

The Effectiveness of Network Systems in Providing Project Maturity of Public Management

Svitlana Bondarenko ¹, Oleksandr Halachenko ², Leonid Shmorgun ³, Iryna Volokhova ⁴, Alla Khomutenko ⁴, Valerii Krainov ⁵

¹ Department of Hotel, Restaurant and Tourist Business, Kyiv National University of Culture and Arts, Kyiv, Ukraine

² Department of Entrepreneurship and Management, Interregional Academy of Personnel Management, Kyiv, Ukraine

³ Department of Art Management and Event Technology, National Academy of Sciences in Ukraine, Kiev, Ukraine

⁴ Department of Finances, Odesa National Economic University Odesa, Ukraine

⁵ Research Laboratory of information technology issues The National Defence University of Ukraine named after Ivan Cherniakhovskiy, Kyiv, Ukraine

Abstract – The purpose of this study is formation of mechanisms to ensure the effectiveness of the created network systems in increasing the project maturity of public management. The relevance of this study is due to the need to address the problem of modernization of public administration by implementing project management in the implementation of development programs of territorial communities on the basis of continuous increase of the project maturity of organizations and network systems. The study proved the existence of a direct dependence of the level of project maturity with regard to public management on the effectiveness of the network systems. A variant of the project maturity model adapted to the local self-government body is being developed. This model distinguishes three levels of maturity of local governments.

The coefficient of self-organization of the network system is offered as a dynamic indicator of the development of project maturity.

Keywords – Network Systems, Effectiveness, Project Maturity, Public Management, Project, Project Management, Self-organization.

DOI: 10.18421/TEM101-34

<https://doi.org/10.18421/TEM101-34>

Corresponding author: Svitlana Bondarenko,
Kyiv National University of Culture and Arts, Kyiv, Ukraine.
Email: ana.bond@ukr.net

Received: 13 December 2020.

Revised: 29 January 2021.

Accepted: 03 February 2021.

Published: 27 February 2021.

 © 2021 Svitlana Bondarenko et al; published by UIKTEN. This work is licensed under the Creative Commons Attribution-NonCommercial-NoDerivs 4.0 License.

The article is published with Open Access at www.temjournal.com

1. Introduction

The latest technological paradigm has become the basis for the formation of a network structure in the organization of the economy and society, based on network information flows, network structures and network interaction. Under the influence of technological transformations, the economy spontaneously transforms into a network system, which is characterized by continuous flows that are capable of continuous renewal. A new "society of organizations" is emerging, and a dynamic meta-environment with numerous network groups is emerging in the economy [9], [10]. The current management model considers the development of the system as a result of the collaboration process, which involves government agencies, businesses, educational and scientific institutions, etc. [15].

The system of public administration, which is being transformed in the conditions of digitalization and network interaction of the participants of the administrative process, has to be effective in the direction of the implementation of socially significant projects. Instead, Ukraine is characterized by targeted diversity of existing regional programs. So far, a long-term register of such programs has not been created, there is no unified methodology for assessing the consequences of the implementation of such programs, and the sectoral state policy is poorly coordinated. Experience shows that regional authorities are mainly focused on addressing current issues. The main element of an effective system within government in Ukraine should be capable united territorial communities. Reforming the system of public administration, decentralization of power - require the search for the latest tools to ensure the capacity of local communities. Most responsibilities are gradually shifting from the state level to the local and regional levels. The problem for Ukraine is the lack of funds for the development of quality long-

term documents, insufficiently qualified staff, lack of mechanisms for partnership and co-financing in the implementation of projects under state regional territorial development programs. In Ukraine, a project approach is being implemented in the activities of public administration bodies. However, there are difficulties in adapting project management tools to domestic public administration. The reason, among other things, is the uncertainty in the categorical apparatus, the lack of a concept of project maturity in public management. The choice of the project maturity model will reveal the strengths and weaknesses of public authorities, assess the level of service quality, create a system of monitoring the effectiveness of processes, assess the readiness of local government to effectively manage and implement the project approach.

Therefore, the need to increase the project maturity of public management on the basis of mechanisms to ensure the effectiveness of established network systems has become relevant. The purpose of the study is to form mechanisms for ensuring the effectiveness of the created network systems in increasing the project maturity of public management. The main idea of the study is that the effectiveness of network systems is the main criterion for ensuring and qualitative changes in project maturity in public management. The condition for modernization of the public administration system is the integration of the principles of effectiveness of network relations in the project management with regard to the implementation of development programs of territorial communities on the basis of continuous increase of project maturity of organizations and network systems.

2. Theoretical Section

2.1. The Essence of Network Systems and Models of Maturity in Public Management

Scientists are actively searching for the ideal model of public administration. The concepts of public administration (new public management, political networks, good governance) are actively developing, which substantiate the need to form public administration on the basis of criteria regarding efficiency and effectiveness of public administration process in all its forms - economic, social, organizational [23].

