

Approaches to the Formation of a Mechanism for Sustainable Development in the Innovative Ecosystem of Housing and Communal Services in the East Kazakhstan Region

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Abstract: This paper highlights a sustainability and self-organization perspective of the innovation ecosystems in housing and communal services. The theoretical basis of the research are the concepts of sustainable development, open innovation, circular economy, and the theory of complex systems sustainability. The article formulates the basic principles of innovative technologies implementation in the water supply sector of housing and communal services. A conceptual model of the organizational and economic mechanism for managing the development of an innovative ecosystem in the water supply sector in the East Kazakhstan region has been developed. Theoretical and methodological provisions, conclusions, applied recommendations can be used in the process of diagnostics and monitoring of innovative development of water supply systems on the regions level, in the development of national strategies for economic and innovative policy of the Republic of Kazakhstan. The propositions arising from this analysis provide information to help academics, policymakers, government, and individual enterprises with a more adequate understanding of the practical mechanisms and tools that help trigger self-organization and sustainable development of the innovation ecosystems.

1 INTRODUCTION


Globalization has led to an increase in competition on international markets. Technological, digital, and political trends have rapidly engulfed all institutional and economic processes. Breakthrough innovation and cross-industry impact have become the norm in many processes.


At the same time, integration, in which different systems interact with each other and create value from data streams, forming an innovation space is crucial. The unsolved problem of post-Soviet states economies is the search for specific drivers that ensure innovative sustainable development, which creates favourable conditions (organizational and economic mechanisms, scientific and technical base,


motivational and stimulating mechanisms) for the generation and implementation of innovative activities, the introduction of scientific and technological developments in production, and the promotion of products to the market.

The Sustainable Development Goals (SDGs) aim to promote sustainable economic growth through higher levels of productivity and implementation of technological innovations. As stated in Goal 9, there is a request to build “sustainable infrastructure, promoting sustainable industrialization and innovation” (Report of the WCED, 2019). There is a need for an integrated multi-stakeholder approach to progress across the multiple SDGs set in the 2030 Agenda for Sustainable Development.

Innovative technologies in the field of housing and communal services as the leading direction of

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socio-economic development of the state, have an impact on the quality of life of a person and society. The implementation of innovation development policy is mainly due to the internal innovation potential and effective management influence. The study of the innovative development theories has increased the attention to innovations in the field of water supply.

The lack of quality drinking water is an important factor in the health of the population. Back in the 19th century, Louis Pasteur said: "People drink 90% of their diseases." (Garrone, 2017).

In Kazakhstan, every year there are up to 1,000 new cases of diseases per 100 thousand people due to the poor quality of drinking water. Water is an exhaustible resource, so more and more countries around the world are recognizing the need to increase innovation capacity in the water sector.

The water supply sector is a socially significant area, the infrastructure and condition of which are of strategic importance for the national security and economy of each state. The importance of strengthening the innovative sector of modern water supply systems is largely due to the course of modernization of socio-economic policy and sustainable development.

The paper is organized as follows. First, a theoretical overview of the innovation and sustainable development concepts, related schools are provided. Section 3 introduces the factors influencing the development of innovative processes, followed by Section 4, which presents research methodology. Section 5 presents an innovative organizational model of housing and communal services (HCS) reform. In Section 6, the authors make some concluding remarks and discuss prospective models for creating an innovation ecosystem in HCS. The key findings of the study, theoretical contribution and practical significance of the study are highlighted.

2 LITERATURE REVIEW

The theoretical basis of the research are the concepts of sustainable development, open innovation, circular economy, and the theory of the stability of complex systems. The most acknowledged definition of "sustainable development" is that proposed by the United Nations World Commission on Environment and Development (UNWCED): "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs". This means that the strategy of each market participant focused on

long-term development should ensure a balanced triad of economic, social, and environmental components. There are different approaches to the concept of sustainable enterprise development (Adams, 2016; Hope, 2009; Zu, 2013; Tolstykh, 2020a; Wirtenberg, 2008). Sustainable enterprises consider both the economic and social aspirations of people related to the enterprise and the impact on the natural environment (Shmeleva, 2018).

