# The National Model of the Smart Economy for Achieving the Goals of Innovative Development

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**Abstract:** The primary direction of economic development in modern conditions is the transition to the digital economy, which is caused by changes in the forms and methods of providing various high-tech consumer services. Digitalization is becoming the main tool for developing the world economy, and its role is significantly increasing. The competitiveness of each country depends on the degree of implementing innovative banking technologies as tools for creating digital financial ecosystems. It should be noted that the scientific community does not have a clear definition of the term "digital economy" yet. The transition from Industry 4.0 to Industry 5.0 has set new challenges for the national economy regarding the need to bring the mechanisms of operation and development to innovative standards. In practice, the evaluation of the economic results of implementing digital business technologies is practiced to finance the future development of the digital transformation of the business into an intelligent economy using the net present value method. It calculates income from investment projects in the digital economic system and allows cost reduction to their current value. The main reason for the difficulty of carrying out smart economy innovations and digital transformation of the national economy based on the elements of Industry 4.0 and Industry 5.0 concepts is the use of high discount rates. This approach to financing the digital transformation of business, focusing on the smart economy, does not allow for solving many economic problems, in particular, growing income inequality, and the state of the environment. The issue of investigations and empirical measurements of the smart economy and the digital transformation of the economy, as well as the prospects for the formation of a national model of the smart economy, are the objects of the present research. The academic paper proposes a scheme for responding to changes in the external environment and directions for adaptation to changes, based on the analysis of the prerequisites for forming the digital economy and creating a national model of the smart economy. Prospects for further scientific studies may include an investigation of the national economy's sectorial structure, an assessment of its effectiveness to improve the national smart economy model, as well as the development of cloud computing, the implementation of the latest bioengineering research, and blockchain development.

**Keywords:** Modeling, development, innovation, digitalization, competitiveness.

## INTRODUCTION

World trends determine the direction of developing the digital economy. An analysis of the Internet audience for the years 2012-2021 shows that the number of people using the Internet increased from 2,18 billion at the beginning of 2012 to 4,95 billion at the beginning of 2022. In 2021, the number of Internet users increased by 192 million, and the annual growth was 4% (Santos A. R. P., Prasetyo Y. T., Persada S. F., & Nadlifatin R., 2022, Sangmeister H., Villhauer B., 2022). At the same time, the global market of Internet tech-

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nologies is also growing. Government and business expenditures on information technology, the rapid growth of stakeholders in the information market, and the gradual increase in government spending on the smart economy drive this growth. The authors (Hradecky D., Kennell J., Cai W., Davidson R., 2022) recognize Western Europe as the second largest with the fastest growing IT economy in their scientific work. IT services for companies, management consulting, and export of services are named market drivers. It is worth noting that the United States of America follows a leading strategy in the field of information technology. Its main goal is to achieve leadership positions in various fields of knowledge, which not only guarantees the leading positions of its economic entities but also their prospective development of informatics and other fields of management of the direction of knowledge (Unruh L., Allin S., Marchildon G., Burke S., Barry S., Siersbaek R., ... Williams G. A., 2022). The United States has the largest IT software and services industry in the world, with 40% of the global IT market worth more than 5 trillion USD. Digitalization is growing rapidly in the United States and other countries around the world. The impact on the economic and social development of the United States of America is quite strong. This experiment should be carefully studied and adapted to the economic conditions of Ukraine, as well as accelerate the transition to standards adapted to a smart economy. Scientists note that the most developed country in the world acts as a message of the ten functions of society and define this state as the result of systemic development and social progress, with clear vectors: informational and innovative progress (Angus I. H., 2022, Usman M., Makhdum M. S. A., Kousar R., 2021). The stable and powerful development of the world organic food market allows Ukraine to take its place in the world (Bazaluk, O., Yatsenko, O., Zakharchuk, O., Ovcharenko, A., Khrystenko, O. & Nitsenko, V., 2020), for this, a study of the production capacities of agricultural enterprises was conducted (Ostapenko, R., Herasymenko, Y., Nitsenko, V., Koliadenko, S., Balezentis, T. & Streimikiene, D., 2020). Involvement of engineers specializing in the development of virtual laboratories (Panasiuk, O., Akimova, L., Kuznietsova, O. & Panasiuk, I., 2021) to develop possible options. Also the involvement of specialists in plant defensins for better breeding (Kovaleva, V., Bukhteeva, I., Kit, O. Y. & Nesmelova, I. V., 2020). Formation and development according to new characteristics of industries with the involvement of renewable energy for the preservation of the environment (Gavkalova, N., Lola, Yu., Prokopovych, S., Akimov, O., Smalskys, V. & Akimova, L., 2022) and development of new thermal characteristics of agricultural buildings made of metal frame walls (Panasiuk, I., Akimova, L. & Kuznietsova, O., 2020). With the help of stock trading indices into mechanisms of speculative capital (Slobodianyk, A., Abuselidze, G., Buriak, R., Muzychenko, A., Momot, O., & Romanova, L., 2022) to reorganize financial and economic security on financial European integration markets (Novak, A., Pravdyvets, O., Chornyi, O., Sumbaieva, L., Akimova, L., & Akimov, O., 2022), and the implementation of an improved state strategy for national security planning (Bondarenko, S ., Bratko, A., Antonov, V., Kolisnichenko, R., Hubanov, O., & Mysyk, A., 2022) in the conditions of information society and innovative approaches to the development of human potential in public administration (Semenets-Orlova, I ., Shevchuk, R., Plish, B., Grydiushko, I., & Maistrenko, K., 2022). Thus, the innovative development of the national economy should be aimed at implementing the latest concepts of Industry 4.0 and Industry 5.0.