The basic priorities of administrative reform are to increase the efficiency of the use of taxpayers' resources and the satisfaction of the latter with the quality of public services - public and municipal services [4]. The population acts as a "client of the state organization", a consumer who is given the right to choose. Customer orientation, as an element of a

market economy, puts forward the latest need to ensure the individualization of services, improve their quality and, consequently, the quality of public administration [7]. Openness of public administration begins to be combined with consumer orientation. Governance ceases are to be a key aspect of the state, of particular importance is the Government's processes of organizing interaction between the state and society to meet public interests [24].

There is a transition from traditional governance to government, which involves the transformation of the main institutional interactions in the public sector according to the criteria of efficiency and effectiveness of government institutions. Therefore, given the limited resources, the public sector has to ensure the consolidation of opportunities in strategically important areas of activity.

The following characteristics of government are [8]:

- 1) focus on measured results and output;
- 2) managerial instrumentalism, i.e. the development of public policy by the main ministries and departments, with the implementation of subordinate structural units;
- 3) integration of government, i.e. a high degree of coordination, coherence and coherence between different government agencies;
- 4) targeted approach in the activities of government agencies and services.

In the conditions of decentralization the expediency of application of the network approach in public management is actualized. The network model of public administration fully reflects the systemic approach, when instead of organizations and officials, inter-organizational and interpersonal relations come to the fore. In the implementation of the approach to local development with a focus on the community, a special role is played by a set of network systems, which include networks in the areas of public policy. The community has the right to control and dispose resources for the implementation of projects within the relevant community development programs. The condition for the implementation of such projects is the partnership of the united territorial community, business, local governments and local authorities at various levels, other national and foreign organizations [26].

The basis of the network system is a set of network interactions, which are built on the following principles:

- voluntariness, i.e. the freedom to choose a partnership to achieve the goals of each participant in the interaction, as well as the selected common goals and mutual benefits from cooperation;

- priority of relations, relying on relevant institutions to address issues of public administration;
- collegial decision-making to choose the vector of development of both the network system and each participant in such a system;
- congruence / coherence of actions based on the mechanisms of coordination of decisions, actions and the nature of relations between network partners;
- structuring activities and division of responsibilities to maximize the effectiveness and efficiency of processes.

The created network system in the development passes stages which are characterized by the corresponding mission, strategy, technological level of production, type of organizational architecture, competence of the personnel, etc. Development is the basis for the transition to a higher level, for each of which there is a Maturity Model (technological, design, process, organizational, etc.).

According to the definition of the International Organization for Standardization (ISO), the maturity model describes a set of elements that ensure the implementation of processes and opportunities for gradual improvement of their quality - to regulated mature processes of appropriate quality and efficiency (ISO / IEC / IEEE 24765: 2017).

To implement projects in public administration, the created network system has to acquire the appropriate level of project maturity [17], [1] and institutionalization of project management, according to the organizational context and strategies [29]. It is also important for the network system to acquire the maturity of an integrated management system [19].

Maturity models that have been tested in the corporate business sector are being actively implemented in the field of public administration and administration. For example, the Local Governmental Organizations of Greece implemented the Project Management Capability Model (PMCM) in order to implement local development projects [13]. The best practices of project maturity models used in the implementation of e-government were studied by Fath-Allah et al. [12].

Currently, about 30 maturity models and approaches to assessing maturity in public administration are known.

The most widely used are the following models:

- Capability Maturity Model for Software (SW CMM);
- Project Management Maturity Model (PMMM);
- Organizational Project Management Maturity Model (OP3M);
- Maturity Model for the Project-oriented Company (POC);

- Project Management Capabilities Maturity Model (PMCMM).

These models can become the basis for improving the existing model of maturity, i.e. compliance of public administration processes with the requirements of international standards. Such maturity models provide an opportunity to assess the current state of the system, choose adequate tools for staff training, create conditions for continuous improvement and implementation of capacity. Methods for estimating the level of maturity of specific systems for the selection of the vector for further improvement of the model and processes are considered by Mettler [21] and Helgesson et al. [14]. In public administration, an important point is to assess the maturity of project management in organizations using the model of maturity of project management processes. To select the model of design maturity of the network system it is necessary to evaluate:

- the degree of involvement of employees (network members) in the implementation of quality models;
- the nature and extent of changes in current activities within the organization and network system;
- the level of readiness and ability of the organization and network members to change as a result of the implementation of specific models of maturity.

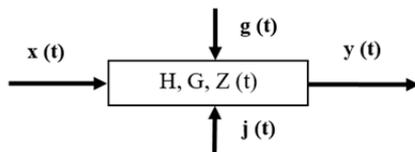
Levels of process maturity of different models have common features, their own characteristics of transitions to the next level of maturity: initial - repetitive - standardized - measured - continuous improvement - integrated. The highest level of maturity is the integrated level, which reflects the nature of integration into the internal processes of organization of supply chain management processes together with suppliers and customers. To improve and ensure the efficiency of public and private management systems, it is necessary to create conditions for combining separate standardized management systems into a single integrated management system (IMS) [18].