Summarizing the positions of researchers, the authors understand the sustainable development of an individual industrial enterprise as the long-term balanced development of a company, the targets of which are accumulated and harmonized according to the principle of triad: technological, social, and environmental areas. In the digital age, a large role is given to innovativeness in the triad of sustainable development.

Innovative sustainable development is a development that creates favourable conditions (organizational and economic mechanisms, scientific and technical base, motivational and stimulating mechanisms) for the generation and implementation of innovative activities, the introduction of scientific and technological developments in production, and the promotion of high-tech products to the market.

The concept of open innovation was first formulated by Chesbrough H. (Chesbrough, 2006). This concept allows us to overcome geographical, institutional, and disciplinary barriers due to the openness of R & D, the diffusion of technologies, the exchange of knowledge between universities, scientific laboratories, engineering centers, suppliers, consumers, government. Open innovations (Yun, 2019; Carayannis, 2016) are based on the following principles:

- transition from the use of exclusively internal closed developments to the use of external knowledge.
- there are many ideas on the market that can make a profit for the company.
- creating a sustainable business model of the organization is a priority compared to market leadership.

An innovation ecosystem can be defined as an open and self-developing system of network equality of economic actors, self-organizing based on a special environment formed because of the exchange (overflow) between the actors of innovative energy, namely, new knowledge, technology, information, or unique resources (Tolstykh and Shmeleva, 2020b).

Over the last decade, the discourse on enhancing the sustainability of industrial development has focused on the circular economy model, and the idea

to reshape the industrial systems following the objective of a more balanced interplay of environmental and economic systems has gained increased attention worldwide. Circular economy is widely considered as a strategy to reconcile industrial systems with the natural environment through the careful design of new products and implementing the "closed-loop system" processes (Fischer, 2017). Implementing the circular economy (CE) concept encourages environmental protection and social prosperity (Sverko,2020), eliminate the environmental problems faced by society, while enabling value-added growth of industries in line with country's sustainable development. Originally, CE aims to increase the efficiency of resource use, with a special focus on urban and industrial waste, to achieve a better balance and harmony between economy, environment, and society (Ghisellini, 2016). The understanding of circular economy is ambiguous among researchers today. Many studies argue the CE implications in managerial terms for business efficiency (Bocken,2016). Meanwhile, "there is no single group with the undisputed authority to define what circular economy means exactly" (Lewandowski,2016). Many studies show that the CE model traces different methodological approaches and that its origins seem to be mainly rooted in different fields. The principles of CE are mainly gathered from other schools of thought, including industrial ecology, ecological economics, performance economy, natural capitalism, product-service systems, blue economy (Pauli, 2010), etc. A deeper analysis of the approaches proposed by these schools of thought is presented in (Borrello,2020) In addition, it is crucial to identify how CE and the concept of sustainability relate. As noted in (Tolstykh and Shmeleva, 2020b), CE can contribute to the United Nations Sustainable Development Goals, including environmental, economic, and partly social dimensions of sustainability.

Several approaches are used to define the stability of the socio-economic system as a complex concept (Gershanok, 2006; Blaug, 1973). The first approach, the stability of the socio-economic system is related to the security, stability, reliability, integrity. It should be noted that the stability of the national economy is determined based on the criteria of its security, stability, ability to be updated and constantly improved. The stability of a country as a single system means the strength and reliability of its elements, economic and organizational ties between them, and the ability to withstand internal and external loads. In contrast, safety, reliability, and resistance are considered as conditions and attributes

of the stability of a socio-economic system, while reliability and resistance are mainly inherent in technical systems.

