

## INNOVATIVE DEVELOPMENT OF ENTERPRISES IN THE CONTEXT OF DIGITAL TRANSFORMATIONS OF THE INSTITUTIONAL ENVIRONMENT OF THE NATIONAL ECONOMY

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### Abstract

The dynamic evolution of the market environment causes a violation of the institutional balance and the appearance of disproportions between the existing model of the functioning of industrial enterprises and the current state of the economy. This determines the relevance of the innovative development and institutional changes mutual influence study in the conditions of the national economy digitalization. The purpose of the article is to study the theoretical aspects of the enterprises' innovative development in the context of digital transformations of the institutional environment. The authors proposed a methodology for calculating a complex indicator of enterprises' innovative development. The basis of the calculation method is the allocation of the following blocks: block of personnel and competence potential, block of innovative potential and block of economic potential. Each of them includes a number of indicators reflecting the general level of innovative development of the enterprise. The practical application of the developed methodology for calculating the complex index of enterprise' innovative development in the conditions of digital transformations of the institutional environment will contribute to the identification of problems that prevent the transition of the enterprise to a management model built on the principles of digitalization.

**Keywords:** *innovative development, enterprise, institutional environment, industrial sector, digital economy, digital transformations, national economy.*

**JEL Codes:** *E5, V21, L26, O31, O33.*

### Introduction

The digital economy is a priority factor necessitating the transformation processes of the industrial production and innovative development of enterprises. It dictates the conditions for the transition to a new model of

the industry's development, which is associated with a change in the evolution of its social and economic institutions, the logic of business processes, mechanisms of communication between business entities, and approaches to the

production organization. As a result of these changes, the basic conditions for ensuring the competitiveness of enterprises are changing, namely, the innovative potential and its digital component begin to play an important role in achieving the competitive advantage.

At the same time, the dynamic evolution of the market environment causes a violation of the institutional balance and the appearance of the disproportions between the existing model of the functioning of industrial enterprises and the current state of the economy. This determines the relevance of the study of the mutual influence of the innovative development and institutional changes in the conditions of digitalization of the national economy.

The purpose of the article is to study the innovative development of enterprises in the context of digital transformations of the institutional environment.

### **Literature review**

The COVID-19 pandemic and its impact on the socio-economic development of any country demonstrates that only the innovative component of all economic sectors is the main source of economic and social growth, which generally contributes to increasing the level of competitiveness of goods and services (Socoliuc et al. (2022); Grosu et al. (2019)). In this way, issues of qualitative and comprehensive assessment of innovative potential also become relevant (Marhasova et al. (2023)). It is well known that the economy of the developed countries of the world is oriented towards innovation, through the relations of science, industry and society (Butko et al. (2021)).

The study of the mutual impact of the digital transformation of the institutional environment and the innovative development of enterprises is quite new for economic science, which is due to the relatively short time of the formation of the digital economy (Grigoraş-Ichim et al. (2018); Nikiforov et al. (2022)). The analysis of developments in this

area allows us to conclude that thanks to the development of economic science, the research of the foundations of the digital economy is based on an institutional approach (Djakona et al. (2021)).

Most of the works of scientists (Melnyk et al. (2021); Zhavoronok et al. (2022)) in this direction are devoted to the study of individual institutions and the impact of digital technologies on the institutional environment. The main range of research is represented by the justification of the importance of institutional changes in the conditions of the digital economy, the study of institutional traps and the institutional structure of the digital economy.

