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## DEVELOPMENT OF COLLECTIVE INTELLIGENCE IN THE ENTERPRISES' DIGITAL TRANSFORMATION

**Purpose.** Theoretical and methodical foundations deepening and projecting concerning business structures collective intelligence recommendations improvement based on human capital digital literacy in enterprises' digital transformation.

**Methodology.** The presented scientific research results were obtained using general and special cognition methods: morphological analysis, generalization and scientific abstraction; dialectical cognition, deduction and induction; system and cluster data analysis by Data Mining means; grouping and systematization; graphical and tabular presentation; abstract-logical method; econometric trend formation method.

**Findings.** We deployed a science position regarding the progress of the enterprises collective intellect based on one of the main components – human capital computer knowledge. Emphasis is placed on anthropocentricity, which plays a decisive role in the business structures' innovative activity. Our study argued the demand for joint intellect technologies in the enterprises' cyber conversion. We highlighted the mass cooperation fundamental principles, which are based on a new management paradigm and proposed a new understanding of the categories essence: “digital competence”, “digital competency” and “knowledge culture”. Our research revealed computer knowledge concept subject status as an imperative for the joint intellect improvement. We analyzed the “EU digital competence frameworks”; proposed the computer literacy framework for the enterprises' staff capital; determined the primary role of education in the context of the society digital proficiency formation.

**Originality.** We improved the science and methodical approach to determining company's staff capital computer literacy level based on the analysis of “EU digital competence frameworks”. The proposed method makes it possible to determine the cyber maturity potential and readiness for computer technologies implementation into business practice in order to ensure its development.

**Practical value.** The results of authors' science projects and practical recommendations contribute to the effective use and development of the business organizations' collective intelligence and their network associations in the conditions of cybernated conversion.

**Keywords:** *innovative development, human capital, collective intelligence, digital transformation, digital competency, DigComp 2.2, digital literacy*

**Introduction.** The progress of modern civilization is based on intellectual potential, which is objectified in science, engineering and technologies, and the intention to manage natural and social processes. At the same time, beside these optimistic trends, there are large-scale regressive phenomena associated with the environmental crisis, the growth of social antagonisms, and market instability. They are the result not of complete absence of management, but of defects in its system. One of the main such defects is the fundamental asymmetry between the locality of subjects and their groups and the systems globality that are the object of management (whether it is the natural environment, the world market, or scientific and technological progress). In other words, the limits of individual and local-group actors' capabilities became apparent when they began their tries to control and regulate systems that far surpass their former ones in their complexity and scale. A separate big problem is the “cognitive deficit” of such subjects, the lack of reasonableness and optimality of the decisions they make. The predominance at the human level of atomized subjects and their groups with personal commitment, insufficient competence and weak reflection creates a situation of “pars pro toto” (part instead of whole). The latter is capable of turning into the impersonality of human civilization. Management decisions have reached the limit of their cognitive capabilities in connection with the ever-increasing complexity of management objects and the total digitalization of all business pro-

cesses. Therefore, one of the strategic trends should be replenishing this deficit, overcoming the discrepancy between “local subject and global object”. The priority direction is the formation of collective intelligence.

According to the approved Vision for the Restoration of Ukraine, the main strategic vectors will be the key principles of digital transformation and the transition to the “Green” economy”. Under these conditions, the main drivers of recovery will be: transformation of priority economy sectors; strong human capital; efficient infrastructure. The relevance of this issue is reinforced by the fact that digital development has been chosen as the key elements of the progress of European countries, namely: digitalization of business; digitization of public services; strengthening the digital infrastructure, expanding the rights and opportunities of citizens thanks to digital competences, including digital literacy, which is a socio-cultural need of the modern world community.

There is no doubt about the relevance of research organization along this strategic vector. The thesis on the intellectual progress priority became a reference point for the development of Ukrainian society concept in the last decade in terms of aspects: education, infrastructure, investments, innovations, intelligence.