The second approach is based on the understanding of the stability of the socio-economic system as the stability of parameters over a certain period. Stability is "a necessary condition under which the system must return to a state of equilibrium after any small jolt." The stability of a system is characterized by its ability to remain relatively unchanged, despite internal and external disturbances. As a counterargument, the opponents of this approach put forward the property of self-organization of the socio-economic system. It has a built-in mechanism for transforming the system and performing its functions, ensuring the survival and stability of the system and its approach to the goal. This does not exclude the occurrence of contradictions in the system itself since its parameters are constantly changing during development and operation.

The third approach, stability is "the ability to maintain a dynamic balance". From this point of view, the economic stability of the regional economic system is considered as an integral property of the system to maintain dynamic equilibrium when changing the parameters of the external and internal environment within acceptable limits. Considering the approaches exposed, we must emphasize that there is a lack of organizational and managerial models that ensure sustainable development.

3 CONCEPTUAL FRAMEWORK

The search for organizational and managerial models that ensure innovative sustainable development has been conducted for more than a decade. However, common approaches to determining the effectiveness of the activities carried out in the innovation sphere have not yet been fully developed. The study of the factors influencing the development of innovative processes in water supply systems and the conditions for the development of socio-economic systems from the perspective of an innovative approach allows to solve the following priority tasks:

- precise definition of the institutional conditions for innovative development of a particular region.
- search for the most significant and effective factors for the effective functioning of state and regional systems.
- determination of the optimal criteria for the ratio of the scientific result and the invested funds.

- identification of relationships between different sectors of the economy that also affect innovative development.
- assessment of the current state of innovative development of the water supply system in the region.

Ignoring the priority of solving the set tasks raises several objective and subjective obstacles to the effective development of both the state as a whole and its individual regions.

Noting the high potential of regional and urban mechanisms of socio-economic policy that can influence innovative management. The level of innovation in the country's region is formed from the general interaction of many factors. All factors influencing the formation of the innovation environment can be divided to four groups: socio-economic conditions of the region's development; human capital; innovative potential and management capacity.

Ensuring the sustainable development of the economy, the formation of the economic security of the country or region assumes a state of the economy in which the level of social, political, defense existence and innovative development is consistently maintained.

The ability to self-develop and progress means the ability to independently create a favourable investment and innovation climate, develop innovative and intellectual potential.

Developing countries depend on innovation, as new digital technologies and innovative solutions create opportunities to fight disease, poverty, and hunger in the world's poorest regions.

As a result of the survey of residents of the East Kazakhstan region, the key factors hindering the development of innovative activities were identified (Fig. 1)

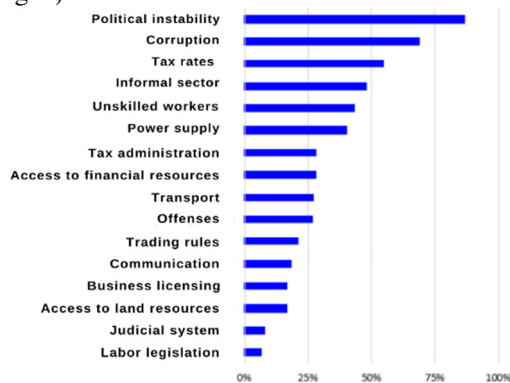


Figure 1: The main barriers to the development of innovation activities.

These are, first, political instability, corruption and high taxes, and a shortage of qualified workers. To consider, the interests and identify consumers of housing and communal services, their classification is proposed:

1. Focus on satisfying the customer's details.

- direct services that meet the immediate needs of customers (payment, commercial, investment services).

- indirect or related services that make it more convenient to provide direct services without the client receiving additional utility (clearing services, consulting services, etc.).

- services that bring additional utility to the functioning of housing and communal services or reduce housing and communal services costs.

2. Segmentation by customer groups. According to the complexity of the organization, there are several options for services provided by housing and communal services enterprises:

- services that are in the greatest demand from residents (services for overseeing the provision of water resources).