For public administration bodies of local self-government, the transition to a higher level of project maturity will eliminate the influence of the human factor. In terms of network interaction, the transition of public administration to a sufficiently developed level of project maturity will systematically ensure continuous improvement of the quality of administrative services, which directly depends on the quality of individual employees, members of organizations and networks. The effectiveness of the elements of the network interaction system depends on them.

3. Methodology

To achieve the goal of this study, a system of general scientific and special methods and approaches was used, in particular: general, general scientific, interdisciplinary and special research methods.

The project is an abstract complex system, the central chain of which is a unit that changes its state (Figure 1).



extract from the figure:

$Z(t)$ - possible state of the unit at any time t , state at a fixed point in time $t > t_0$, is determined by the previous state and management actions $Z_0, g(t)$ and $j(t)$ in accordance with the conversion operator H , according to the dependence $Z(t) = H[Z(t_0), g(t), j(t)]$. The unit has input contacts, which receive input signals $x(t)$, which, in accordance with the output operator G , converted into output signals $y(t)$: $y(t) = G[Z(t), x(t)]$.

Figure 1. The scheme of functioning of the project as a complex system

The basis of this study was the methodology of project cycle management in the public sphere for project management [28].

According to this methodology, project management processes form a project cycle, which consists of six stages: programming; identification; formulation; financing; implementation; evaluation and audit. Project Cycle Management (PCM) refers to the management processes and decision-making procedures used throughout the project life cycle and include, inter alia, the delineation of key objectives, the assignment of roles and responsibilities, the availability of basic documentation and the availability of decision options. Projects have to meet the objectives of a comprehensive strategy of all partners who create the network system. At the same time, projects should be developed on the basis of an agreed strategy and address the pressing issues of the target groups / parties, to meet the needs of which the projects are focused. Projects have to be realistic from a practical point of view, i.e. their objectives are considered achievable by constraints available in the implementation environment and the capabilities of the network system organizations involved in the implementation of projects. The results achieved within the projects must be sustainable.

PCM is focused on the active participation of stakeholders, i.e. all participants in the network system involved in the project in order to promote the

principle of local ownership. Stakeholder analysis involves identifying all stakeholders / organizations / institutions that may be affected by the proposed intervention (both positively and negatively), identifying and analyzing their interests, problems, potential, etc. [19]. The conclusions of such an analysis are then integrated into the project plan. Logical-structural analysis is used to implement PCM, as well as other tools for analysis / evaluation of key aspects (such as problems, goals and strategies). Based on this analysis, a set of safety indicators for project implementation is determined. Each stage in the project cycle includes the main criteria for assessing the quality of performance [6]. Key documents with sound information (i.e. those that contain common concepts and definitions) should be developed for each stage, on the basis of which informed decisions can be made [11], [20]. Such indicators further serve as indicators for assessing the effectiveness of the project, and hence the effectiveness of the created network system.

4. Evaluation and Analysis of Results

4.1. Characteristics of Project Maturity of State Management of the Ukraine

Decentralization reform in the Ukraine, which began in 2014, aims to create new opportunities to address the challenges of improving the quality of life of residents at the local government level. The formation of a network system of inter-municipal cooperation is based on the principle of pooling community resources [25] to ensure the performance of government functions in various areas: housing and communal services, landscaping, fire safety, education and health care. Forms of inter-municipal cooperation were the implementation of joint projects [27]. To do this, the network is coordinated by the central governing body. According to the Law of Ukraine "On Cooperation of Territorial Communities", the introduction of such a partnership has spread in the field of administrative services. For this purpose, administrative service centers have been established, which operate on the basis of cooperation agreements. According to official data, as of March 2019, 368 cooperation agreements were concluded, in particular in the areas of administrative services, collection and disposal of household waste, public utilities, education and medical services, etc. The success of project implementation at the level of territorial communities is ensured by the appropriate level of project maturity. To do this, according to the model of project maturity, the overall level of skill of organizations in the field of project activities is assessed. A variant of the project maturity model adapted to the local self-government body is being

introduced in Ukraine. This model distinguishes three levels of maturity of local governments: (1 - "starting", 2 - "level of basic standards", 3 - "level of managed methodology") with separate sub-levels (1+ - "starting advanced" and 2+ - "advanced" - level of basic standards "). Their characteristics are presented in Table 1.

Assessment of project management maturity is based on indicators in key areas: organizational, methodological, resource provision and project effectiveness. A system of indicators for each direction is being developed.

Table 1. Characteristics of the levels of project maturity of the network system for the implementation of development projects of territorial communities

No	Level name	Level characteristics
1	Start	Network members are generally aware of the importance of project management; there is a selective, usually unprofessional use of certain project management tools in their implementation; however, certain problems often arise and, as a result, there are deviations in terms and / or budget.
1+	Starting advanced	The network employs people who have an initial level of project literacy; special tools of project management are used, but there is a lack of consistency in project implementation, weak control
2	Level of basic standards	Formalization of project management processes is created; introduction of terminological apparatus, basic provisions, standards and tools of project management; the size and frequency of time and budget deviations are significantly reduced.
2+	Advanced level of basic standards	An organizational structure is created to coordinate the implementation of projects; special training for project management is carried out.
3	Level of managed methodology	Project management processes are clearly established; current methods and tools of project management are systematically used, their constant improvement and development is carried out; developed and maintained knowledge base - internal regulations / standards / instructions that summarize the requirements and practices of projects by their types and categories; there are successfully implemented projects, deviations in the cost and duration of projects are infrequent, their size is minimal.