**Literature review.** Collective intelligence as a concept has numerous analogues, they are: the collective mind, the wisdom of the crowd, and the global brain. The understanding of collective intelligence concept should be attributed to the researches of XIX century period by H. Lebon, H. Tarde and E. Durheim, S. Sigel, G. Simmel. In the future, the psycho-

logical aspect of collective intelligence is supplemented by an economic one, distinguishing two types of solidarity between people: one – with the recognition of general rules and laws, the other – with the need for division of labor. New Jersey Institute of Technology researchers T. Attlee and J. Por [1] defined the basis of collective intelligence practically as: innovative thinking, desire to share information and openness to values that serve the common good. The maximum benefit of this phenomenon, in their opinion, lies in the ability to accept, develop and bring to perfection the “golden idea”. In this context, Y. Naplekov [2] investigates the problems of applying collective emotional intelligence, which will contribute to the development of the “collective mind” and the effective use of social capital. The problems of collective intelligence become more significant with the development of the Internet. Researchers emphasize that it is extremely important to learn how to use network communications for increasing the “collective mind” in such a way that the group intelligence exceeds the intelligences sum of the group members [3, 4]. American scientists from the Carnegie Center found a relationship between the complexity of Wikipedia content and the competence of this project editors. S. Verhulst [5] conducted research on the intersection of artificial and collective intelligence to achieve the goal for introducing innovations into management. S. Weng, M. Yang, and R. Hsiao confirmed in their work that collective intelligence technologies are one of the knowledge management tools in the Internet [6]. It was proposed to consider all social networks as knowledge infrastructure (knowware) of collective intelligence. Worthy of attention are the studies of T. Malone, R. Laubacher and C. Dellarocas [7], who proposed a classification called the “genome” of collective intelligence. Solutions to the problem of developing a methodology for assessing the enterprise’s human capital digital literacy level are covered by the authors in works [8, 9]. A number of researchers [10, 11] assign the primary role in the effective use of intellectual potential and the society digital competence formation to education.

Despite the considerable bibliography of the considered problem, a full-fledged collective mind consisting of people, networks and computers collection has not yet been created. The literature presents mostly theoretical works based on a multi-agent approach. As for the ratio of collective and individual intelligence, this problem not only hasn’t been studied, but hasn’t yet been fully set.

**Methods.** In the research process, general scientific and specific methods were used: morphological analysis, generalization and scientific abstraction; economic and mathematical modeling; cluster analysis by means of Data Mining; survey; expert evaluations; grouping and systematization; graphical and tabular representation.

**Results.** Today, researchers distinguish the intelligence of: a team or an organization; industries; communities; region; states; nation, international organizations, humanity. In this context, intelligence is no longer a characteristic of separate individuals, but an organized set of people, their collective quality, that is, it represents the potential for collective or mass activity, which consists in combining intellectual efforts or joint intellectual action [12]. The content of the latter is associated with intellectual synergy and indicates its interaction with synteletics, that is defined as the science of the united (collective) intelligence functioning, which creates a specific effect of complex creative (intellectual) elements accumulation system, endowed with reason (cognitive level). Under these conditions, the integrative analytical and synthetic thinking activity process of an intellectual system, which arises as a result of its component elementary structures and processes combined interaction in the course of purposeful, mediated and generalized cognition, objective reality active reflection, is interpreted as intellectual synergy.

In this study, we will focus our attention precisely on the issue of personnel’s digital literacy as one of the main enter-

prise’s collective intelligence forming elements. The world is rapidly modernizing thanks to collective intellectual data, so a strong foundation in digital literacy is the key one. At the same time, digital literacy is one of the most important global elements of human development. Acquiring digital competencies is a considerable condition for competitiveness in the labor market, as well as an important element of an active life position.

According to studies of digital economy sectors number, the main challenges of successful digital business transformation include: unpreparedness of the team, accompanied by motivation lack; fear; low expertise and level of digital literacy. Instead, to become a leader in business, it is necessary to have a desire to develop and create an environment of innovative culture, to cultivate the desire of the whole team for constant progress, to develop collective intelligence and to move forward. In this context, the rapid spread of digital technologies presents digital competences as the key ones.

Digital competences are understood as a socio-labor characteristic of a set of new knowledge, experience, professional practice, skills, abilities, culture and motivational characteristics of an employee, which possess the urgency necessary for the successful use of ICT and digital technologies, correspond to the enterprise strategic goals.