Considering the novelty of the concepts of Industry 4.0 and Industry 5.0, there are few works reflecting the results of thorough research and the risks of implementing their technologies in the field of forming a national model of the smart economy, and they do not fully reveal the essence of this transition. Thus, in the scientific works (Fattahi A., Sijm J., Faaij A., 2020, Melnyk L. H., Sommer H., Kubatko O. V., Rabe M., Fedyna S. M., 2020), the authors studied the formation of the national economy based on ensuring energy security. Authors Yang, F., & Gu, S. (2021) consider the risks of Industry 4.0 in their investigation. Other scholars also work in this scientific direction, in particular: Xu, X., Lu Y., Vogel-Heuser B., Wang L. (2021), Akundi A., Euresti D., Luna S., Ankobiah W., Lopes A., Edinbarough I. (2022), Carayannis E. G., Morawska-Jancelewicz J. (2022).

The purpose of the present academic paper is to analyze the prerequisites for the formation of a national smart economy model and to develop a response scheme to changes in the external digital environment.

Based on the goal outlined, the following issues were solved in the academic paper:

- review and analysis of the components of the smart economy;
- defining the principles of Industry 4.0 and Industry 5.0 for research purposes;
- analysis of the current state of development of the national economy;
- formation of promising directions for establishing a smart economy model;
- analysis of the stages of creating a national smart economy model;
- development of a scheme for analyzing the impact of changes in external factors on the need to improve the national model of the smart economy.

The principles, methods, and mechanisms of the formation of the national model of the smart economy were the objects of the research.

The organizational relations arising between interested parties in the process of forming a national model of the smart economy are the subject of the research.

## MATERIALS AND METHODS

The hypothesis of the present research is the need to form a national model of the smart economy on the conditions of taking into account the directions of developing the innovative sphere.

The academic paper analyzes the prerequisites and prospects for developing the digital industry to systematically present the mechanisms of creating the national model of the smart economy. This approach made it possible to analyze the evolution and risks of applying Industry 4.0 and Industry 5.0. It has been determined that the high dynamism of developing

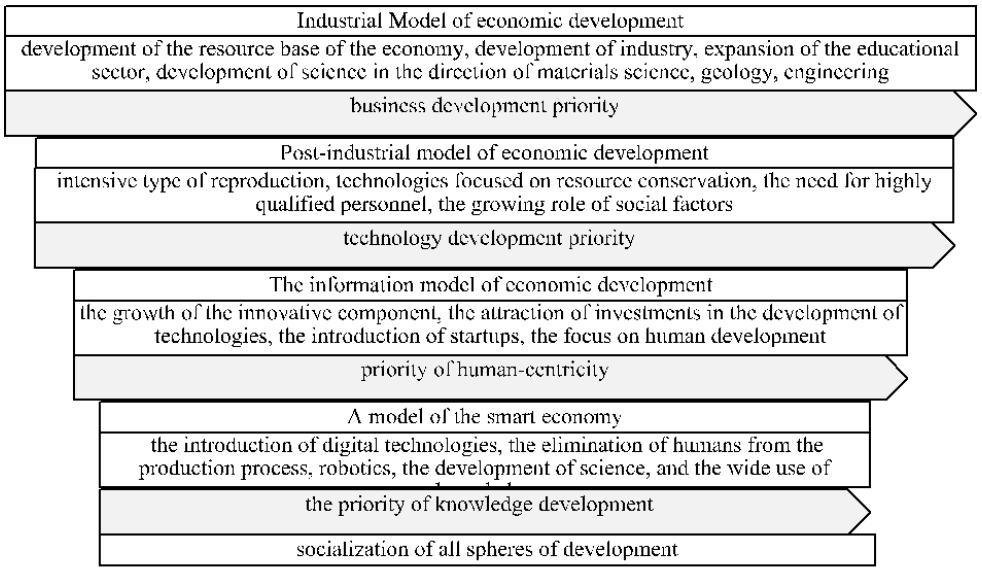


**Fig. (1).** Stages of formation of the national smart economy model (developed by the author).

the digital environment does not allow for a quick response to changes.

In the course of the research, dialectical methods were used, in particular, the principles of systematicity. This method made it possible to determine the concepts of smart economy and directions for implementing innovative changes.