The level of each direction is determined by the method of expert assessments.

For example, indicators are offered as indicators on the selected directions (table 2).

Table 2. System of indicators of project maturity of network system for realization of projects of development of territorial communities

Indicators	Level assessment (points from 1 to 5)				
	1	1+	2	2+	3
Organizational level					
1. Support for the development of project management by local governments of network participants	1	2	3	4	5
2. The largest number of project managers and a clear division of responsibilities between project participants	1	2	3	4	5
3. Regularity of the project team	1	2	3	4	5
4. The level of communication with project stakeholders	1	2	3	4	5
5. Organization of measures for monitoring and continuous improvement of project management	1	2	3	4	5
Methodological level					
6. Availability of project management methodology	1	2	3	4	5
7. Classification of projects by their types / types	1	2	3	4	5
8. Existence of a project management regulation / standard	1	2	3	4	5
9. Planning and control of project implementation deadlines	1	2	3	4	5
10. Planning and control of project resources and costs	1	2	3	4	5
11. Planning and control of project risks	1	2	3	4	5
12. Planning and control of volumes and quality of works on the project	1	2	3	4	5
Level of resource provision					
13. Availability of sufficient resources and the mechanism of their distribution between projects	1	2	3	4	5
14. Level of knowledge of employees in the field of project management	1	2	3	4	5
15. Training and advanced training of employees in the field of project management	1	2	3	4	5
16. The presence of a system of staff motivation for participation in project activities	1	2	3	4	5
17. Use of automated project management tools	1	2	3	4	5
The level of project effectiveness					
18. Frequency of deviations on projects on terms	1	2	3	4	5
19. Significance of deviations on projects on terms	1	2	3	4	5
20. The presence of financial losses due to violation of targets for project implementation	1	2	3	4	5
21. Frequency of budget deviations on projects	1	2	3	4	5
22. Significance of budget deviations on projects	1	2	3	4	5

According to the selected criteria, the created networks for the implementation of local government projects and the development of territorial communities can be attributed to the appropriate level of project maturity. Questionnaires are used to interview respondents. Based on expert evaluation, the assessment of the project maturity of the network is determined (minimum - 22 points, maximum - 110). Such a survey makes it possible to identify the most problematic areas in the functioning of the network and its ability to implement projects. To determine the quantitative ranges of scores that characterize each level of project maturity of the network, estimates of at least 2/3 of the indicators (15 of 22) have to correspond to the level (or exceed it) for which the lower limit of calculation is calculated, and the rest of the indicators estimates may correspond to the previous level of project maturity.

According to the selected criteria, the created networks for the implementation of local government projects and the development of territorial communities can be attributed to the appropriate level of project maturity. Questionnaires are used to interview respondents. Based on expert evaluation, the assessment of the project maturity of the network is determined (minimum - 22 points, maximum - 110). Such a survey makes it possible to identify the most problematic areas in the functioning of the network and its ability to implement projects. To determine the quantitative ranges of scores that characterize each level of project maturity of the network, estimates of at least 2/3 of the indicators (15 of 22) have to correspond to the level (or exceed it) for which the lower limit of calculation is calculated, and the rest of the indicators estimates may correspond to the previous level of project maturity.

For example, to achieve the second level of maturity, the network has to receive a score of 3 points on at least 15 indicators, and a score of 2 points on 7 indicators. In total we get 59 points, which corresponds to the lower limit of the second level of maturity (basic standards). Similarly, the lower quantitative limit for the third level (level of managed methodology) was calculated: 15 indicators of 5 points and 7 indicators of 4 points, which is a total of 103 points. Thus, taking into account the potential minimum and maximum results of evaluation by indicators (based on the questionnaire), as well as the minimum set values for each of the levels of maturity of project management, we obtained the following quantitative ranges: 1st level (starting) - estimated in the range of 15- 22 points; 1+ level (starting advanced) - is estimated in the range of 23 - 58 points; 2nd level (level of basic standards) - is estimated in the range of 59-66 points; 2+ level (advanced level of basic standards) - is estimated in the range of 67-102 points; 3rd level (sustainable

development) - is estimated in the range of 103-110 points.

To determine the level of maturity of project management, one has to first calculate the sum of points for each questionnaire, and then calculate the average score obtained on the basis of the survey for the entire set of questionnaires, and determine on the basis of the proposed ranges to which maturity levels it corresponds.

