SYSTEM MODEL OF FORMATION OF THE VALUE OF PROJECTS OF DIGITAL TRANSFORMATION IN RURAL COMMUNITIES

The state of science and practice of implementation of digital transformation projects in various subject areas is analyzed. The expediency of developing a toolkit for managing projects of digital transformation of rural communities on the basis of computational intelligence is substantiated. The tasks that should be solved in projects of digital transformation of rural communities based on computational intelligence are formulated. A system model of value formation of projects of digital transformation of rural communities with the use of computational intelligence is proposed. It refers to seven levels of digital transformation of rural communities, each of which provides value creation through the implementation of four sub-cycles. Separate sub-cycles of the digital transformation of rural communities provide value for stakeholders and increase the effectiveness of the implementation of relevant projects. Completed mathematical description of the full cycle of value formation of projects of digital transformation of rural communities using computational intelligence. The results of the implementation of processes in the projects of digital transformation of rural communities are determined. They ensure the identification of the structure of digital transformation projects, taking into account the available resources and the project environment of the rural community. The proposed system model of value formation of projects of digital transformation of rural communities with the use of computational intelligence is the basis for the development of management decision support systems during the planning of relevant projects.

Keywords: projects, management, digital transformation, rural communities, system model, computational intelligence.

Formulation of the problem. The development of certain rural territorial communities, as well as ensuring the safety of life and activities of their residents, is impossible without their digital transformation. At the same time, the development of information technologies is observed, which ensures the penetration of digital technologies into all areas of people's lives and activities [1; 2]. In addition, all this is accompanied by global challenges and threats for Ukraine in recent years, in particular, the long-lasting COVID 19 pandemic, martial law, etc. At the same time, new scientific and applied tasks of managing digital transformation projects of individual territories, industries and organizations are emerging [3; 4; 5]. In this direction, the state is taking certain steps through the newly created Ministry of Digital Transformation of Ukraine. One of the areas of activity coordinated by the mentioned ministry is transformation thanks to the implementation of digital innovations, electronic document circulation and the development of the information society, including rural territorial communities. As for rural communities, despite their autonomy, they are in a dynamic and changing project environment, the forecasting and modeling of which is the basis for the development of effective tools for the implementation of digital transformation projects [6; 7; 8]. At the same time, the basis of projects of digital transformation of rural territorial communities is data, information and knowledge about the processes that take place in them.

An important role when choosing an effective toolkit for the implementation of digital transformation projects is the availability of data that ensures obtaining

information and forming knowledge about the state of the project environment in the territory of rural communities [9; 10]. Thanks to the implementation of digital transformation projects, it is possible to increase their value. At the same time, the implementation of digital transformation projects related to production activities requires the use of "Industry 4.0" [11; 12]. It is this achievement of the fourth industrial revolution that ensures the forecasting of the components of the project environment and projects on the basis of the received information and formed knowledge from the digital transformation of rural communities. As a result, it ensures the creation of value for stakeholders and the adoption of management decisions, without the participation or with the partial participation of project managers, which significantly reduces the possibility of making erroneous management decisions and contributes to the timely exchange of the necessary information, as well as project management in a single organizational and information system.

The achievement of certain levels of digital transformation by rural communities ensures the acquisition of the necessary data from the established databases, which is the basis for the prompt acquisition of the necessary information for the implementation of projects. For this, it is possible to use computing intelligence, which provides the solution of a number of management tasks and the formation of knowledge regarding the implementation of projects, taking into account their dynamic and changing project environment [13; 14; 15]. Computational intelligence is a component of artificial intelligence and belongs to one of the most popular areas of research by scientists and the use of developed tools by practitioners. Computational intelligence is one of the key drivers of implementation of digital transformation projects of rural communities. Computational intelligence belongs to the basic directions that ensure the implementation of projects in the territory of rural communities in accordance with the fourth industrial revolution "Industry 4.0" [16]. This leads to an increase in value for the production business structures of rural communities due to an increase in the level of digital transformation, labor productivity, infrastructure efficiency and ensures food security for the population.