It should be noted that competences and competency can be considered discriminators in relation to human capital. Accordingly, digital competence is a form of an individual’s human capital manifestation in his practical activities, which is the result of digital competences actualization, that is, it is a manifestation of an individual’s maturity in a professional context.

The future workforce needs a balance of knowledge that develops technical skills, as well as knowledge that focuses on cognitive, social and emotional aspects, i.e. general abilities such as: problem solving, creative potential, social skills and emotional intelligence.

According to Deloitte Global Human Capital Trends survey in 2023, more than 90 % of business leaders believe that the digital technologies use is quite important for improving team performance and productivity, as well as the overall success of their organization. Only 22 % believe that their organizations are ready to actively use technologies to improve work results and team productivity. However, they see these opportunities in the future. 42 % of business leaders expect that over the next 2–4 years, technologies will enable improved organizational performance by motivating employees and teams to work more effectively.

In the context of improving the quality of life and professional activity, digital competency has been recognized by the EU as one of the eight priority competences. It should be noted that in 2017, the Digital Competence framework (DigComp 2.1) was submitted to the EU, which was formed from five key dimensions of digital competences, eight blocks (levels) of the development of these competences. Instead, in 2022, an updated version of this framework was presented in the form of DigComp 2.2, which consisted of five competence development levels, a total of 21 competences, namely: 1) information literacy (information didactics), working with data literacy; 2) communication and interaction; 3) digital content; 4) security; 5) problem solving (Table 1).

DigComp1.0–2.0 and its updated version DigComp 2.2. plays a key role in achieving the EU’s ambitious goals for improving the digital skills of population. In this context, by 2030, 80 % of population will have basic digital skills, which is foreseen by the European Pillar of Social Rights Action Plan. The update takes into account new technologies such as artificial intelligence, the Internet of Things and data, and modern telecommuting conditions, which have led to increased demands for digital competency on the part of consumers. There is also a need to solve environmental problems

Framework of digital competences (Digital Competence (DigComp 2.2) [13], \*\*[14]

EU digital competences (DigComp 1.0-2.2) for society								
DigComp 1.0	Basic		Intermediate		Advanced		Expert	
Level of DigComp 2.1 and DigComp 2.2	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level 8
Components								
1. Information and data literacy [13]								
1.1 Browsing, searching, filtering data, information and digital content [13]								
1.2 Critically evaluating and interpreting data, information and digital content**[14]								
1.3 Managing data, information and digital content [13]								
2. Communication and collaboration [13]								
2.1 Interacting through digital technologies [13]								
2.2 Sharing through digital technologies [13]								
2.3 Engaging in citizenship through digital technologies [13]								
2.4 Collaborating through digital technologies [13]								
2.5 Netiquette [13]								
2.6 Managing digital identity [13]								
3. Digital content creation [13]								
3.1 Developing digital content [13]								
3.2 Integrating and re-elaborating digital content [13]								
3.3 Copyright and licences [13]								
3.4 Programming and automating processes **[14]								
4. Safety [13]								
4.1 Protecting devices [13]								
4.2 Protecting personal data and privacy [13]								
4.3 Protecting health and well-being [13]								
4.4 Protecting the environment [13]								
5. Problem solving and continuing learning *[14]								
5.1 Solving technical problems [13]								
5.2 Identifying needs and technological responses [13]								
5.3 Creatively using digital technologies [13]								
5.4 Identifying digital competence gaps [13]								
<b>Levels of business organization human capital digital literacy (competences) "H"</b>								
Levels of digital literacy of human capital (skills and competences)	Low level of digital literacy		Basic level of digital literacy		Transition level of digital literacy		Progressive level of digital literacy	Expert level of digital literacy
Gradation of digital literacy level ("H")	<b>H1 = 0.2</b>		<b>H2 = 0.4</b>		<b>H3 = 0.6</b>		<b>H4 = 0.8</b>	<b>H5 = 1</b>

Note: structured based on \* [9]

and aspects of sustainable interaction with digital technologies. Therefore, the updated version of DigComp 2.2 takes into account the knowledge and skills that consumers need to master these developments. Recent developments also confirm that consumers must be able to verify online content and its sources (information literacy), as well as possess competences to interact with artificial intelligence systems. The update of DigComp 2.2 will make it possible to maintain the relevance of DigComp 2.1 for education, work and participation in public life, as well as for the formation of EU policy [13].