Thus, the model is dynamic, over time, these criteria may change, moving from a liberal approach to a more rigid, in accordance with the maturity of the created network systems. At each level of the model, the network systems of territorial communities are rated by a weighted sum of indicators. Spearman and Kendall coefficients are used to assess the difference between actual and normative ranks. Spearman's ratio takes into account differences in deviations:

$$p = 1 - 6 \frac{\sum_{i=1}^n d_j^2}{n(n^2-1)}; 1 \geq p \geq -1; \quad (1)$$

where

p - is the Spearman rank correlation coefficient;

n - number of ranks;

d_j^2 - the difference between the ranks on the basis of factor, Y_j and effective Y_j , otherwise $d_j = R_{x_j} R_{y_j}$.

The correlation coefficient takes values within ± 1 , ie $1 \geq \rho \geq -1$. The closer $\rho \rightarrow 1$, the greater the consistency between the test results. A negative value of ρ indicates the opposite consistency. Since the difference in scores can occur by chance, it is necessary to check the significance of the value of ρ with a certain level of probability $\rho \approx 0.95$ depending on the number of ranks n . The test is performed according to the corresponding table of critical values of Spearman's rank correlation coefficient. If the actual value of ρ is greater than the critical $\rho_{0,95}(n)$, ie $\rho > \rho_{0,95}(n)$, is considered significant, otherwise the relationship is random or the significance of the relationship is not proven. Kendall correlation coefficient is calculated by the formula:

$$\tau = 1 - 4 \frac{\sum_{i=1}^n m_s}{n(n-1)}; \quad (2)$$

where

τ - Kendall correlation coefficient;

n - the number of indicators included in the evaluation system;

m_s - is the sum of inversions Kendall correlation coefficientis, a tool for estimating the proximity of two series based on the calculation of inversions.

In this method, one variable is represented as a monotonic sequence in ascending order; the other variable is assigned the appropriate rankings. The number of inversions (monotonicity violations

compared to the first row) is used in the formula for correlation coefficients. The calculation of rank correlation coefficients allows to determine the indicator that integrates the volume (deviation estimate) and structural (inversion estimate) aspects of the network operation into a single estimate. This ratio is a tool for determining the stage of self-organization of the created network and, accordingly, the level of its balance and capacity to implement projects. According to the absolute value of this correlation coefficient, it is possible to draw a conclusion about the degree of connection.

The final estimate of K_s , obtained on the basis of two correlation coefficients (Spearman's and Kendall's coefficients) will be determined by the formula:

$$K_s = \frac{(1+p)(1+T)}{4}, \quad (3)$$

where K_s - is the coefficient of self-organization of the network system.

The Kendall and Spearman coefficients estimate the proximity of one rank series to another, the reference, in the range from +1 to -1. The result is equal to (+1) if the ranks of the pair of both series are located in the same sequence (i.e., when the compared order coincides with the reference). The negative value indicates the complete divergence of the directions of movement of the indicators of the reference and actual series.

The score K_s varies in the range from 0 to 1. The value of the coefficient equal to 1 indicates the coincidence of the actual and specified in the reference system of the order of indicators, when all the normatively established ratios of growth rates of indicators are actually met. This ratio is typical for the most effective level of design maturity of the network system. The closer K_s the value is to 1, the more the reference growth rate is followed. A value of 0 indicates the inefficiency of the network system, when the actual ratio of the indices of movement of the indicators contradicts the established reference.

On the basis of numerical interpretations of correlation coefficients accepted in statistics it is possible to estimate closeness of development of two modes of activity: actual and reference. Management influence is aimed at the possibility of the network system to achieve a certain state of equilibrium.

The ratio of self-organization processes and managerial influences depends on the value K_s as follows: with increasing correlation increases the level of self-organization of the network system, which is a positive indicator in the development of project maturity and ability to operate effectively in projects.

Each stage of the process of self-organization corresponds to a certain value of the coefficient K_s , which is a dynamic indicator. This indicator can be a

criterion for assessing the effectiveness of the network system, i.e. its ability to implement projects. Accordingly, increasing the rate of self-organization is a criterion for increasing the level of design maturity of the network system.

Approbation of the proposed method of assessing the design maturity of network systems in the development of territorial communities of Ukraine showed the following results [22]. Territorial communities of Ukraine in the number of 56 united territorial communities became participants of the survey. The largest number of communities is Dnipropetrovsk region (78%), Odessa region (15%) and Zaporizhia region (7%). All respondent communities were located at two levels of the project maturity model - the first (57%) and the second (43%); no united territorial community reached the third level. All four areas of project maturity assessment are problematic. Especially with regard to the qualification of personnel in project management, the functions of project management are not developed, insufficiently reflected and enshrined in the provisions on structural units and job descriptions of staff and a very low methodological level. Lack of practical experience in project development and implementation, work in project teams, etc. Therefore, the introduction of project management in public administration should be preceded by significant preparatory work and the creation of special network structures for the implementation of such projects

4.2. Modeling the Balance of the Network Systems

The condition for the effective functioning of the network system is its network maturity. This state, the network system acquires over the time, provided that the goals and strategies of network participants are consistent. Readiness for network interaction determines the nature of the effectiveness of future network systems. According to the Global Connectivity Index, Ukraine ranks 50th among 79 countries. The Global Connectivity Index measures performance on 40 indicators to track the impact of information and communication technologies (ICTs) on the national economy, digital competitiveness and future growth. Network interaction in public administration has its own specifics and is associated with the implementation of tasks to manage the development of the local community, the implementation of various projects and quality assurance of administrative services - improving the lives of the population. A characteristic feature of network interaction is the potential for each member of the organizational system to act as a center or agent, or both as a center and as an agent (when interacting with different participants) [2].