Given the specifics of the research object, the research directions were based on an interdisciplinary approach. Thanks to this, the statistical data of the formation of the smart economy's national model were taken into account, as well as the directions of interaction at the international level were outlined. Thus, comparative and systematic methods were used.

To study the possibilities of introducing digital innovations into the national model of the economy, the methods and directions of the formation of industry development indicators and the determination of the resulting indicator were analyzed. For this purpose, the methods of logical construction, modeling, and systematization were applied.

In the course of the research, an analytical method was used to search for, select and summarize data on the analysis and selection of indicators characterizing the national model of the smart economy in the conditions of the external environment's instability.

Based on the analyzed data, a response scheme to changes in the external environment was constructed in the academic paper to improve the national model of the smart economy. The proposed scheme made it possible to determine the stability zone of the national model, in which responsible persons cannot react to changes, but only observe them. Modeling, comparison, and generalization methods were used to achieve this goal.

The primary advantage of the proposed model, which distinguishes it from similar models, is the integrity and completeness of the presented data and the ability to take into account the external environment's variability. The main limitation of the research was the impossibility of taking into account all instability factors.

## RESULTS

The formation of a modern model of innovative economy is a necessary condition for the sustainable development of the country and regions. The primary goals of the National Innovation Development Strategy are as follows: ensuring long-term sustainable development of the country, the formation of a national economy based on knowledge, the development and effective use of innovative potential, targeted material, and financial support, the creation of knowledge-intensive technologies, goods (works, services) and the production of competitive knowledge-intensive products.

The current stage of developing the national economy is characterized by difficulties connected with the spread of the COVID-19 pandemic, which radically changed the requirements for conducting business and actualized the need to adapt the market to new requirements. At the same time, internal problems of the national economy's state in Ukraine significantly complicate the adaptation of enterprises to the direction of innovative development, which is associated with the imperfection of the legislative framework, Russia's military invasion of Ukraine, and a weak institutional environment for innovation and entrepreneurship.

The positive developments in the direction of innovative development of the national economy include the possibility of quickly establishing intercity information and communication links (Suyunovich M. X., Siddiqovich O. L., 2022), growing ability to record, process, and store information quickly and on a large scale with the help of small technological means (Atitallah S. B., Driss M., Boulila W., Ghézala H. B., 2020), unification of communication technologies: television, radio and IT (Cardoso A., Boudreau M. C., Carvalho J. Á., 2019). The reviewed studies highlight the challenges and prospects of ensuring the formation of a national model of economic development by innovation requirements.

Thus, the formation of a national model of innovative economy involves a transition from an industrial and post-

**Table 1. Development of the Digital Economy in Ukraine in Developed Countries of the World (Summarized Based on the Global Skills Report, 2022).**

| Developing Countries | Countries Implementing Digitalization |
|---|---|
| 1. Israel | 1. Colombia |
| 2. Austria | 2. Malaysia |
| 3. Brazil | 3. Thailand |
| 4. Hungary | 4. Taiwan |
| 5. Uruguay | 5. India |
| 6. Chile | 6. Croatia |
| 7. Spain | 7. Tunisia |
| 8. Korea | 8. The USA |
| 9. Cyprus | 9. Greece |
| 10. Latvia | 10. The Czech Republic |
| **Problematic Countries** | **Prospective Countries** |
| 1. Egypt | 1. Indonesia |
| 2. Bolivia | 2. Belarus |
| 3. Myanmar | 3. Japan |
| 4. Uganda | 4. Denmark |
| 5. Trinidad and Tobago | 5. Kazakhstan |
| 6. Lebanon | 6. Singapore |
| 7. Uzbekistan | 7. Switzerland |
| 8. Rouen | 8. Ukraine |
| 9. Ghana | 9. Poland |
| 10. Ivory Coast | 10. Finland |

industrial economy to a new model of a smart economy based on human-centricity and knowledge (Fig. **1**).

By the conducted analysis, it is possible to trace the transition to the formation of a national smart economy from a priority in developing material production and industry to human-centricity and orientation to human knowledge and the maximum removal of it from the production process. The primary features of the smart economy are highly qualified personnel, the development of corporate culture, the development of an innovative component of the economy involving foreign investments, orientation to the "green economy" principles, comprehensive development, and social protection of the population.

At the same time, the implementation of the smart economy is limited by new challenges of the external environment. Such challenges include digital inequality in the regions, imperfection of legal regulation, and provision of information security and privacy. When negative phenomena occur, the process of interrupting the flow of information and filling information channels determines a high probability of rapid interception, leakage, distortion, asymmetry, destruction of information, obtaining its assessment; unauthorized interference with the operation of computer programs, and theft of information. The use of technical means and information technologies in anti-social activities: political, economic, and psychological can create conflict situations and reduce the sovereignty and information security of the country, regions, and citizens. Solving these problems involves constant improvement of the national development strategy from the perspective of conflict of interests, violations of rights, and contractual relations, as well as scientific substantiation of institutional mechanisms and tools.