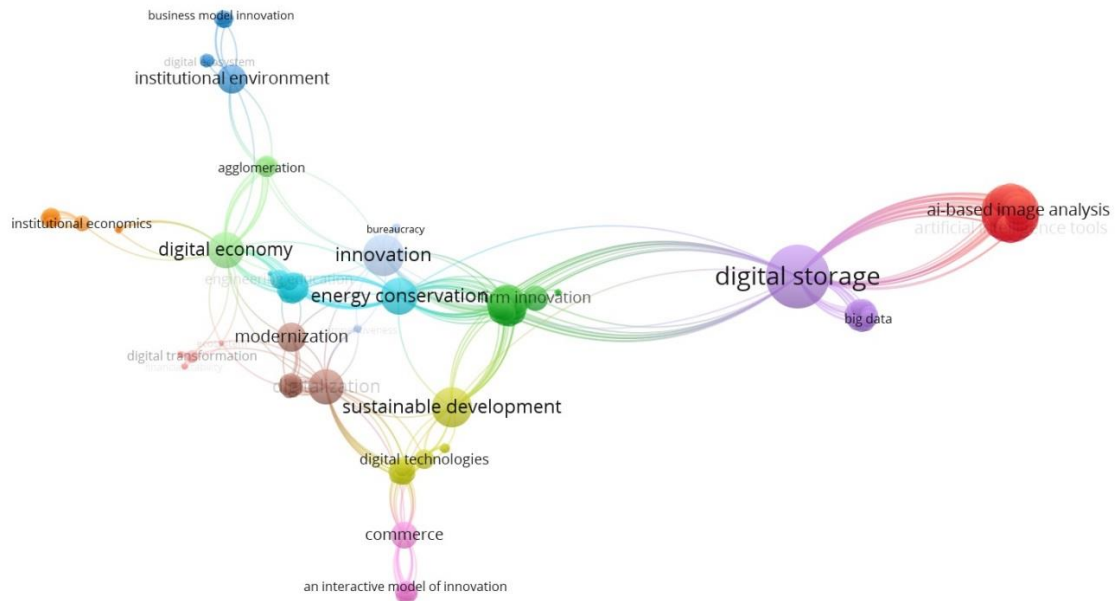
The meta-analysis of relevant scientific studies on this issue in the highest-rated scientific database Scopus (Fig. 1) once again proves the relevance of the topic, since the first scientific work was published in 2006, the following dynamics of publication activity were as follows: 2013 - 5 articles, 2017 - 1 article, 2019 - 2 articles, 2020 - 8 articles, 2022 - 7 articles, 2023 - 4 articles. China, Ukraine, United Kingdom, Austria and Brazil have become world centers of research on this issue.

Focusing on the market, innovations determine the long-term competition of the enterprise (Zybareva et al. (2023)). In turn, business entities react differently to market changes:

- form a two-level management, where top management makes long-term policies, and line managers deal with current management (Zhang and Li (2022); Pysmak et al. (2021));

- are engaged in bringing the organizational structure to innovative reactions, due to specialized departments that focus on innovative areas, and divisions that manage current activities (Grosu et al. (2021));

- small innovative forms of business are created at large enterprises (Tulchynska et al. (2022)).



**Figure 1. Visualization map of the relationship between keywords in scientific publications, in the title of which the words “innovative development”, “enterprises”, “digitalization” and “institutional environment” are met**

*\*Source: compiled by the authors based on information from the Scopus database using VOSviewer tools.*

At the same time, the study of changes in the institutional environment and structure of institutions under the influence of digitalization and the relationship of these processes with the activation of innovative development is of sufficient interest under modern transformational conditions.

### Methodical approach

The theoretical and methodological basis of the research is the dialectical method of cognition, the conceptual provisions set forth in the works of domestic and foreign scientists on the issues of introducing innovations and ensuring innovative development in the context of the development of the digital economy and changes in the institutional environment. In the process of writing the article, the following methods were used: dialectical and structural-logical - to build the logic and structure of the research, to form theoretical ideas about the essence of the innovative development and institutional transformations; analysis and synthesis - to

determine the features of the innovative development of industrial enterprises; abstraction and specification - to identify the main factors of change in the institutional environment, systematization and classification - in the study of the main factors in the change of the institutional environment, economic and statistical analysis - in the study of the dynamics of the innovative development of enterprises, graphic - in the analysis of the innovative development of enterprises and the presentation of the obtained results, index - when developing the methodology for calculating the complex index of the innovative development of the enterprise. The official data of the State Statistics Service of Ukraine, the results of the survey of the innovative activities of enterprises, scientific literature, and personal observations of the authors became the information base of the research. The analysis of developments in this area allows us to conclude that thanks to the development of economic science, the research of the foundations of the digital economy is based on an institutional approach.