In this context, the digital competences development in all spheres of the economy is considered a source of increasing the state's competitive advantages. We note that digital interaction, the intensity of ICT use and their improvement are key components of global competitiveness indices.

It is indisputable that no program or strategic document, state initiative in the context of creating a comprehensive national system for the development of digital literacy was introduced in Ukraine until 2019; tools for monitoring and evaluating digital competences have not been developed; the methodology for conducting research in the field of digital

skills and competencies development has not been formed, at the same time inhibiting the development of the methodology for the digital competencies level independent certification implementation in accordance with the needs of the labor market.

In 2019, the Ministry of Digital Transformation of Ukraine introduced a survey and measurement of Ukrainian population's digital literacy level in the European framework of digital competences DigComp 2.1. This methodology is linguistically and substantively adapted to Ukrainian realities. All competencies were grouped into 4 blocks of skills: information, communication, problem solving and software. In each of these competences groups, the degree of skills mastery was determined according to the complexity and frequency of performed activities: no skills, basic, above basic. On these levels basis for each of the four competences, a general index of digital skills possession was calculated. According to the results of the first all-Ukrainian study of Ukrainians' digital literacy, it was established that more than 53 % of population, according to the methodology for assessing digital skills, which is used by the European Commission, is placed below the "basic" mark. Today, the issue of data collection by state statistical bodies remains relevant, because the system in the context of digital skills and competences development is imperfect. Under these conditions, it is problematic to interpret the individual and business organizations human capital digital literacy levels in general [9].

According to the appropriate classification of digital competences, their context and content, authors proposed to structure the human capital digital literacy levels and the corresponding gradations: low level of digital literacy (H1 = 0.2); basic level (H2 = 0.4); transition level (H3 = 0.6); progressive (H4 = 0.8) and expert level (H5 = 1) (Table 1).

Within the framework of the study on determining the business structures digital transformation level in the Western region of Ukraine, where 34 respondents survey (entrepreneurial activity subjects) was conducted, interesting results were obtained regarding the "H" digital literacy element of the staff and its corresponding impact on the development of organization. Based on the calculations, we obtain the following results (Table 2).

To determine the composite indicator of of the business organizations's human capital digital literacy state ("H"), it is necessary to evaluate the organizations heads answers to this question (Table 2) and use formula

$$Summ_H = \sum_{i=1}^{m_H} n_i^{(H)} \cdot k_i^{(H)}, \quad (1)$$

where  $n_i^{(H)}$  – indicator of the organization's human capital digital literacy level;  $k_i^{(H)}$  – indicator weight coefficient  $n_i^{(H)}$ ;  $m_H$  – number of expert conclusions.

Gradation by level of digital competencies, which reflect the level of company's human capital digital literacy, is shown in the Table 3.

The obtained results confirm the need to increase the level of organization's digital development and literacy, because most of the surveyed respondents have a level of digital maturity below average. So, radical changes in management, meticulous work on the implementation of available digital technologies and tools, as well as improving the digital literacy of human capital are needed, which will enable businesses to achieve competitive advantages and win new market segments.

In general, the digital literacy of human capital and the level of digital tools use will develop at the same tempo (Figure), that is, there is a high degree of correlation between them. Therefore, with the growth of a person's competency, independence and efficiency of his decisions, the requirements for the performed tasks will also increase, and the toolkit will include more complicated ways of solving the tasks.

During the analysis, the points (respondents) overlapped each other, which mean that their indicators are very similar. Based on the cluster analysis of the small and medium-sized businesses structures in the Western region of Ukraine, 5 clusters were obtained with a clear distribution of business entities included in their structure:

*Cluster 1* – 16 respondents: P1, P5, P6, P7, P10, P11, P12, P13, P15, P16, P17, P18, P21, P29, P30, P32;

*Cluster 2* – 10 respondents: P2, P3, P4, P8, P9, P14, P19, P20, P22, P23;

*Cluster 3* – 2 respondents: P25, P34;

*Cluster 4* – 5 respondents: P24, P27, P28, P31, P33;

*Cluster 5* – 1 respondent: P26.