The network system is a graph $G(N, E)$ in which $N = \{1, 2, \dots, n\}$ - a set of vertices (agents), and E - a set of edges that reflect the interaction of agents (Fig. 2).

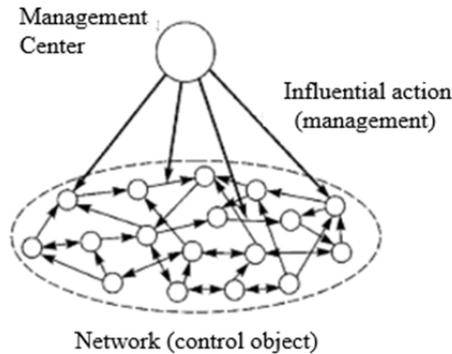


Figure 2. The network system as an object of the managerial influence in the public administration

The following factors are important for determining the nature of network interaction: awareness, communication and coordination [3]. The following approaches of qualitative estimation of network system are allocated: structural, resource, normative, and dynamic [16].

In the structural approach, all network participants are represented as the top of the graph, which reflects their influence on the configuration of the edges and other network participants. The shape of the network, the intensity of interactions (weight of the ribs) is important. When forming a network system, for example, a territorial community, within which there will be active interaction of participants, it is necessary to differentiate the network based on the behavior and nature of the connections between the vertices.

The resource approach considers the possibilities of participants to attract individual and network resources to achieve certain goals, with the differentiation of participants who are in identical structural positions of the network in terms of resource potential. Using the resource potential of network participants will significantly improve the quality of defining the goals and objectives of clustering and classification.

The normative approach is important for the formation of trust between participants, as well as norms, rules and sanctions that affect the behavior of network participants during the implementation of processes to ensure their interaction and its consequences. Here it is important to model the nature and extent of influences, their distribution and so on.

The dynamic approach reflects changes in the network structure over time: the composition of network members, types of connections, the nature of interaction, the structure of networks as a whole and

in individual communities. It is important to identify patterns and the nature of long-term changes in the network, the nature of network configurations, their development.

Decision-making is based on the concept of equilibrium [23].

When forming a network system, each of the participants has its own strategy and vision for the benefits of participating in the network. If we take as a basis the main strategy - sustainable development (economic, environmental and social goals), then we can assume that the choice of strategy is related to improving the quality of their own functioning on these three components: $x_i \in X_i \in R^{n_i}$, $x_i \in X_i \subseteq R^{n_i}$, ie each participant considers their gain as:

$$x = (x_1, x_2, x_3) \in X_1 \times X_2 \times X_3 = X \in R^3, \\ x = (x_1, x_2, x_3) \in X_1 \times X_2 \times X_3 = X \subseteq R^3.$$

Equilibrium [23] :-

$(x^B, f^B = (f_1(x^B)), f_2(x^B), f_3(x^B))) \in X \in R^3$ is determined:

$$f_1(x^e) \max_{x_1 \in X} f_1(x_1, x_2^e, x_3^e) \\ f_2(x^e) \max_{x_2 \in X_2} f_2(x_1^e, x_2, x_3^e) \\ f_3(x^e) \max_{x_3 \in X_3} f_3(x_1^e, x_2^e, x_3) \tag{4}$$

As can be seen from (4), the control system of each individual agent seeks to achieve its own goals, which is a natural phenomenon in the absence of interaction and common interests. Equilibrium is possible only if the strategy of all participants changes in the formation of a network system based on the interaction of interests and goals.

Equilibrium in the interaction of agents

$(x^B, f^B = (f_1(x^B)), f_2(x^B), f_3(x^B))) \in X \in R^3$ determined [5] :

$$f_1(x^B) \max_{(x_2, x_3) \in X_2 \times X_3} f_1(x_1^B, x_2, x_3^e) \\ f_2(x^B) \max_{(x_1, x_3) \in X_1 \times X_3} f_2(x_1, x_2^B, x_3) \\ f_3(x^B) \max_{(x_1, x_2) \in X_1 \times X_2} f_3(x_1, x_2, x_3^B) \tag{5}$$

As can be seen (5), in the formation of a network system, each player (control system) seeks to increase the winning functions of the other two, i.e. to improve the quality of their operation. In the situation of equilibrium (5) the characteristics of individual rationality are not traced, and the winnings of players in some situations exceed the situation of equilibrium (4). In this sense, network interaction brings additional tangible effects to all participants in the interaction.