The impact of crisis processes and the need to the transition to an innovative model of development increase the urgency of developing new approaches to the assessment of innovative development of enterprises. At the same time, despite a sufficiently large number of approaches to the assessment of the innovative development of the enterprise, there is no single approach to the assessment of the comprehensive index of the innovative development of the enterprise. This indicator makes it possible to take into account the indicators characteristic of the digital economy and to draw the conclusions about the available necessary conditions at the enterprise for the implementation of changes due to digitalization. The originality of the proposed

method of calculating the complex index of the innovative development of enterprises lies in the fact that it combines the main existing approaches to assessing the innovativeness level of a manufacturing enterprise as an element of the national economy.

Having analyzed the existing approaches and identified the positions that require refinement, we offer a method for calculating the complex index of the innovative development based on the selection of the following blocks (Table 1). Each of them includes a number of the indicators reflecting the general level of the innovative development of the enterprise.

**Table 1. System of the indicators of the complex index of the innovative development of the enterprise**

<b>№</b>	<b>Indicator</b>	<b>Marking</b>
<b>Personnel and competence potential</b>		
1	Specific weight of employees with higher education, %	X <sub>11</sub>
2	Specific weight of employees with a scientific degree, %	X <sub>12</sub>
3	Specific weight of employees engaged in research and development in the average number of employees, %	X <sub>13</sub>
4	Specific weight of employees with digital competences in the average number of employees, %	X <sub>14</sub>
<b>Economic potential</b>		
5	Specific weight of investments in fixed capital in the total amount of investments, %	X <sub>21</sub>
6	Specific weight for research and development in the total amount of expenses, %	X <sub>22</sub>
7	Depreciation rate of fixed assets, %	X <sub>23</sub>
8	Specific weight of units using electronic document management in the total number of structural units, %	X <sub>24</sub>
9	Specific weight of costs for technological innovations in the total volume of shipped goods, performed works and services, %	X <sub>25</sub>
<b>Innovative potential</b>		
10	Specific weight of innovative goods, works, services in the total volume of shipped goods, completed works and services, %	X <sub>31</sub>
11	Number of received patents, units	X <sub>32</sub>
12	Number of implemented new technologies, units	X <sub>33</sub>

\*Source: developed by the authors.

Let's consider the calculation algorithm in more detail.

1. The values of the corresponding indicators X<sub>ij</sub> are calculated for each block.

2. The values of the sub-indices for each of the thematic blocks are calculated according to the arithmetic mean formula:

$$I = 1/n \sum_{i=1}^n \frac{x_{ij} - x_{ij\min}}{x_{ij\max} - x_{ij\min}} \quad (1)$$

where *I* – innovative development index for the relevant block;

*n* – number of indicators in the thematic block;

*X<sub>ijmin</sub>* - lowest value of the indicator for all analyzed enterprises;

*X<sub>ijmax</sub>* - largest value of the indicator.

3. After calculating the sub-indices for each block, the integral index of the innovative

development of the enterprise is calculated according to the following formula:

$$I_{com} = n_{pcp} / N \cdot I_{pcp} + n_{ep} / N \cdot I_{ep} + n_{ip} / N \cdot I_{ip} \quad (2)$$

where  $I_{com}$  – comprehensive index of the innovative development of the enterprise;

$I_{pcp}$ ,  $I_{ep}$ ,  $I_{ip}$  – subindex value of the innovative development of the enterprise for each thematic block;

$n_{pcp}$ ,  $n_{ep}$ ,  $n_{ip}$  – number of indicators in each thematic block;

$N$  – total number of indicators for calculation.

To ensure an equal contribution of the selected indicators to the final value of the comprehensive index of the innovative development of the enterprise, the weighting coefficients of sub-indices of thematic blocks are calculated as a distribution share of the number of indicators used in the calculation of each sub-index of the thematic block by the total number of indicators of the innovative development used in the calculation. According to the considered method, the maximum possible value of the index is equal to 1, and therefore, the higher the obtained value, the higher the innovative development level of this enterprise.

