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Lykhopok Denys

TECHNOLOGICAL TRANSFORMATION OF DIGITAL COMPETENCE IN THE SERVICE SECTOR

Alfred Nobel University, Dnipro, Ukraine

Technological transformation of society raises increased requirements for consumers' readiness to use services, particularly in the social sphere, in a new digital format. Gradual digitalization of all aspects of socio-economic interaction creates new challenges for both service providers and their consumers. Digitalization processes require rethinking traditional approaches to interaction between market participants and the formation of new competencies. The paper presents theoretical and methodological approaches to defining fundamental concepts such as "digital literacy" and "digital competence" and examines the features of digital transformation in the services sector, taking into account consumer interests and the impact of digitalization on service accessibility for different population groups. A conceptually new author's concept of "digital maturity" of social services consumers is introduced, which allows for a comprehensive assessment of not only cognitive and technical readiness, but also the functional capabilities of consumers to receive the full spectrum of services in digital form with maximum efficiency. This concept goes beyond the traditional understanding of digital literacy and forms an integrated indicator of readiness to function in a digital environment, taking into account dynamic changes in the technological landscape. It is substantiated from the standpoint of systems analysis that the necessary level of consumer digital maturity for comfortable consumption of social services depends on a multitude of interconnected factors: the current state of the social sphere whose services the consumer plans to use, the achieved level of automation and digitalization of business processes in the corresponding sector, as well as the duration of information-network communication in the service delivery process. The relevance of this research is significantly enhanced by contemporary global challenges, particularly pandemic restrictions, which accelerated the pace of digitalization and exacerbated the problem of digital inequality among different population groups, revealing insufficient readiness of consumers to use digital services.

Keywords: digital economy, digital transformation, technological transformation, consumer digital maturity, digital competence, information-network communications, social sphere.

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Introduction

The trade and service sector were one of the first to implement online formats, which determined the special significance of digital transformation for this sphere. The growing integration of information and communication technologies into all aspects of service enterprises' activities requires a detailed analysis of consumers' readiness for new interaction formats. The purpose of this study is a comprehensive assessment of consumers' readiness for digital transformation in service sector in the context of socio-economic changes. The paper provides a systematic analysis of conceptual approaches to digital transformation based on a key component – the digital

maturity of service consumers as an integrated indicator of their readiness to use digital services. A multidimensional index of digital literacy is examined in the context of interconnected sub-indices: digital competence, digital consumption, digital security, and it methodologically substantiates an integrated indicator of digital maturity, which includes: consumer digital equipment (technical capabilities for accessing digital services), digital competence (relevant knowledge, skills, and abilities), and digital flexibility (parameters for dynamic updating of consumer knowledge in conditions of rapidly changing digital technologies).

Technological transformation, which includes a large-scale adaptation of information network communications, "breakthrough" and "end-to-end" digital technologies within the paradigm of the digital economy, introduces significant and mostly radical adjustments to the development trajectory of industries and companies in the service sector, deeply penetrates the social sphere, changing the nature of interaction between subjects of economic activity. Digitalization, which is an integral and system-forming part of transformation processes, influences and imposes new requirements not only on technical-technological and production-economic components of activity but also on socio-economic relations and subjects involved at different hierarchical levels of the economic system.

The social sphere fundamentally differs not only in the specificity of the production process but also in mandatory direct contact with consumers (the population), which creates additional features in the processes of digital transformation in the social sphere. In a modern civilized information-network society under the systemic influence of digitalization, socio-economic development is aimed at improving the integral parameters of the population's quality of life, improving the institutional conditions for developing the human potential of the country's and region's residents as the basic value of society. In our opinion, considering these aspects, it is extremely important to understand the multifaceted impact of technological transformation on consumers in all their dimensions.

Analysis of recent research and publications

Research on digital transformation and digital competence is represented by a wide spectrum of scientific works. Fundamental aspects of the digital economy and technological transformation are examined by A. Prokhorov and L. Konik [1], who systematized global experience in digital transformations. The conceptual foundations of digital literacy were laid by P. Gilster [3], who defined it as the ability to critically use digital information.

Methodological approaches to measuring the digital economy are presented in works by K. Barefoot and co-authors [4], who developed comprehensive indicators of digitalization. The European Digital Competence Framework (DigComp) [2] established international standards for assessing citizens' digital skills.