The following results were obtained for the ratio of human capital digital literacy (H) and digital tools (I) (Figure).

In this context, we note the following: increasing the level of company's human capital digital literacy will be considered effective if the top manager understands the importance of

Table 2

Answers of organizations heads and calculation of the business organizations's human capital digital literacy block ("H")

Respondent No	Level of staff's digital literacy "H"	The value of "H"	Respondent No	Level of staff's digital literacy "H"	The value of "H"	Respondent No	Level of staff's digital literacy "H"	The value of "H"
P1	0.4	0.12	P13	0.4	0.12	P25	0.8	0.24
P2	0.6	0.18	P14	0.4	0.12	P26	1.0	0.3
P3	0.6	0.18	P15	0.6	0.18	P27	0.8	0.24
P4	0.4	0.12	P16	0.2	0.06	P28	0.6	0.18
P5	0.2	0.06	P17	0.2	0.06	P29	0.4	0.12
P6	0.2	0.06	P18	0.2	0.06	P30	0.4	0.12
P7	0.4	0.12	P19	0.2	0.06	P31	0.4	0.12
P8	0.4	0.12	P20	0.2	0.06	P32	0.4	0.12
P9	0.4	0.12	P21	0.4	0.12	P33	0.8	0.24
P10	0.4	0.12	P22	0.2	0.06	P34	0.6	0.18
P11	0.2	0.06	P23	0.2	0.06	–	–	–
P12	0.2	0.06	P24	0.6	0.18	–	–	–



Table 3

Gradation by level of digital competencies

The level of digital literacy	The value of the indicator "H"	Respondents by level of digital competencies
H1	> 0.81	P(26)
H2	(0.61; 0.8)	P(25; 27; 33; 3; 2)
H3	(0.41; 0.6)	P(15; 24; 28; 4; 1; 7)
H4	(0.21; 0.4)	P(8; 9; 10; 13; 14; 21; 29; 30; 31; 32; 5; 6)
H5	<= 0.2	P(11; 12; 16; 17; 18; 19; 20; 22; 23; 34)

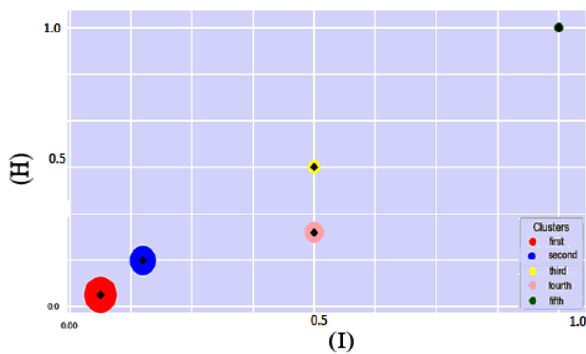


Fig. The position of the formed clusters centers in the ratio of "H" and "I" indicators

certain transformations, and at the same time, personal transformation takes place. It consists in self-education and training of personnel to adapt to new realities, in motivation to use the latest digital technologies and tools.

It is necessary to understand that in the process of transformations in the business environment, fundamental things change. Let's take as an example the approach to conducting activities: to replace the projected marketing model, enterprises introduce a client-centric system. Therefore, we pay attention to the so-called value chain, which we consider as a sequence of interrelated processes and actions of the enterprise, aimed at creating a product or service that underlies the creation of added value in order to increase the level of customer satisfaction and create competitive advantages of the enterprise. Under these conditions, the element of digital literacy for the organization should be led from three trajectories, namely: personnel (skills and competences, culture of interaction, structure and positions); partners (interaction, cooperation channels); consumers (channels of interaction, communication (interaction)). The enterprise must outline the goals to be achieved, the challenges and opportunities for achieving the respective goals, and in these conditions develop practical recommendations for their achievement.