Network analysis uses an indicator that reflects the degree of proximity of the position between different actors in the network. In addition to determining the functional and role positions of network participants,

it also determines the range of actors who have access to important network resources through external contacts, which is of strategic importance for improving the efficiency and effectiveness of the network structure. A network is heterogeneous if it consists of a large number of participants involved in multiple interstructural contacts, which expands the vision and understanding of the problem and ensures the attraction of new valuable resources.

The task of each i -th player is to choose a strategy that $x_i \in X_i$ which allowed to achieve the greatest possible gain - values $f_i(x, y)$. In this case, each player has to take into account the implementation of any unpredictable uncertainty $y \in Y$.

Participants of the network system are business structures of territorial communities, authorities, public organizations, the population. The main source of resources are business structures. To create a model of a network system for the implementation of community development projects, two variables are used, for business entities and for municipal authorities:

$E(t)$ - the number of participants in the network system in the time period; t

$G(t)$ - resources of municipal authorities, which are directed to the formation and maintenance of a favorable configuration of the network system.

For the resources allocated by the authorities for the formation and maintenance of the network system (G), the equation will look like this:

$$G = \lambda_0(E) \left(1 - \frac{E}{l}\right) gE \quad (6)$$

where

λ_0 - the rate of taxation of income of business structures, taking into account tax benefits (relative value);

g - average unit costs for maintaining a favorable business environment per business structure (cost units).

For each territorial community there is a threshold value l_{max} , which is determined by the resource potential of the territory.

Accordingly, the function $l(G)$ can be represented as follows:

$$l(G) = l_0 \left(1 + s \frac{G}{g_0 + G}\right) \quad (7)$$

where

l_0 - business capacity of entrepreneurship, in the absence of unreasonable non-market intervention by public authorities (units);

S - the maximum possible increase in the number of business structures, with positive profitability with unlimited resources (relative value); l

g_0 - an indicator that indicates how l it depends on G (relative increase l with increasing G from zero

g_0 to is $S/2$).

The parametric model of network system development, based on the formation of a favorable business environment of the territorial community, will look like this:

$$\begin{cases} E = wE \left(1 - \frac{E}{l(G)}\right) \\ G = E \left(1 - \frac{E}{l(G)}\right) lE \\ l(G) = 1 + s \frac{G}{g_0 + G} \end{cases} \quad (8)$$

The model will make it possible to calculate the parameters of the network system. This will contribute to the adoption of rational management decisions on the most effective and efficient maintenance of appropriate conditions for the development of the network system, which will increase the level of project maturity in the future.

5. Conclusion

In this study the main aspects of formation of mechanisms of maintenance with regard to efficiency of the created network systems in increase of project maturity of state management are considered. The existence of a direct dependence of the level of project maturity of public management on the effectiveness of network systems is proved. A variant of the project maturity model adapted to the local self-government body in the conditions of Ukraine has been developed and is being implemented. The model assumes three levels of maturity of local governments. It is established that the majority of the created united territorial communities in Ukraine are characterized by the first two levels of maturity. The analysis shows that the most problematic aspects in the implementation of project management at the level of development of territorial communities for Ukraine are the qualifications of personnel in project management, organizational and institutional aspects of project management, low methodological level, lack of practical experience in project development and implementation, etc. The coefficient of self-organization of the network system is offered as a dynamic indicator of the development of project maturity. This indicator can be a criterion for assessing the effectiveness of the network system, i.e. its ability to implement projects. Accordingly, increasing the rate of self-organization is a criterion for increasing the level of design maturity of the network system. Determining the level of self-organization of the network system in the implementation of projects for the development of united territorial communities can be used as a direction for further research. This indicator can be a

criterion for assessing the effectiveness of the network system, i.e. its ability to implement projects. Accordingly, increasing the rate of self-organization is a criterion for increasing the level of design maturity of the network system. Determining the level of self-organization of the network system in the implementation of projects for the development of united territorial communities is also the direction for further research. This indicator can be a criterion for assessing the effectiveness of the network system, i.e. its ability to implement projects. Accordingly, increasing the rate of self-organization is a criterion for increasing the level of design maturity of the network system. Determining the level of self-organization of the network system in the implementation of projects for the development of united territorial communities is as well the direction for further research.