Therefore, there is a need to develop a system model of value formation of projects of digital transformation of rural territorial communities based on computational intelligence. It is quite relevant and corresponds to the prospective direction of development of project management for the implementation of projects on the territory of rural communities.

Analysis of recent research and publications. Many scientists devoted their work to digital transformation and the use of modern digital technologies in certain sectors of the national economy [3; 4; 7]. They relate both to the development of concepts of digital transformation and to solving the problems of digitalization of society. Some of them devoted their works to the digital transformation of communities [6; 7; 8]. In these works, the main aspects of the digital transformation of communities were investigated, the main problems related to the implementation of digital technologies in the activities of territorial communities were identified [8]. Scientific works that present the results of

research into the processes of digitization and digital transformation in Ukraine, in particular, the digital economy and its relationship with business processes [17], deserve attention. However, the above-mentioned works do not consider the interrelationships between the processes of digital transformation projects to achieve the fourth industrial revolution, which provides forecasting of the component projects and events of the project environment of rural communities.

In others works [11; 16] presented certain aspects of the new direction of economic development "Industry 4.0", as well as defined the problems of implementation in the production of various industries, etc. Nevertheless, there are quite a few domestic scientific works devoted to "Industry 4.0" and its use in project management, taking into account the project environment of individual rural communities. In addition, there are no systematic models of value formation of projects of digital transformation of rural territorial communities, taking into account the achievements of the fourth industrial revolution "Industry 4.0" and the use of computational intelligence.

The purpose of the task. The goal is to identify projects for the development of rural communities based on their digital transformation using computational intelligence and to substantiate the system model of their value formation, taking into account the achievements of the fourth industrial revolution "Industry 4.0". To achieve this goal, you need to complete the following tasks:

- to identify development projects of rural communities based on their digital transformation using computer intelligence;

- to substantiate the system model of value formation of projects of digital transformation of rural communities using computational intelligence.

Presenting main material. Computational intelligence is one of the branches of artificial intelligence, the development of which is partly related to the digital transformation of certain areas of people's lives and activities, which concerns the formation of large data about individual objects and their activities [18; 19]. In addition, this development is greatly facilitated by the development of information technologies that ensure the presence of residents of rural communities on the Internet, make it possible to store large amounts of information, which ensured the digitization of accounting documentation, which made it possible to create the necessary data sets for machine learning. The main projects that ensure the development of rural communities on the basis of their digital transformation with the use of computational intelligence include the following projects:

1.   creation of digital personalized programs with functions of communication and customer support of service structures, as well as analysis of customers and encouragement of potential consumers thanks to the analysis of their requests;

2.   To create safe conditions and saving money on electricity due to the management of lighting in production workshops, street lighting in rural communities, as well as online monitoring of the condition of roads and the presence of obstacles for the movement of technical equipment on them, which ensures the avoidance of emergency situations;

3.	cloud services for medical centers and medical clinics of rural communities for the purpose of storing and classifying medical data about community residents, and forecasting their health based on intelligent information systems;

4.	monitoring the state of health of residents of rural communities thanks to the use of intelligent applications on mobile devices, as well as thanks to the connection to the network of personal gadgets with intelligent applications;

5.	creation of effective communications between the community leadership, residents and business structures using intelligent systems, which will significantly increase productivity and ensure the uniqueness of solving controversial issues;

6.	information systems for forecasting price policy and demand for raw materials produced on the territory of rural communities, taking into account their production and natural and climatic conditions, which is the basis for solving the problems of seasonal planning of volumes and types of agricultural production;

7.	operative planning of the activities of infrastructure objects of rural communities on the basis of big data bases;

8.	creation of separate business structures on the territory of rural communities, the production processes of which will take place with the participation of smart object;

9.	information systems for planning retail trade and improving the quality of customer service thanks to the development of intelligent web software products and mobile applications;

10.	information systems for forecasting individual processes of the infrastructure facilities of rural communities using machine learning models and static models;

11.	decision-making support systems for substantiating project plans for the development of the territories of rural communities in conditions of data inaccuracy and uncertainty of the project environment, as well as the presence of data gaps or their emissions;

12.	decision-making support systems for coordinating the volumes of electricity generation by renewable sources and its consumption by infrastructure facilities with the forecasted characteristics of the natural and climatic conditions of rural communities.