- services that require a special level of organization of housing and communal services and training (asset management of housing and communal services, investment services).

- services that require professional knowledge in the use of services.

- services that require special knowledge and skills in the field of institutional planning of housing and communal services, investment engineering.

In addition, the innovation management principles in the housing and utilities system are determined, based on the quality management system and innovation management. The system model that provides the implementation of the principles of innovation management in housing and communal services is shown in Figure 2.

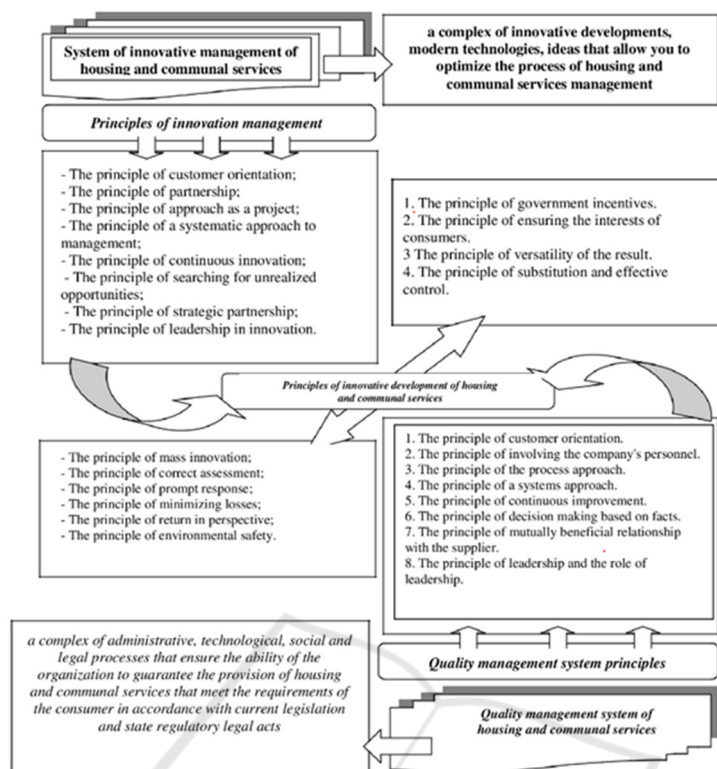


Figure 2: Principles of innovation management in housing and communal services.

Source: compiled by the authors

The fundamental principles of the innovative technologies in the water supply sector of housing and communal services, which allow to ensure proper quality by meeting a certain set of established requirements.

The first group of requirements, utilities based on the introduction of innovations must strictly meet the system of quality standards, standards, technical and sanitary requirements, the terms of the concluded contract, ISO criteria.

The second group of requirements, a utility service based on the introduction of innovations, must meet the needs and expectations of the consumer, the requirements dictated by the company's charter, rules, norms for the protection of the environment, and the welfare of the housing stock. Moreover, it is the consumer (the homeowner or the initiative group) who should evaluate the impact of innovations on the quality of the service provider's work. To implement a full-fledged comprehensive assessment, it is necessary to develop a methodological approach and a system of indicators for assessing the impact of innovation results on the quality of services in the housing and utilities system.

This system should be based on the following groups of indicators: organizational and economic; technical and operational indicators; indicators of resource conservation; environmental efficiency.

The third group of requirements, the utility service must be built based on an economically reasonable tariff that can satisfy all sides of the utility relations and be profitable for them.

The process of implementing the principles of innovation management in the housing and utilities system is based on the development and description of certain rules and algorithms for the work of the management company and accountable persons in the context of innovation implementation. This process assumes that the operations performed in the provision of services based on the introduction of innovations should be put under the control of responsible persons, and that orders, decisions and orders will be communicated to a specific performer and executed at the required level. The presented principles and factors of innovative development should be considered when forming the mechanism of sustainable development of housing and communal services.