## Results

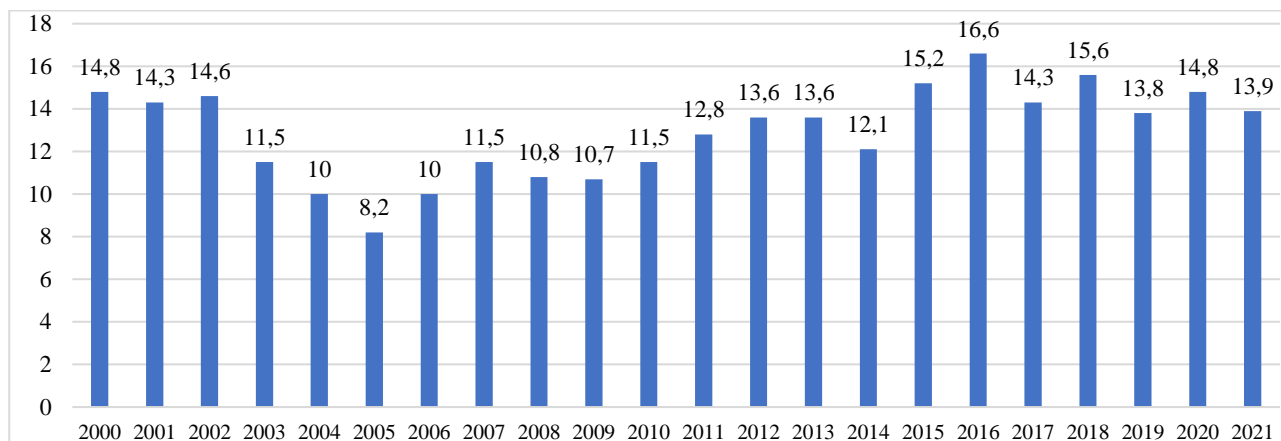
The formation and specifics of the digitalization development in Ukraine takes place depending on the state of the institutional environment. According to the institutional approach as one of the main ones in economic theory, the institutional environment is understood as "a set of basic political, social and legal rules that form the basis for production,

exchange and distribution. Some researchers view the institutional environment as a set of the fundamental social, political, and economic rules that constrain human behavior. At the same time, the decisive place in the interaction of formal and informal institutions should be given to the state, which task should be to optimally combine them for the effective functioning and development.

The accumulated volume of problems forms the so-called leffectiveness limit of the organizational and economic model of the industrial enterprise functioning, which is manifested by the following characteristics:

- constant and dynamic expansion of the subject and object of the necessary changes in the enterprise management;
- limitation of the spectrum of the tactical management solutions for leveling the problems of the enterprise functioning;
- systematic decrease in the dynamics of technical and economic indicators of the activity of industrial enterprises and industrial production of the country as a whole.

We will analyze the innovative development of the industrial sector of the Ukraine's economy. According to the analysis of the specific weight of the number of enterprises that introduced innovations in the total number of enterprises, the industry is characterized by low indicators of the innovative development. Thus, for the period from 2000 to 2021, the lowest value of the indicator was observed in 2005 – 8.2%. During the last decade, this indicator reached its highest value in 2016 – 16.6% compared to 2020, the indicator value decreased by 0.9% in 2021 (Fig. 2).

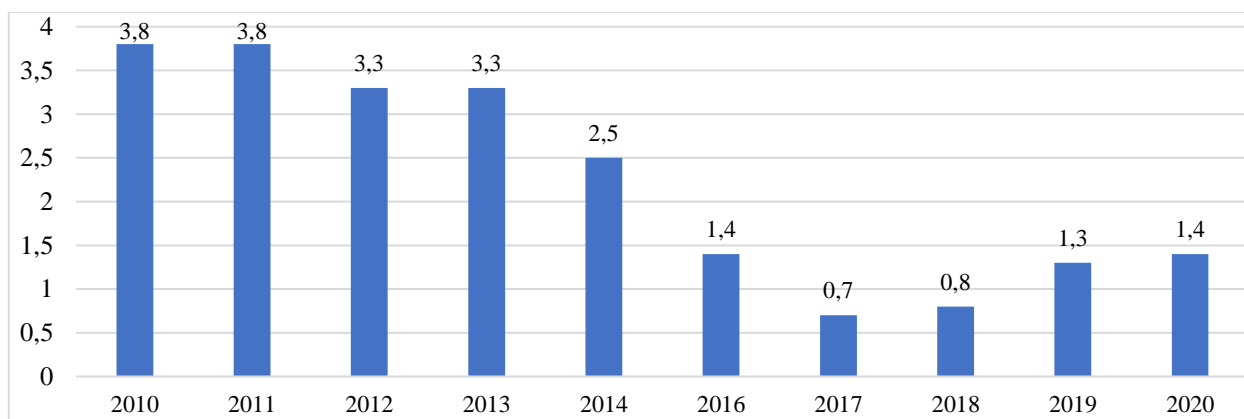


**Figure 2. Dynamics of the specific weight of the number of enterprises that introduced innovations in the total number of industrial enterprises**