Despite the rapid development of the information and innovation component, Ukraine currently lags behind the information and innovation developed countries of the world in the degree of digitalization of the economy and education and planned development of the information environment (Table **1**). The reasons for this situation are the presence of negative factors preventing the full use of new information and telecommunication technologies in various spheres of economy, production, and education.

Such negative facts and conflict situations include unsystematic support of the IT sector and its weak integration into the industry, the agro-industrial complex and the social sphere, insufficient implementation of scientific and industrial innovations accumulated in the IT sector, commercialization of

innovative projects for developing distance education and work remotely from the office, the unsystematic transition of the fields of knowledge and research to modern information technologies, the low level of intellectual education, the inconsistency of developing informatization with the needs of scientific research, the lack of a knowledge management concept in the systems of science and education, the asymmetry of regional development – economic, social, technological; asymmetric information about the development of the city and the village.

In this regard, reorientation to the smart economy involves:

- optimization of territorial infrastructure due to the creation of united territorial communities;
- digitalization of the economy due to the introduction of digital innovations and attracting investments into the economy;
- development of information and communication infrastructure due to improving corporate culture and activation of the scientific component;
- retraining and advanced training of personnel (civil servants and IT specialists) in the direction of implementing digital technologies.

The innovative strategy should take a new place in the entire national regulatory system in the context of the transition to a smart economy. Thanks to this, the national development strategy is separated from the strategy of social-economic development and formed as a central element of state management in all spheres of economic and social development. At the same time, the strategy's main focus should be on human knowledge, its comprehensive development, and its focus on international integration.

The value of the smart economy lies in:

- self-control and accuracy of decision-making, which provide the opportunity to independently control the internal structure, environment, and conditions of use to increase the accuracy and speed of decision-making;
- efficiency and savings, which are ensured by reducing operating costs;
- reliability, which consists in minimizing downtime, and service failures;
- security, protection, and stability provided by adaptive processes and structures about anthropogenic and natural risks;
- interoperability and enhanced usability for providing services that can adapt to the consumers' changing needs;
- sustainability about optimization of decision-making to ensure sustainable use of resources;
- minimizing redundancy, which consists in minimizing redundant components in the system, reducing energy consumption, and saving resources;
- the duration of the response, which is formed based on the early detection of critical events, preventive maintenance, and their quick resolution;
- reduction of carbon emissions based on minimization of greenhouse gas emissions and energy consumption;
- the quality of services to improve the level of quality and expand infrastructure services to improve living conditions.

At the same time, significant tasks of the state are as follows: to determine the priorities of innovative development in conditions of limited resources, the formation of innovative, scientific and industrial activities reflecting the common interests of science, business, and investors, the results of large-scale studies and their further implementation in production as a necessary prerequisite for an effective transition to a smart economy. In these conditions, taking into account the challenges of the external environment, public administration should be aimed at constantly improving the structure and mechanisms of functioning due to the optimization of available limited resources.

Economic and mathematical modeling is one of the main methods of optimization in conditions of limited resources and takes into account the results of the development of economy, mathematics, and cybernetics. Fig. (**2**) shows the stages of economic-mathematical modeling and creating an optimization model of the smart economy.

Block 1 of the proposed model provides an analysis of the current state of developing the national economy. The development of the national economy in Ukraine is accompanied by an imbalance between the information provided by local authorities and the companies' activities (of an informational, technological, and technical nature), leading to asymmetry. The reasons for this may be the presence of regions with different sectorial structures (agricultural, industrial, agro-industrial, metallurgical), the development of the capital region, and its leading position in economic development (investment volumes and wages exceed other regions). Another factor influencing the formation of the imbalance is the actual incomplete coverage of the mobile Internet connection. It should be emphasized that the coverage of 3G and 4G Internet in Ukraine is uneven. In general, the annual dynamics of Internet penetration in Ukraine shows a constant increase in the total number of users, which by the end of 2021 reached 21 million people, or 64% of the population (Striy L., Chukurna O., Tanashchuk E., 2022). Meanwhile, data from the latest survey of the Internet audience conducted by the Internet Association of Ukraine and Factum Group Ukraine (Khmil Y., Benchak O., 2022) indicate that the number of Internet users is slowing down, and even prove that the number of regular Internet users is decreasing. This decrease is associated with a decrease in the total number of permanent residents of Ukraine mainly due to the emigration of the Ukrainian population aged 18 - 45 (Zatonatska T., Liashenko O., Fareniuk Y., Dluhopolskyi O., Dmowski A., Cichorzewska M., 2022). Also, the imbalance indicator is affected by the weakening of the regulatory role of the state, and the growth of regional inequality in information technology provision. In the conditions of the rapid process of globalization and European integration in Ukraine, serious imbalances are forming regarding information provision, access to information resources, as well as qualitative and quantitative parameters of the information environment. It is neces-