4 RESEARCH METHODOLOGY

The study of innovation ecosystems is based on the methodology of complex systems and networks. In accordance with the theory of complex systems, ecosystems belong to the class of nonlinear systems. The innovative organizational model as an ecosystem of integrating knowledge obeys a systematic and self-organization law. The law of self-organization works when the sum of the potentials of the system significantly exceeds the total effects of the micro- and macro environment. The basis for implementing preventive measures for the ecosystem is the constant work to increase the amount of knowledge accumulated by complex systems, the constant processing and transformation of information and creative ideas into knowledge and new technologies. From our point of view ecosystem is not only the ability to respond and reflect technological and digital challenges, but also create intelligent technical environment that are minimize negative consequences and create optimal conditions for the implementation of projects at any level.

Another approach to the study of ecosystems is represented by the entropy theory by I. Prigogine (Prigogine, 1991). The ecosystem is a dissipative system, as the dissipation function (entropy production within the ecosystem per unit time in a unit volume) is different from zero. Dissipativity is a loss of energy. One of the main properties of complex self-organizing systems is the accelerated production of entropy, that is, when a new ordered structure arises, the rate of knowledge entropy production increases. Entropy is a quantitative measure of disorder in a system. The greater the entropy of the ecosystem state, the more ways it can be implemented between actors, the less ordered it is, and the more self-organized the actors of this ecosystem are. In other words, an increase in entropy means an increase in the degree of freedom of the actors from external control, and, consequently, an increase in its self-organization and, as a result, responsibility for its own sustainable development.

The assessment of knowledge production in the system or intellectualization should reflect the economic return on investment in the development of technologies, human resources and increase the level of intellectual potential. The effect of system intellectualization occurs when technologies stimulate the transfer of knowledge, business innovations, and lead to increased productivity within the company.

And finally, speaking of innovation ecosystems as cooperation of actors it is necessary to study the processes of networkization in terms of the theory of

scale-free networks. B. Barzel and A.-L. Barabási [2013] suggested that networks form a kind of framework for the corresponding complex systems and proved that scale-free networks are very resistant to accidental damage, or external accidental influences. However, deliberate damage to one or more nodes with many connections (degree centrality) leads to the disintegration of the network. The authors propose using this approach to model water system in East Kazakhstan region.

5 RESULTS

The East Kazakhstan region belongs to the most affluent and rich in water resources region of the of Kazakhstan, which is determined by its natural and climatic conditions. The water fund of the region includes rivers, lakes, swamps, ponds and reservoirs, underground waters, and glaciers. The total freshwater resources per inhabitant of the region are about 50 thousand cubic meters per year.

However, the East Kazakhstan region is a major industrial centre of the Republic of Kazakhstan. There are more than a thousand medium and large industrial enterprises operating in the region. In this regard, the water fund of the region has a "moderate and high level of pollution" in terms of chemical indicators: the maximum permissible concentration of sulphates, nitrites, ammonium, and some heavy metals of copper, zinc, and magnesium. The main factors of technogenic influence are the discharge of untreated industrial, agricultural, and domestic wastewater into filter reservoirs, the loss of polluted water from utilities, emissions of gaseous substances into the atmosphere, and the increase in the groundwater level in residential areas and irrigation massifs. Water is defined as a "critical resource", and growing problems with water supply and wastewater treatment are turning the water agenda into an area of increased attention from large corporations and the state.

To ensure the sustainable development of the economy of the East Kazakhstan region, it is proposed to develop and implement a promising innovative model for managing the development of the water supply system.