*\*Source: compiled by the authors based on the data of the State Statistics Service of Ukraine.*

The analysis of another indicator - the percentage of the implemented innovative industrial products to the total volume of the sold industrial products - also indicates a low level of the innovative development of

domestic industrial enterprises. Thus, since 2010, the indicated indicator had a downward trend and in 2020 amounted to 1.4% compared to 3.8% in 2010 (Fig. 3).



**Figure 3. Dynamics of the specific weight of the sold innovative products in the total volume of sold products**

*\*Source: compiled by the authors based on the data of the State Statistics Service of Ukraine.*

Let's consider the practical use of this methodology on the example of four enterprises, namely the Private Joint-Stock Company "KREDMASH", Limited Liability Company Industrial Company "POZHMACHINA" (Pryluky), Public Joint-Stock Company "Poltava

Ventilating Plant" and Public Joint-Stock Company "Kryukov Railway Car Building Works" (PJSC "KRCBW") (Kremenchuk). According to the proposed algorithm, we will calculate the values of the corresponding indicators  $X_{ij}$  for each enterprise (Table 2).

**Table 2. Initial data for the calculation of the comprehensive index of innovative development of enterprises**

Indicator	PJSC “Kredmash”	PJSC “Pozhmachina”	PJSC “PVZ”	PJSC “KRCBW”
Specific weight of employees with higher education, %	59	70	64	76
Specific weight of employees with a scientific degree, %	5	3	1	0.8
Specific weight of employees engaged in research and development in the average number of employees, %	14	8	9.3	10.8
Specific weight of employees with digital competences in the average number of employees, %	69.4	80.6	83.9	94.2
Specific weight of investments in fixed capital in the total amount of investments, %	74.6	68.0	56.9	58
Specific weight for research and development in the total amount of expenses, %	21.8	18.9	9.4	14.1
Depreciation rate of fixed assets, %	18.1	16.8	28.1	34.8
Specific weight of units using electronic document management in the total number of structural units, %	97.1	98.4	97.9	98.9
Specific weight of costs for technological innovations in the total volume of shipped goods, performed works and services, %	11.5	8.6	5.4	7.3
Specific weight of innovative goods, works, services in the total volume of shipped goods, completed works and services, %	1.3	0.9	1.05	0.93
Number of received patents, units	2	-	1	3
Number of implemented new technologies, units	4	2	1	3

\*Source: calculated by the authors according to enterprise reporting.

The next stage will be the calculation of sub-indices for each block of indicators. Calculation data are given in Table 3.

**Table 3. Sub-indices by blocks of innovative development indicators**

№	Name of the index	PJSC “Kredmash”	PJSC “Pozhmashina”	PJSC “PVZ”	PJSC “KRCBW”
1	Index of the innovative development by block “Personnel and competence potential”	0.6	0.41	0.57	0.65
2	Index of the innovative development by block “Economic potential”	0.76	0.83	0.77	0.74
3	Index of the innovative development by block “Innovative potential”	0.84	0.71	0.7	0.83
4	Comprehensive index	0.72	0.67	0.69	0.73

\*Source: calculated based on company data.