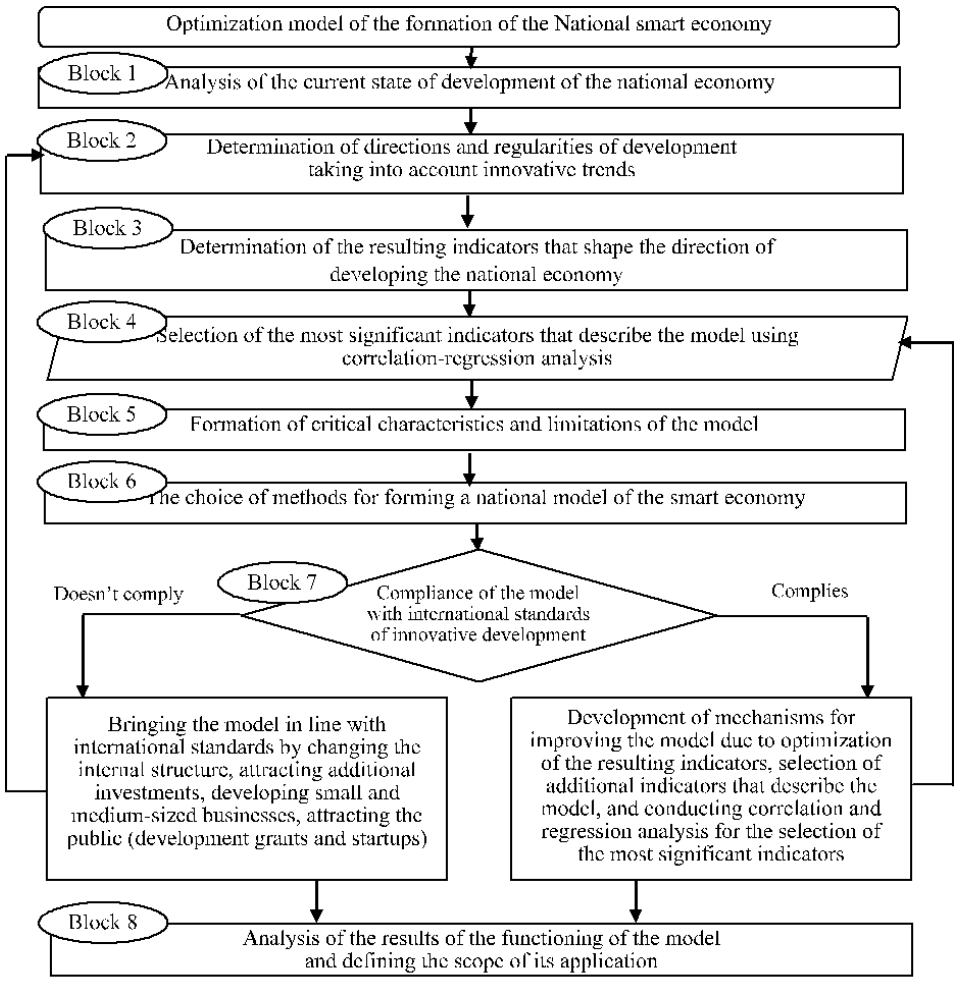


**Fig. (2).** Stages of formation of the optimization model of the smart economy (developed by the author).

sary to study, diagnose, and develop regulatory measures and improve global access to information, reduce the risk of information dissemination, and accelerate the solution of promising integrated models of the smart economy.

When creating an optimization model, it is important to choose the optimal criteria and restrictions, taking into account economic resource capabilities. The model's performance criterion usually indicates a deviation from the set goal. Before deciding on a criterion for the model's efficiency, it is necessary to primarily define the requirements and establish the relationships between the set goal and the mechanism for achieving it. All intermediate data needed to calculate this criterion should be available for tracking and comparison. The objective function of the optimization model should determine the main optimization criterion to ensure profitability. Specialists in the field of modeling have different approaches to this issue. Therefore, models of similar purposes differ significantly in the number of indicators and the nature of the connections between them.

Determining the directions and regularities of developing the national smart economy (Block 2) involves the analysis of performance indicators in three main areas: public administration, technological development, and entrepreneurial activity.

The analysis within the framework of Block 3 provides for the selection of the resulting indicators in each of the three main directions of developing the national economy. Fig. (**3**) represents a generalized set of resulting indicators for each direction, taking into account tendencies in innovative development

A system of supporting indicators is formed based on the selection of those indicators that will describe the model. These indicators of the smart economy can be divided into blocks: energy consumption, use of water resources, waste management, mobility, city management, digitalization in the field of recreation and tourism, health care management, distance education, and remote work from the office, home management (Table **2**).

According to Block 5, the critical characteristics of each model indicator are determined, which reflect the direction of optimization in terms of maximizing or minimizing the characteristic. Block 6 provides for the development of a model for optimizing the national smart economy. After analyzing the compliance of the developed model with the requirements of international standards regarding digitalization (Block 7), two possible options for optimizing the national smart economy are developed. If it is necessary to clarify the parameters of the model, it is possible to return to the previ-

ous stages of the analysis. Therefore, to improve the national smart economy, achieve financial stability, increase production, diversify economic systems, ensure flexibility, and reduce the cost level, taking into account world market trends, it is advisable to use state orders and additional foreign investments and financing schemes.