Each of the above-mentioned projects requires the development of a specific toolkit for managing them on the basis of relevant research, as well as substantiation of the system model of their value formation.

Experimental results and their analysis. Let's consider one of the above-mentioned projects for the creation of decision-making support systems for substantiating the plans of projects for the development of the territories of rural communities. The peculiarity of the project is that it is implemented in the conditions of data inaccuracy and uncertainty of the project environment, as well as the presence of data gaps or their emissions. The implementation of such a project requires both the digital transformation of rural communities and the use of "Industry 4.0", which ensures the creation of automated production and automated management decision-making, as well as facilitates data exchange and management of production processes in a single organizational and information system [20]. There are systemic relationships between the digital transformation of rural communities and the use of "Industry 4.0", which are reflected in

the proposed system model of value formation of projects of digital transformation of rural communities using computational intelligence, which is presented on pic. 1.
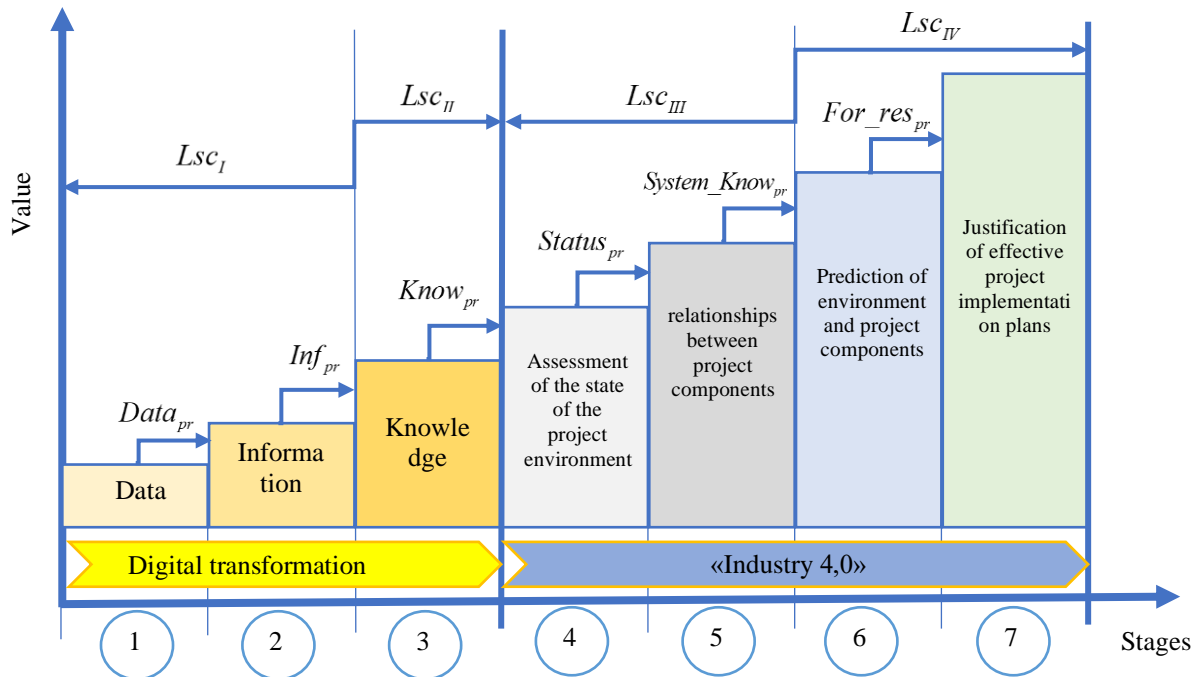
Pic. 1. System model of value formation of projects of digital transformation of rural communities using computational intelligence: $Lsc_I, Lsc_{II}, Lsc_{III}, Lsc_{IV}$ — these are the first, second, third and fourth transformation sub-cycles; $Data_{pr}$ — database; Inf_{pr} — information about project environment state; $Know_{pr}$ — knowledge about the project and the project environment; $Status_{pr}$ — the state of the project and the project environment; $System\_Know_{pr}$ — system knowledge about the project; For_res_{pr} — the results of forecasting the components of the project environment and actions in the project using computational intelligence