We will calculate the complex index of the innovative development of enterprises according to the formula (2):

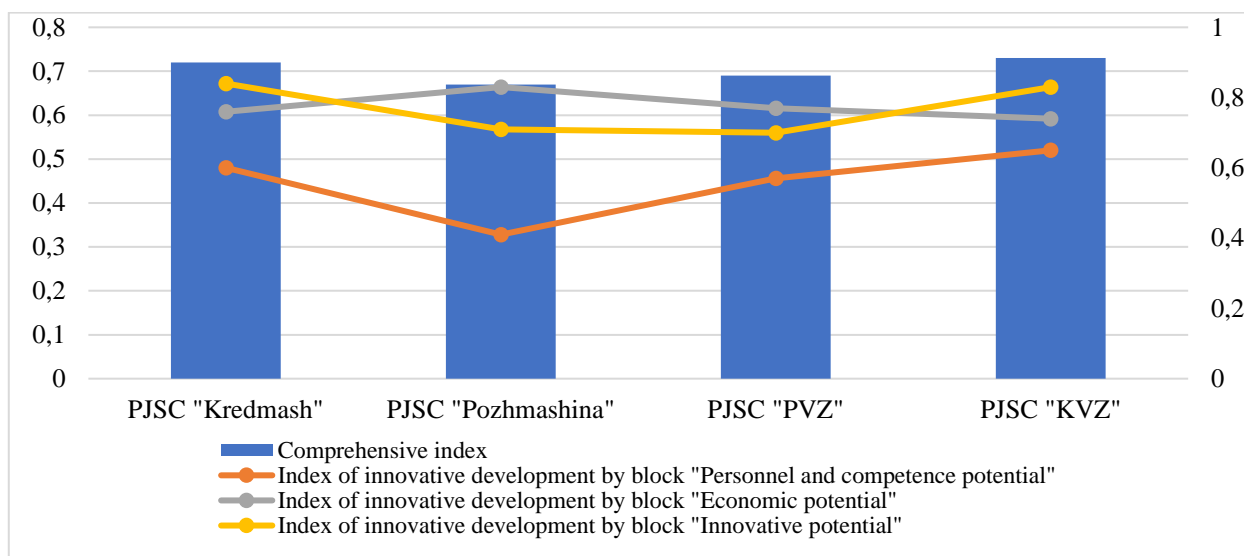
$$\text{PJSC "Kredmash": } I_{\text{com}} = 4/12 \cdot 0.6 + 5/12 \cdot 0.76 + 3/12 \cdot 0.84 = 0.72$$

$$\text{PJSC "Pozhmashina": } I_{\text{com}} = 4/12 \cdot 0.41 + 5/12 \cdot 0.83 + 3/12 \cdot 0.71 = 0.67$$

$$\text{PJSC "PVZ": } I_{\text{com}} = 4/12 \cdot 0.57 + 5/12 \cdot 0.77 + 3/12 \cdot 0.7 = 0.69$$

$$\text{PJSC "KRCBW": } I_{\text{com}} = 4/12 \cdot 0.65 + 5/12 \cdot 0.74 + 3/12 \cdot 0.83 = 0.73$$

Therefore, according to the calculations, the highest level of the innovative development is held by Public Joint-Stock Company "Kryukov Railway Car Building Works" (Fig. 4).



**Figure 4. Comprehensive index of the innovative development of enterprises and its sub-indices**

*\*Source: compiled by the authors based on the data of the State Statistics Service of Ukraine.*

The conducted research testifies to the scientific value of the obtained results and the presence of the real possibilities of their practical application in the practical activities of enterprises, which is confirmed by our calculations.

### Conclusions

On a global scale, digital transformations change both the nature of relations and market connections of the enterprise with the main stakeholders, and create new opportunities for the innovative development. However, success of the innovative development and its effectiveness in the information age depends on the ability of the enterprise to integrate into the global information system and build business processes based on the digital technologies use.

A calculation method of the complex index of the innovative development is proposed based on the separation of the following blocks: the block of personnel and

competence potential, the block of the innovative potential, and the block of the economic potential. Each of them includes a number of indicators reflecting the general level of the innovative development of the enterprise. The practical use of this methodology was considered on the example of four industrial enterprises, namely the Private Joint-Stock Company "KREDMASH", Limited Liability Company Industrial Company "POZHMACHINA" (Pryluky), Public Joint-Stock Company "Poltava Ventilating Plant" and Public Joint-Stock Company "Kryukov Railway Car Building Works" (PJSC "KRCBW") (Kremenchuk).

The practical application of the developed method of calculating the complex index of the innovative development of the enterprise in the context of digital transformations of the institutional environment will contribute to the identification of problems that prevent the transition of the enterprise to a management model built on the digitalization principles.



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