References

- [1]. Backlund, F., Chronéer, D., & Sundqvist, E. (2014). Project management maturity models—A critical review: A case study within Swedish engineering and construction organizations. *Procedia-Social and Behavioral Sciences*, 119, 837-846.
- [2]. Bakulina, O., Lehan, I., & Bakhov, I. (2019). Cluster associations as a factor of innovative and integrative development of the economy. *International Journal of Innovative Technology and Exploring Engineering*, 8(10), 2249-2255.
- [3]. Begma, V. M., Lutsik, J. O., Skurinevska, L. V., Tkach, I. M., Trehubenko, S. S., & Ulianov, K. Y. (2019). Events identification and risks evaluation in the process of planning of risk-oriented internal audit. *Espacios*, 40(38), 15-15.
- [4]. Behn, R. D. (2001). *Rethinking democratic accountability*. Brookings Inst Press.
- [5]. Berge, C. (1954). Sur une convexité régulière non linéaire et ses applications à la théorie des jeux. *Bulletin de la Société Mathématique de France*, 82, 301-315.
- [6]. Bondarenko, S., Ivanchenkova, L., Okhrimenko, O., Zybarena, O., Karpitskaya, M., & Huz, M. (2020). Risk Management of Enterprise Restructuring Strategy. *International Journal of Advanced Research in Engineering and Technology (IJARET)*, 11(5).
- [7]. Bozeman, B., & Straussman, J. (1991). *Public Management Strategies: Guidelines for Managerial Effectiveness*. San Francisco, CA: Jossey-Bass, Inc., 264 p. <https://doi.org/10.1002/pam.4050100315>
- [8]. Considine, M. (1988). The corporate management framework as administrative science: A critique. *Australian Journal of Public Administration*, 47(1), 4-18.
- [9]. Danylyshyn, B., Bondarenko, S., Malanchuk, M., Kucherenko, K., Pylypiv, V., & Usachenko, O. (2019). Method of real options in managing investment projects. *International Journal of Innovative Technology and Exploring Engineering*, 8(10), 2696-2699.
- [10]. Drucker, P. F. (1993). *The society of organizations*/Peter F. Drucker. *Post-Capitalist Society.—Elsevier Ltd*, 43-60.
- [11]. Dykha, M., Cheban, Y., Bilyk, O. I., Siryk, Z. O., Khytra, O., & Dudnyk, A. (2020). Management of Corporate Social Activity in the Organization. *International Journal of Management*, 11(5).
- [12]. Abdoullah Fath-Allah, A., Cheikhi, L., Al-Qutaish, R. E., & Idri, A. (2015). E-Government Portals Maturity Models: A Best Practices' Coverage Perspective. *JSW*, 10(7), 805-824.
- [13]. Fitsilis, P., & Chalatsis, T. (2014) Adoption of Project Management. *Practices in Public Organizations Business*, 6(3), 131-142.
- [14]. Helgesson, Y. Y. L., Höst, M., & Weyns, K. (2012). A review of methods for evaluation of maturity models for process improvement. *Journal of Software: Evolution and Process*, 24(4), 436-454.
- [15]. International Organization for Standardization (2020). Retrieved from: <https://www.iso.org/home.html> [accessed: 15 November 2020].
- [16]. Provan, K. G., & Kenis, P. (2008). Modes of network governance: Structure, management, and effectiveness. *Journal of public administration research and theory*, 18(2), 229-252.
- [17]. Kerzner, H. (2002). *Strategic planning for project management using a project management maturity model*. John Wiley & Sons.
- [18]. Kerzner, H. (2015). *Project management 2.0: leveraging tools, distributed collaboration, and metrics for project success*. John Wiley & Sons.
- [19]. Khomutenko, A., Mishchenko, A., Ripenko, A., Frum, O., Liulchak, Z., & Hrozovskyi, R. (2019). Tools of the neuro-fuzzy model of information risk management in national security. *International Journal of Engineering and Advanced Technology*, 8(6), 4526-4530.
- [20]. Kuznetsov, A., Smirnov, O., Gorbacheva, L., & Babenko, V. (2020). Hiding data in images using a pseudo-random sequence. In *CEUR Workshop Proceedings* (Vol. 2608, pp. 646-660).
- [21]. Mettler, T. (2011). Maturity assessment models: a design science research approach. *International Journal of Society Systems Science*, 3(1-2), 81-98.
- [22]. Model of project maturity of hromadas first presented for AHs of Dnipropetrovsk Oblast. Retrieved from: <https://decentralization.gov.ua/en/news/8746.amp> [accessed: 20 November 2020].
- [23]. Nash, J. (1953). Two-person cooperative games. *Econometrica: Journal of the Econometric Society*, 128-140.
- [24]. Osborne, D. (1992). Gaebler. T.: *Reinventing Government: How the Entrepreneurial Spirit Is Transforming the Public Sector*. New York: Addison-wesley Publishing Co.
- [25]. Romanenko, Y. O., & Chaplay, I. V. (2016). Marketing communication system within public administration mechanisms. *Aktual'ni Problemy Ekonomiky=Actual Problems in Economics*, (178), 69.

- [26]. Seryogin, S.M., & Chikarenko, I.A. (2019). Decentralization of power in Ukraine: evaluation of the results of formation and development of self-sufficient communities. Dnipro, Ukraine, 292.
- [27]. Sudomyr, S., Niziaieva, V., Lutay, L., Prodanova, L., Havryliuk, O., & Sherstyukova, K. (2020). Methods and Techniques Of Motivation of Subjects of Regional Economy for Innovative Improvement. *International Journal of Scientific & Technology Research*, 9 (3), 1196-1200.
- [28]. Komadinić, V. R., & Majstorović, V. D. (2017). Maturity model of integrated management system. *International Journal of Advanced Quality*, 45(3), 47-50.
- [29]. Viana, J. C., & Mota, C. M. D. M. (2016). Enhancing Organizational Project Management Maturity: a framework based on the value focused thinking model. *Production*, 26(2), 313-329.