As the analysis showed, in the water supply sector of housing and communal services of the East Kazakhstan region, there are no uniform norms and rules of activity, as well as mechanisms for their interaction with state authorities. As a mechanism for improving the water supply system in the territory of the East Kazakhstan region, a model of an innovative ecosystem is proposed, the main actors of which are

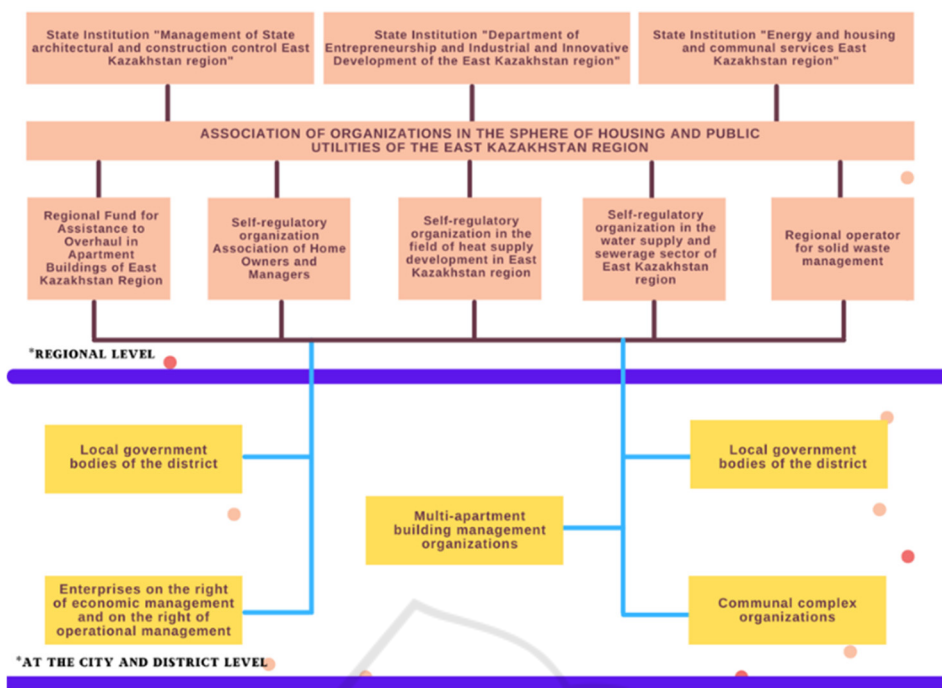


Figure 3: Innovative organizational model of housing and utilities sector reform in East Kazakhstan region.

regional operators in the housing and utilities sector. The proposed model is shown in Figure 3.

In accordance with the presented model, a non-profit association of organizations in the housing and utilities sector of the East Kazakhstan region appears on the territory of the subject, which is an open platform where housing and utilities professionals and regulatory authorities have the opportunity to meet and discuss important topics, highlight current problems and try to find ways to solve them together.

"The process of governance is gradually becoming not one-sided, but a bilateral and even multilateral process." This leads to the transformation of the borders between the state and society, as well as changes in the format of their interaction. This cooperation is necessary to find the most effective tools for the development and strengthening of the housing and utilities sector. To solve the problems, it is necessary to regulate the issues of protection and rational use of water resources at the legislative level, more strictly, as well as to accelerate the processes of innovation in water supply systems as early as possible.

6 DISCUSSION AND CONCLUSIONS

As a result of the study, it was found that water system in the East Kazakhstan region has not yet reached the necessary level of development. One of the priority tasks is to create an effective innovative model based on the ecosystem and circularity principles, considering the concept of open innovation.

Further steps for the implementation of the innovative model should be the formation of self-regulatory organizations of the East Kazakhstan region in the field of water supply and sanitation. To do this, it is necessary, first, to increase the scientific potential of the region through the implementation of large innovative projects in the field of water supply, financing of R&D by the state on a grant basis. Secondly, by improving the tax system, developing cluster strategies aimed at commercializing innovative projects, accelerate the development of innovative entrepreneurship. Third, by reducing bureaucratic processes in making investment project decisions, increasing the number of grants, creating business incubators, and increasing the level of development of multi-level innovation infrastructure. Fourth, by simplifying the conditions for attracting investors and financial institutions, by promoting the

development of a network of individual investors, to develop the financial infrastructure of the region.

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