At the final stage (Block 8), a model for optimizing the formation of the national smart economy is created. It is evaluated in terms of efficiency and possible areas of improvement. Fig. (**4**) reflects a generalized scheme of optimization and response to changes in the main indicators of the development of the smart economy.

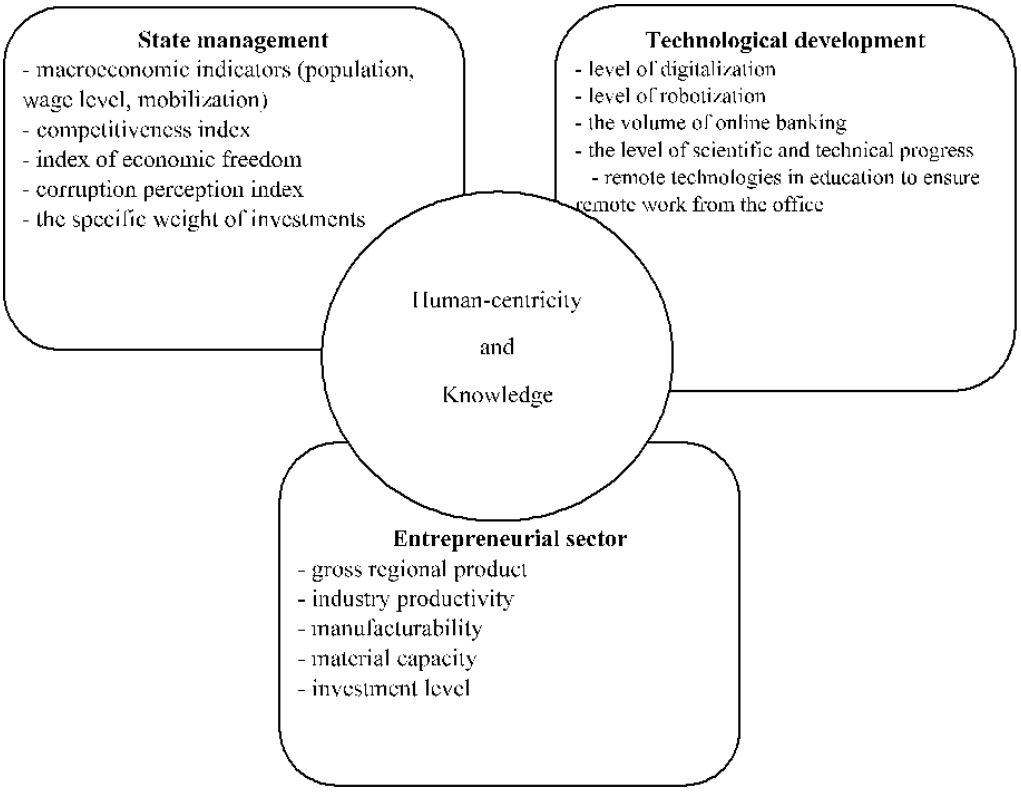


**Fig. (3).** The resulting optimization indicators of developing the national smart economy (developed by the author).

**Table 2. Supporting Indicators of the Optimization Model (Developed by the Author).**

| Indicator | The Essence of the Indicator | Directions of Use |
|---|---|---|
| Energy consumption | a rational system of energy equipment is created, which allows careful control of energy consumption, facilitating the implementation of energy consumption monitoring programs at the community level and increasing the energy efficiency of facilities | decentralized production of energy from renewable sources, micro-energy systems, rational network technology, energy storage, automatic response to changes in demand, virtual management of power plants |
| Use of water resources | using IoT technology to monitor water use, water quality, and leak detection | intelligent network management of water resources |
| Waste management | reduces the amount of waste and ensures its separation by type, source, and the development of relevant treatment methods | equipping garbage containers with sensors that determine the amount of waste |
| Mobility | reading traffic flow and adjusting speed limits in real time for traffic control | increasing highway capacity without the need for physical expansion and reducing travel time, pollution, and fuel consumption |
| City management | the parking system works as follows: each parking space is equipped with a sensor that determines the availability of a free parking space | optimization of time and space for parking, online booking, reduction of traffic jams and air pollution |
| Digitalization in the field of recreation and tourism | creating controlled robots that can approach people or their groups, answer questions and show visitors everything they are interested in | crowd control, museum tour guides, autonomous robot control |
| Health care management | enable the transformation of population health data into clinical information, including electronic patient registries, home medicine and remote diagnosis, treatment, and monitoring mechanisms | Wi-Fi sensors to track personal mobile devices, cameras to automatically count people, social networks, and GPS trackers |

| | | |
|---|---|---|
| Distance education and remote work from the office | changing the way of learning, effective combination of learning and counseling | open online courses, digitalization of the educational process, lifelong education |
| Home management | the ability to control and manage the house using the so-called single remote control | Monitoring electronic devices, surveillance, and home security using a smartphone or tablet |