The system model of value formation of projects of digital transformation of rural communities with the use of computational intelligence, presented in Figure 1, involves the implementation of seven levels, each of which provides an opportunity to obtain the desired result that has value for communities:

1. **Initialization of the database** $(Level1)$, which makes it possible to collect such a set of data on the state of production facilities on the territory of rural communities, on the availability of raw materials, with the establishment of the necessary characteristics of these data, as well as the relationships between their attributes;

2. **Promptly obtaining the necessary information** based on the collected data $(Level2)$, which ensures the reduction of "information overload" of users, and is also the basis of sending the necessary information (information routing) for individual users, performing information sorting (information filtering), carrying out ordering

(classification) of information (information categorization) and the necessary selection of information (information extraction));

3. **Obtaining the necessary knowledge** (*Level3*), which represent pre-processed information recorded and tested in practice, which can be used repeatedly to make the necessary decisions in development projects of rural communities;

4. **Carrying out an assessment of the state of the project** and the project environment in the territory of the given rural community (*Level4*), which is based on the acquired knowledge and ensures the establishment of trends in the volume of raw materials and resources due to changes in the state of the project environment;

5. **Carrying out a description of the relationships** between the components of the project of digital transformation of rural communities and the components of its project environment (*Level5*), which ensures the availability of systematic knowledge about them and is the basis for choosing an effective toolkit for using computing intelligence;

6. **Forecasting** the components of the project environment and the project of digital transformation of rural communities using computational intelligence (*Level6*), which ensures getting rid of inaccuracy, uncertainty and the presence of data gaps regarding the state of the project environment or their emissions;

7. **Justification of effective plans** for the project of digital transformation of rural communities (*Level7*), which is based on the results of forecasting the components of the project environment and the project using computer intelligence, which ensures an increase in the quality, accuracy and duration of making relevant decisions.

Each of the stages of the project of digital transformation of rural communities with the use of computing intelligence has its own characteristics, which determine the justification of the tools for their implementation. Execution of individual stages is carried out sequentially without the possibility of transition to the next stages without completing the previous stages of digital transformation. At the same time, the implementation of digital transformation at each of the stages provides an opportunity to obtain value for rural communities. As the status of certain rural communities increases in terms of digital transformation, it leads to an increase in value for them. The greatest value is obtained by those rural communities that have achieved digital transformation, which ensures the level of substantiation of effective plans for projects of digital transformation of rural communities with the use of computational intelligence.

Projects of digital transformation of rural communities using computational intelligence are implemented on the basis of the implementation of four cycles, each of which provides its own result, which is used to make the necessary decisions. That is, the full cycle of digital transformation of the above is:

$$Lc_{dt} = Lsc_I \cup Lsc_{II} \cup Lsc_{III} \cup Lsc_{IV}, \tag{1}$$

Lc_{dt} – the cycle of digital transformation of the rural community; – the first sub-cycle, which provides information on the status of the project of digital transformation of the rural community; Lsc_{II} – the second sub-cycle, which ensures the acquisition of knowledge about the project of digital transformation of the rural community; Lsc_{III} – the

third sub-cycle, which ensures the formation of systemic knowledge about the project of digital transformation of the rural community, taking into account changes in the project environment; Lsc_{IV} – the fourth sub-cycle, which provides substantiation of effective plans for projects of digital transformation of the rural community using computational intelligence.

