of transmission is based on interaction with each other or the external environment. The widespread use of the Internet of Things is actively used in the spheres of healthcare, logistics, heat and power engineering, etc. The HCS sphere is no exception (Fig. 2) The advantage of using the Internet of Things is: economic increase in electricity, an increase in the level of comfort of life, an increase in the level of consumer safety.

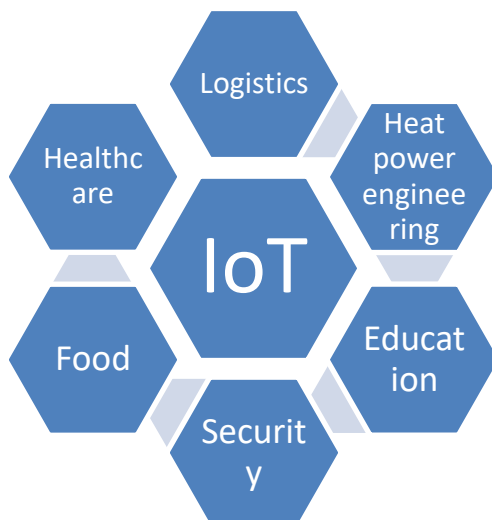


Fig. 2. Structure of The Internet of Things

The HCS industry is exactly the sphere of the Russian economy that needs digitalization and cannot develop without its implementation. [3]. For example, the creation of “smart” control platforms that generate the importance of accidents at any site would eliminate direct financial losses and timely elimination of deviations in the technical condition of the equipment, thereby extending its life cycle, as well as minimizing rapid wear. Comprehensive modernization of the HCS sector with the subsequent introduction of innovative technologies will be a support for reducing the risks of a complete shutdown of production, as well as eliminating the cancellation of the supply of all types of energy to consumers (Fig. 3). In the future, the use of such platforms will allow increasing the service life of the uninterrupted functioning of engineering systems, and also significantly reducing the economic consumption of energy resources. This experience is applicable in Europe and the United States, allowing active development in this area and achievement of new innovative solutions.

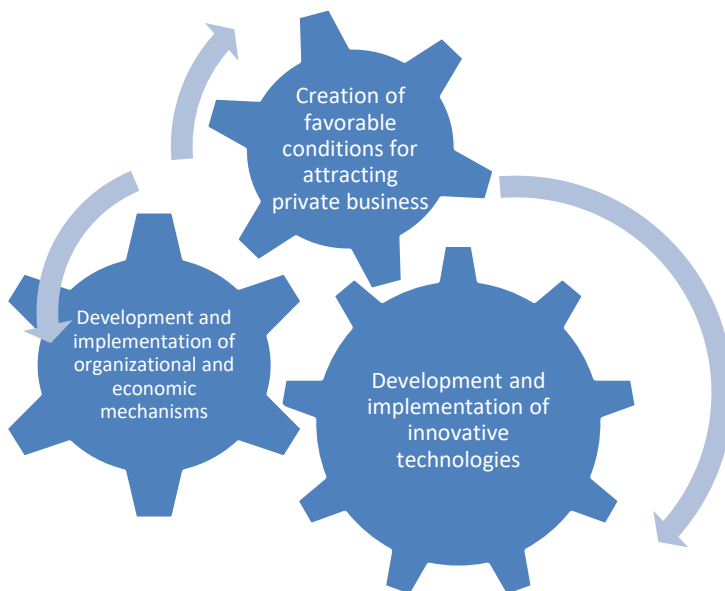


Fig. 3. Activities for a comprehensive modernization of the sphere

In the modern world, housing and communal services cannot do without the use of artificial intelligence. In his article “Can a machine think?”, Alan Turing, an English mathematician, the “father of computer science” and one of the inventors who played a major role in the development of artificial intelligence, started a discussion about artificial intelligence, which is still conducted in our country and has a wide range of development prospects in the future of innovation.

The term “artificial intelligence” appeared in 1956, but its immense popularity was reached in the last decades. Artificial intelligence (AI) refers to the development of new computer algorithms used to create intelligent machines and mechanisms. The goal of AI is to reliably and continuously perform large-scale computing tasks. The use of AI allows the HCS sector to achieve unprecedented levels of precision in solving problems related to the operation and maintenance of facilities, and also to get the most out of data.