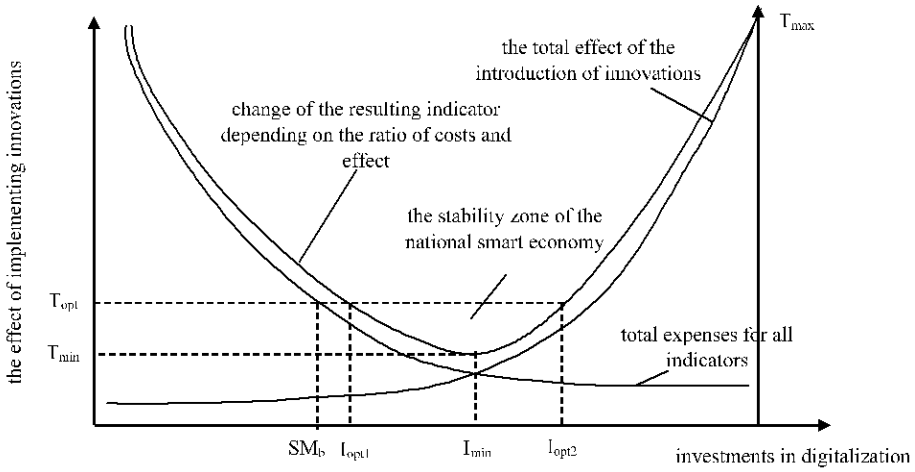


**Fig. (4).** Scheme of response to changes and determination of the need to improve the national smart economy model (developed by the author).

where

$T_{max}$ – maximum effect from implementing innovations;

$T_{min}$ – the minimum level of efficiency achieved;

$T_{opt}$ – the optimal level of the ratio of costs and results to ensure sustainability;

$I_{min}$ – the minimum level of total costs for implementing innovations;

$I_{opt1}$ – the optimal level of innovation costs based on consideration of aggregate costs;

$I_{opt2}$ – the optimal level of costs for innovation due to the achieved effect;

$SM_b$ – the basic required level of the ratio of the total costs of innovation and the desired minimum level of the achieved effect;

($T_{opt}$ - $T_{min}$) – the zone of the optimal ratio of total costs and the achieved effect, which forms the zone of resistance of the national smart economy to external influences. The greater the difference ($T_{opt}$ – $T_{min}$), the more stable the developed model (responsible persons may not react to changes in the external environment but only observe them).

This scheme will allow those responsible for developing and improving the national smart economy model to respond to changes effectively, take into account limitations and relationships, and make effective decisions.

## DISCUSSION

Modern tendencies in developing the national economy are aimed at forming a smart economy. The next stage in the development of the concept of economic knowledge is based on new-generation technologies, comprehensive modernization of all spheres of life, innovative development, high-added value, energy efficiency, the formation of a protected natural environment, and social stability.

Effectively designed and managed smart infrastructure can contribute to environmental sustainability. Smart infrastructure becomes the basis for achieving energy efficiency and maximizing the ability of countries to achieve their goals for reducing greenhouse gas emissions. According to the study conducted by Caineng, Z. O. U., Xiong, B., Huaqing, X. U. E., Zheng, D., Zhixin, G. E., Ying, W. A. N. G., ... & Songtao, W. U. (2021), the global replacement of traditional urban infrastructure is expected to reduce global greenhouse gas emissions by 5-10% each year. Cities can observe and understand in real time what the biggest air pollution problem is, why the next change is happening, and how it affects city residents. Air quality sensors can be placed on public transport, lampposts, benches, and garbage cans.

Despite the potential advantages of introducing intelligent technologies, the effectiveness of their use varies depending on the conditions (social-political, social-economic, and technological). The number of "smart" solutions in cities is increasing. However, at the same time, there are inherent barriers at all stages of implementing smart solutions.

Thus, Appio, F. P., Lima, M., & Paroutis, S. (2019) in their scientific work note that the lack of national strategies for establishing smart infrastructure can be an obstacle to the development of a national model of a smart economy. The large projects implemented within the framework of the smart economy are often complex and expensive. They require the support of a large number of stakeholders, especially with public-private partnership mechanisms where the interests of the public and private levels are combined. Ineffective collaboration and interaction between stakeholders

may be the biggest obstacle to smart infrastructure, as communities and companies are reluctant to share sensitive data.

Cities need money to install sensors and integrate other digital technologies. However, funding is very limited and the approval process can take years. According to the Smart Cities World report (Beheshti B., 2019), financing is the biggest challenge in creating a smart economy. The risk is because many infrastructure investments are large and have low returns. In addition, modern technologically complex infrastructures do not receive adequate financial resources for several reasons, including a lack of awareness of the importance of such infrastructures, in particular: physical infrastructure is large and highly visible, which allows optimally achieving the required level of investment. Smart infrastructure is knowledge-based and largely opaque. From a management perspective, the diversity of smart technologies required to support each stage of infrastructure development also creates challenges.