Businesses can increase productivity and creativity by creating the right environment to use the vast amount of information and knowledge about their systems, processes, products and customers. Leaders who value the experience, knowledge, and potential accumulated by employees over the years seek to harness this collective intelligence with the many business benefits it offers. In this way, they give their employees a special status, which is a key feature of an engaged workforce.

The collection of data on one's own personnel, accordingly, their analysis and development of further management decisions, creative projects, etc., can occur through the creation of a digital profile of the employee, where all elements of collective intelligence will be displayed (Table 4).

Table 4

Digital profile of the organization's collective intelligence development

Components of collective intelligence	Element – category	Challenges	Recommendations and goals
Digital literacy of human capital	H. Human resources		
	Personnel		
	Skills		
	Modern culture		
	Structure and position		
	....		
	Partners		
	Interaction		
	Cooperation channels		
	....		
	Consumers (customers)		
	Channels of interaction		
	Communication (interaction)		
....			

Respectively, the profiles will be combined into a network of departments and the organization's profile as a whole. Managers of the organization will have faster access to information about personnel, there will be a clear understanding of business needs, accordingly making justified decisions to improve productivity.

According to D. Tapscott and E. Williams, collective intelligence is the result of group behavior, which they classify as mass cooperation, based on four principles [15]:

*Openness.* Collective intellectual property and ideas use.

*Peering.* Horizontal organization of management structure with the "openness" of Linux programs, which allows users to freely change and refine the program.

*Shared usage.* Expanding access to companies' intellectual property opens the way to opportunities. This is important because it allows to exchange of ideas and criticism.

*Global action.* The development of communication technologies opens wide access to new ideas, new talents, new markets and technologies.

For group recruitment to be successful, companies must provide the right favorable environment. In our view, they should: maintain their ability to explore new opportunities while exploiting existing ones; enable creative people to engage others; allow, but not compel, the employment of people, even if they work in the main business; enable the system to independently select the best ideas and support the winning ideas with sufficient resources. In this context, the researchers of the company "Cap Gemini Ernst & Young" are working on creating an "idea market" open to those organizations that meet the specified conditions.

Based on the above, we can state that new business opportunities in digital ecosystems have determined the importance of digital competences. In order to successfully solve the tasks related to the formation of collective digital competences for the human capital of business structures, modernization of the education system is necessary in a number of key directions:

1. Orientation of the education system at its all acquisition stages on the gaining of skills and competences for innovative activities. No age restrictions.

2. Increasing digital literacy not only of specialists, but also of the entire society.

3. Introduction of interdisciplinary educational programs and project activities, establishment of courses on commercialization of developments for higher education institutions graduates, especially technical and natural sciences, their stimulation for innovative entrepreneurship skills.

4. Creation of a system for stimulating the young people innovative activities, which includes the holding of forums and take-offs, full-time and correspondence schools, competitions and olympiads of various project-research practices, the use of open education platforms.

5. The formation of innovation culture, its acceptance in society and, as a result, an increase in the prestige of the search for and commercialization of new ideas, bringing them to innovation.

6. Popularization of humanitarian courses invested in intercultural communication, learning foreign languages, education of a tolerant society.

7. Emotional intelligence as a group of mental abilities that contribute to the awareness and understanding of one's own emotions and the emotions of others. Emotional intelligence is perceived as a substructure of social intelligence.

8. The culture of knowledge, which is understood as a cultural environment that promotes the exchange of knowledge and the elimination of existing cultural barriers, includes awareness of unique knowledge bearer's role importance – of a person, and also builds a system of motivation to exchange knowledge in order to create a collective intellectual product or service.

Therefore, the concept of education should change from a qualification model to a competence model.

Under these conditions, digital ecosystems have to: achieve a positive result due to the balance of stakeholders' interests; synthesize new knowledge using collective thinking; identify and formulate problems as a result of creative search; eliminate their mistakes and compensate for the shortcomings of their own knowledge.