3 Results

The first step towards solving the problem, and, therefore, modernizing our homes and cities into “smart” ones will be a high-quality data collection. This data will allow preventing or solving the problem at the initial stage of its occurrence, significantly reducing the time for finding, analyzing and eliminating the problem. The task is not easy, since the accurate collection of information is a capacious process and does not always imply the correctness of the output data. An assistant in the work will be one of the areas of artificial intelligence, which is aimed at helping to calculate accurate information through the collection of photo and video images. In the future, the use of AI will be used to timely monitor the accident rate of areas, which, in turn, will reduce the time spent by emergency services personnel by 30%, while reducing the time for analyzing the problem. The most important aspect of the work of AI in the field of housing and communal services is a fast, harmonious and transparent process of operation of all systems, which allows us to count on a comfortable level of living.

The main tasks of AI in the field of housing and communal services include:

- forecast of the technical condition of the house (condition of the foundation, floors, roof, elevator, basement);
- forecast of consumption of consumed resources (water, gas, electricity, heat energy);
- recognition of the meter interface.

The introduction of quantum computers can help for the rapid qualitative collection of information at technical objects (Fig. 4). A quantum computer is a device designed for fast processing and transmission of information. The device stores and processes data using qubits (quantum bits). Compared to the most powerful classical computers used in science and technology, a quantum computer, when properly organized, allows for high-speed programming of the computational process, which, in turn, significantly speeds up data acquisition or problem solving. It is assumed that in the future, a perfect quantum computer will be able to solve problems for hundreds and thousands of points in a short period of time, while an ordinary computer or platform requires a long process. Reasonable processing time - from a few seconds to several hours. At the same time, traditional computational methods will remain relevant for ordinary computers. Quantum computers will expand the possibilities for modeling and control of many tasks related to the HCS sector and its development in the field of economics, the solution of which can be accelerated using the special capabilities of qubits. Thus, there will be an active increase in planning, structuring and management of business, various scientific developments, and a number of technical systems. Nowadays, there are about a dozen different models of such computers in the world. All experimental setups are in the finalization mode and require a lot of money. There is a huge future behind such technologies. Developed giant countries, such as China, Japan, the USA, and Germany, are actively attracting partners to participate in their investment. Russia, on the other hand, is at an early stage of development, and the level of investment is significantly low.



Fig. 4. Quantum computer model

Nowadays, innovative technologies and technical solutions are being developed in Russia that allow accumulating and structuring energy costs, as well as increasing the efficiency of using fuel and energy resources. Based on the results of the developments at the pilot facilities, a number of measures have been developed and implemented that provide significant control over the efficient operation of the HCS industry. In general, state support in the form of financing innovative projects in the HCS sector through such development institutions as Technopark Skolkovo, OJSC Rusnano, State Corporation “Rosatom”, etc. is a promising and relevant aid for the development of an innovative future.

The second step towards solving the problem of modernizing the HCS industry is attracting investors. It was noted that the issue of their participation in supporting the development of housing and communal services in Russia is at an acute level. The country is

actively implementing a set of developed measures to attract private investors. At present, this is very important, since the main investor in this industry is the state, which is the main source of financing. Housing and utilities enterprises in economically developed countries are profitable, while in Russia most of them suffer losses. The situation is a closed chain, where investors do not invest in unprofitable industries, and the industry, accordingly, will not become productive unless capital is invested in it.

Since the beginning of economic reforms, HCS sphere was the sector of the economy where state and municipal property prevailed. The management of such property was transferred to state and municipal enterprises. The number of investors in the total volume of production and sale of housing and communal services was insignificant.

However, at the current stage of reforming HCS, it is worth noting the positive dynamics in the transition from municipal to private ownership. The participation of private business in the modernization and support of the HCS sector of the economy is a point of growth in the level of development of the country and the entire economy as a whole.

Support in investment in HCS is an important task for local governments, which is based on the development of a set of measures to create a favorable environment for the implementation of successful work.