Low digital literacy of the population, lack of experience, and knowledge of municipal and state officials are obstacles that prevent city residents and various commercial enterprises from fully switching to using digital media (Zdjelar R., Keleman R., 2019). To implement the full potential of the smart economy, people must fully understand the strengths and transformative potential of the cities in which they live. Therefore, to create a national model of a smart economy, it is recommended to implement educational initiatives that support citizens.

Most analytical and scientific works are mainly aimed at studying technical (Lai C. S., Jia Y., Dong Z., Wang D., Tao Y., Lai Q. H., ... & Lai L. L., 2020, Ahad M. A., Paiva S., Tripathi G., Feroz N., 2020), environmental (Lamnatou C., Chemisana D., Cristofari C., 2022, Norouzi M., Chàfer M., Cabeza L. F., Jiménez L., Boer, D., 2021) and social-economic aspects (Duygan M., Fischer M., Pärli R., Ingold K., 2022, Allam Z., Jones D. S., 2021), construction of smart infrastructure and its benefits. However, few studies deal with the issues of a smart economy, which is important for establishing a national model of innovative economy and which must be taken into account during the formation of development directions to reduce the negative impact of the external environment.

Thus, the main tasks are deepening and detailed study of the proposed response scheme to the challenges of the external environment to create an effective model of the national smart economy. The analysis should be based on forecasting the impact of indicators that describe the development model of the national economy. Along with this, a necessary task is to analyze the influence of these indicators on the resulting factor, which forms the effectiveness of developing the national model of the smart economy.

## CONCLUSIONS

The formation of the national model of the smart economy acquires a new quality, primary value, which is manifested in the function of information integration. Such management should ensure the integrity of social-economic development and natural-economic balance. Modern information technologies and the complex innovation system formed on their basis, modern intellectual technologies are becoming an irreplaceable and significant tool for ensuring the achievement of strategic goals of regional sustainable development. Participation in cloud technologies already recognized in the world is especially important for improving the existing national smart economy model. The following aspects should be considered priorities for using cloud technologies: statistical and analytical support, electronic government, and communication with the authorities, businesses, and citizens, remote provision of services, provision of educational services, and cooperation with regional business.

The modern fourth industrial revolution makes it necessary to set other priorities when assessing the smart economy. This concerns new technological solutions, production technologies, and modernization of organizational and management structures, that is, the improvement of management systems. At the current stage, there is a transformation of the economy from the exchange of physical objects to a system of information interaction, the transformation of intellectual potential into real economic resources, the transformation of the organizational structure from the management of a hierarchical structure to a network structure, rapid adaptation to a changing reality, the quality of managing the economy of the enterprise and ensuring their safety. At the same time, the digital economy is characterized by high dynamism, which requires a constant response to new challenges of the external environment.

With the beginning of the economy digitalization, this process takes on a revolutionary character. As a result, new technologies of digital production have appeared: artificial intelligence, robotics, smart houses, networks, and cities, human participation in production is evaluated differently. Currently, production and management methods have changed, and production and management methods based on the new platform system are called "Industry 5.0". This is a new step in the technical division of labor, which excludes the direct participation of a person in the production process. Therefore, there is an opportunity to increase production efficiency and labor productivity significantly. The prospects and priorities of economic development are often associated with the inevitable technical revolution, the deployment of robotic production, management, and computer technologies, and, as a result, the introduction of digital changes. The essence of the digital economy lies not only in Internet technologies and e-commerce but also in the integration of production and information technologies, which indicates the radical nature of the changes taking place in the digital sphere.

A systematic approach to solving this problem, multifactorial analysis determines and quantitatively evaluates the main factors of the decision-making process, taking into account their interaction. The transition to a platform approach within the framework of Industry 4.0 is due to the limitation of the development prospects and capabilities of the electronic complex within the framework of the integrated development model. The model primarily involves the improvement of certain types of equipment, aggregates, and units of electricity generation, transmission, and distribution. The factors on which the integrated development model is based include restrictions on investment financing of new buildings, re-

strictions on the possibility of increasing the energy efficiency of production facilities, increased environmental requirements, the futility of more efficient use of traditional hydrocarbon resources, and the high cost of renewable energy. The outlined circumstances require the smart economy to depart from the traditional path of development and develop based on digital transformations, which is a platform approach within the framework of Industry 4.0 and Industry 5.0. From this perspective, new smart technologies (control centers) are considered special cases of the Internet of Things of the digital economy.

The national model of the smart economy should become the basis for forming an effective and sustainable model of the digital economy at the current stage of transformation and active implementation of the digitalization process of the economy and society. At the same time, the implementation of the proposed model will be possible only under the conditions of full state support and accelerated digitalization of the economy and state governance. It will be based on the formation of effective legal and fiscal instruments for stimulating high-tech production, infrastructure, communication, personnel training, and accelerated transition to digital technologies of production, business, and society as a whole.

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