First sub-cycle (Lsc_I) includes the implementation of two levels of the project of digital transformation of the rural community, related to the formation of the database $(Level1)$ and receiving information $(Level2)$ about the status of the respective project:

$$Lsc_I = (Level1 \cup Level2) \rightarrow Inf_{pr}, \qquad (2)$$

$Level1$ – the first level of the project of digital transformation of the rural community, which ensures the formation of a database; $Level2$ – the second level of the project of digital transformation of the rural community, which ensures prompt receipt of the necessary information for management; Inf_{pr} – information on the status of the project of digital transformation of the rural community. Second sub-cycle (Lsc_{II}) includes the implementation of the third level of the project of digital transformation of the rural community $(Level3)$, related to obtaining the necessary knowledge regarding the specified process:

$$Lsc_{II} = (Level3) \rightarrow Know_{pr}, \qquad (3)$$

$Level3$ – the third level of the project of digital transformation of the rural community, which ensures the acquisition of the necessary knowledge; $Know_{pr}$ – knowledge about the project of digital transformation of the rural community.

Third sub-cycle (Lsc_{III}) includes the implementation of the fourth and fifth levels of the project of digital transformation of the rural community, related to the assessment of the state of the project and the project environment $(Level4)$ and description of relationships between project components and components of its project environment $(Level5)$:

$$Lsc_{III} = (Level4 \cup Level5) \rightarrow System\_Know_{pr}, \qquad (4)$$

$Level4$ – the fourth level of the digital transformation project of the digital transformation of the rural community, which provides an assessment of the state of the project and the project environment; $Level5$ – the fifth level of the project of digital transformation of the rural community, which ensures the fulfillment of the description of the relationships between the components of the project and the components of its project environment; $System\_Know_{pr}$ – system knowledge about the project of digital transformation of the rural community, taking into account changes in the project environment.

The fourth sub-cycle (Lsc_{IV}) includes the implementation of the sixth and seventh levels of the project of digital transformation of the rural community, related to the prediction of the components of the project environment and the project using computational intelligence $(Level6)$ and substantiation of effective plans $(Level7)$:

$$Lsc_{IV} = (Level6 \cup Level7) \rightarrow Plan\_effective_{pr}, \qquad (5)$$

$Level6$ – the sixth level of the project of digital transformation of the rural community, which provides forecasting of the components of the project environment and the project

using computational intelligence; $Level7$ – the seventh level of the rural community digital transformation project, which provides justification for effective plans; $Plan\_effective_{pr}$ – an effective project plan for the digital transformation of the rural community.

As a result of the implementation of the full cycle of the project of digital transformation of rural communities with the use of computing intelligence, a set of results are obtained that contribute to increasing its value:

$$Effective_{pr} = Level^{1-7} : \left\{ Lsc_{I}, Lsc_{II}, Lsc_{III}, Lsc_{IV} \right\} \rightarrow$$
$$\rightarrow \left\{ Inf_{pr}, Know_{pr}, System\_Know_{pr}, Plan\_effective_{pr} \right\} . \tag{6}$$

The proposed system model of value formation of projects of digital transformation of rural communities with the use of computational intelligence involves the implementation of seven levels, which are included in four sub-cycles. It is the basis for choosing the levels of digital transformation for each individual rural community, taking into account their capabilities and the need to obtain the desired value, and is also the basis for the development of tools to support management decision-making during the planning of digital transformation projects of rural communities using computational intelligence.

Conclusions. The analysis of the activities of rural communities and scientific works devoted to digital transformation in various spheres of human activity made it possible to establish the feasibility of identifying projects related to the development of rural communities on the basis of their digital transformation with the use of computational intelligence and the development of tools for their management. Based on the analysis of the subject area and modern achievements and the field of project management, twelve types of projects related to the development of rural communities based on their digital transformation with the use of computational intelligence have been formulated. The proposed system model of value formation of projects of digital transformation of rural communities with the use of computational intelligence involves the implementation of seven levels, which are included in four sub-cycles, each of which provides the desired value and increases their efficiency. A completed mathematical description of the full cycle of projects of digital transformation of rural communities using computing intelligence with the definition of the obtained results ensures the selection of the necessary projects of digital transformation for each individual rural community, taking into account their project environment and resources. The developed system model of the formation of the value of projects of digital transformation of rural communities is the basis of the toolkit to support management decision-making during the planning of the specified projects with the use of computational intelligence. Further research should be conducted in the direction of developing tools for planning projects of digital transformation for rural communities.