**Conclusions.** The panorama of scientific research makes it possible to state that the mentality performs many functions, among which management functions occupy a significant place. At the same time, the individual mind is significantly limited in its management potential due to subjective engagement and insufficient reflexivity, limited ability to realize the consequences and risks of one's actions. These aspects are revealed in a clear form when local subjects or their groups begin to claim the status of civilization development subject in general. The latter is actively integrated and globalized, and these processes will gradually be reflected in the sphere of consciousness. It is worth expecting that the formation of collective intelligence will take place. In its humanistic version, it will not become fully artificial (identical to the individual intellect) and will not foresee the "cancellation" of individual minds as some kind of totality, on the contrary, it will represent a synergistic union of many of the latter. The emergent nature of this network will be expressed by the growing ability to forecast and plan development, rationally choose and implement the most optimal trajectories.

Digital competences are considered the starting framework condition for the development of all other priorities in the field of the EU and Eastern Partnership countries digital markets harmonization in the context of the society digital transformation global trend progress. A detailed analysis of the European Union documents showed that for the successful development of the European Union member states, the guarantee of their competitiveness, overcoming the economic crisis, the creation of a digital economy, a necessary condition is the improvement of the quality and efficiency of education aimed at the digital competences acquisition by the Ukrainian nation, motivating them to

obtain IT specialties. The growing need to use modern computing in the workplace has led to the need for increased computer literacy for most occupations. At the same time, the intensity of ICT use and improvement, digital interaction should be harmonized with global digital indices and ratings as benchmarks for achieving national digital development goals, as they are key components of global competitiveness indices.

We believe that the formation of a collective intelligence would mark the overcoming of a fundamental asymmetry, which is defined as a violation of the techno-humanitarian balance. It consists in the global disruption of the already internal co-evolution of civilization itself, when technological progress begins to significantly outpace mental and cultural development. That is why in our next scientific studies we will take a closer look at other elements of the organization of collective intelligence.

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## Розвиток колективного інтелекту в умовах цифрової трансформації підприємств

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**Мета.** Поглиблення теоретико-методичних засад і розроблення рекомендацій щодо розвитку колективного інтелекту бізнес-структур на основі цифрової грамотності людського капіталу в умовах цифрової трансформації підприємств.

**Методика.** Результати представленого наукового дослідження отримані за використання загальних і спеціальних методів пізнання: морфологічного аналізу; узагальнення й наукової абстракції; діалектичного пізнання; дедукції та індукції; системного та кластерного аналізу даних засобами Data Mining; групування й систематизування; графічного й табличного представлення; абстрактно-логічного методу; економетричного методу формування тренду.

**Результати.** Розвинута наукова позиція щодо розвитку колективного інтелекту підприємств на основі однієї з основних складових – цифрової грамотності людського капіталу. Наголошується на людиноцентризмі, який віді-

грає вирішальну роль в інноваційній діяльності бізнес-структур. Аргументована затребуваність технологій колективного інтелекту в умовах цифрової трансформації підприємств. Висвітлені основоположні принципи масової співпраці, що ґрунтуються на новій парадигмі управління. Запропоноване нове розуміння сутності категорій «цифрова компетенція», «цифрова компетентність» і «культура знань». Розкрито суб'єктний статус концепції цифрової грамотності як імперативу розвитку колективного інтелекту. Проаналізовані «рамки цифрових компетенцій ЄС» і запропоновані рамки цифрової грамотності для людського капіталу підприємств. Визначена першочергова роль освіти в контексті формування цифрової грамотності суспільства.

**Наукова новизна.** Удосконалено науково-методичний підхід щодо визначення рівня цифрової грамотності людського капіталу підприємства на основі проведеного аналізу «рамки цифрових компетенцій ЄС». Запропонований метод дає змогу визначити потенціал цифрової зрілості й готовності до імплементації цифрових технологій у практику бізнесу з метою забезпечення його розвитку.

**Практична значимість.** Результати наукових розробок і практичні рекомендації авторів сприяють ефективному використанню й розвитку колективного інтелекту підприємницьких організацій, їх мережевих об'єднань в умовах цифрової трансформації.

**Ключові слова:** *інноваційний розвиток, людський капітал, колективний інтелект, цифрова трансформація, цифрова компетентність, DigComp 2.2, цифрова грамотність*

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