It is worth considering that assets with stable content and low impact of various market factors are attractive to investors. The flows of monthly payments from consumers for using public services have this characteristic.

The problem of the lack of an approach to the innovative development of the industry also does not have the ability to attract a sufficient number of investors. Due to the lack of a general picture of long-term development plans, investors cannot build sound financial and economic models and, accordingly, receive planned financing from banks. Therefore, at this stage, a partial financial limitation of the number of projects is possible. Once this problem is resolved, the HCS industry will no doubt become attractive and productive.

4 Discussions

Investor support at the stage of creating innovative technologies is the beginning of positive dynamics for the prospective implementation and introduction of investments not only in the HCS sector, but also in other related sectors of the economy, which contributes to strengthening not only the Russian economy market, but also the world one. The HCS system is a single environment where it is important to take into account the comfortable life support of the population of each constituent entity of the Russian Federation. Therefore, the creation of such conditions for investment can become an engine in the development of the industry.

Thus, it was noted that the HCS sector is an attractive assistant for business due to the stability of consumption of socially significant volumes, as well as vital services, the value of which is determined either by the standards approved by regional authorities, or by real volumes that are read from consumer metering devices.

It should be noted that the paper provides a brief description of a number of proposals for the creation and implementation of digital platforms, the timely implementation of which, with the support of investors, will increase the economic efficiency of comprehensive modernization, as well as the innovative development of the HCS sector. It is worth emphasizing that the authorities should ensure the flow of a favorable environment for HCS investments, while developing competition in the market. An important factor will be the experience of foreign states, which will lead to positive results in the creation of a civilized and actively developing society in the state, characterized by a high standard of living. The tasks set are quite solvable, but they require the creation of a favorable investment climate in Russia at the level of state and municipal support.

5 Conclusion

The transition to a new innovative way of development of the HCS sector, including the introduction of “smart” platforms, has a positive perspective dynamics of economic, technological and technical growth of the country's regions, which is in a critical state and requires innovative improvement.

Innovations are a source for the development of economic sectors and for raising their level among countries in a competitive market.

As a result of transformations and the introduction of innovations in the organizational structure of the HCS sector, there will be an efficient management of the operation of apartment buildings, engineering networks and a number of other complexes. Attracting investors will shorten the path to solving the main problems associated with improving the quality of services provided to consumers. The introduction of innovative platforms guarantees the country's entry into a new breakthrough level of economic development.

References

1. A. A. Natarov, A. A. Chernykh, A. I. Kazartseva, The innovative potential of the Voronezh region. Problems of modern economic, legal and natural sciences in Russia-synthesis of sciences in the competitive economy, 263-265 (2019)
2. O. K. Meshcheryakova, V. Ya. Mishchenko, M. A. Meshcheryakova, *Improvement of housing and communal sphere due to digitalization pf power supply services*. News St. Petersburg state economic university, **2(116)**, 97-101 (2019)
3. I. S. Savvina, S. S. Uvarova, *Impact of digitalization on the formation of receipts for housing and communal services*. Digital and industry economy, 102-108 (2015)
4. D. Proskurin, Yu. Vorobeva, O. Kalinina, *Digitalization of energy facility management processes in the Voronezh region*, E3S Web of Conferences, 02123 (2019)
5. M. Barrett et al., *Service innovation in the digital age: key contributions and future directions* MIS quarterly, **39(1)**, 135-154 (2015)
6. F. Aggogeri, A. Avanzini, A. Borboni, S. Pandini, *International Journal of Automation Technology*, **11(2)**, 311-321 (2017) DOI: 10.20965/ijat.2017.p0311
7. F. Aggogeri, A. Borboni, A. Merlo, N. Pellegrini, R. Ricatto, *Materials*, **10(3)**, 297 (2017) DOI: 10.3390/ma10030297
8. A. Borboni, M. Mor, R. Faglia, *Journal of Dynamic Systems, Measurement and Control, Transactions of the ASME*, **138(11)**, 111003 (2016) DOI: 10.1115/1.4033831
9. M. Shamtsyan, et al. E3S Web of Conferences, **215**, 01002 (2020) doi:10.1051/e3sconf/202021501002