Practical aspects of implementing digital technologies in business processes are studied in digital transformation indices [5, 6], which provide empirical data on the readiness of various economic sectors for digitalization.

However, issues regarding the specifics of digital transformation in the services sector and consumer readiness for digital interaction remain insufficiently researched. The concept of integrated assessment of consumer readiness, which considers not only technical skills but also adaptive capabilities in conditions of rapid technological change, requires theoretical substantiation.

Research objective

The research objective is to develop conceptual foundations for assessing the readiness of service sector consumers for digital transformation through substantiating the concept of "digital maturity" as an integrated indicator of consumers' technical equipment, competence, and adaptive flexibility.

Research tasks:

a) systematize approaches to defining digital literacy and competence in the context of technological transformation of society;

b) identify specific features of digitalization in the services sector, considering the interaction between consumers and service providers;

c) conceptualize the notion of "consumer digital maturity" as a comprehensive characteristic of readiness for digital interaction;

d) identify factors influencing the level of consumer digital maturity in services;

e) substantiate methodological approaches to assessing and enhancing consumer digital maturity.

Research object – digital transformation processes in the services sector.

Research subject – digital competence and maturity of service consumers as factors in the effectiveness of digital transformation in the services sector.

Presentation of main material

Epistemological Aspects of Digital Transformation. When examining the epistemological aspects of digital transformation, it should be noted that the transition to a digital economy should be viewed as a systemic evolutionary process that changes

the essential characteristics of socio-economic interactions. In modern scientific literature, various approaches to understanding the essence of the digital economy have emerged:

– infrastructural approach, which focuses on the technological aspects of information and the functioning of communication systems;

– process-based approach, which views the digital economy as a set of specific socio-economic and organizational processes;

– ecosystemic approach, which interprets the digital economy as a complex self-organizing system with a large number of interconnected elements.

One of the fundamental manifestations of technological transformation occurring in the context of digital transformation is digitalization as a process of implementing digital technologies. The term "digitalization" is interpreted differently by authors of scientific publications, which indicates the multifaceted nature of this phenomenon:

– in a narrow sense, this process is viewed as "the transition from an analog firm to a digital one," that is, the transformation of methods for processing, transmitting, and storing information;

– in a broad sense, it is a comprehensive transformation of an organization "that leads to increased labor productivity in a specific period due to the transition to new digital breakthrough technologies, and each historical period is characterized by its own specific digital transformation" [1].

It should be noted that systemic transformational processes in the digital economy are characterized by fundamental features, among which the following deserve special attention:

a) exponential nature of changes – a fundamentally new pace of technological innovations that shortens adaptation cycles and requires accelerated development of competencies;

b) all-encompassing nature of digitalization - the widespread growth of information network technologies into all spheres of public life;

c) dematerialization of economic processes - the growing role of virtual assets and information resources;

d) transformation of interaction models – formation of new communication mechanisms between economic agents.

Component Structure of Digital Literacy. Digital transformation imposes increased requirements on the readiness of subjects (businesses and individuals) involved in it to engage and be active participants in digitalization processes. In 2006, the European Parliament recommendations justifiably included computer (digital) literacy among the eight key competencies of the 21st century [2], emphasizing its fundamental importance for socio-economic development. The term "digital literacy" itself was introduced into scientific terminology by Paul Gilster in 1997. According to this scholar, it is "the ability to critically understand and use information obtained through computers in various formats and from a wide range of sources" [3]. This definition emphasizes not only the technical side of the issue but also the cognitive aspects of interaction with the digital environment.

In modern scientific literature, different approaches to structuring digital literacy can be identified

The functional approach examines digital literacy through the lens of specific functional skills necessary for solving practical tasks in the digital environment. These skills include:

– information literacy (ability to find, evaluate, and use information);

– computer literacy (skills in working with hardware and software);

– communication literacy (skills in using digital communication tools);

– media literacy (ability to critically analyze digital content).

The cognitive-mental approach emphasizes mental processes associated with interpreting and using digital content. Within this approach, the following are important:

– critical thinking in the context of digital sources;

– ability to synthesize information from various digital resources;

– digital security and privacy skills.

The integrative approach combines functional, cognitive, and social aspects, viewing digital literacy as a complex phenomenon that includes:

– technical competencies (use of devices and software);

– information competencies (search, processing, and critical evaluation of information);

– social-communicative competencies (online interaction, digital ethics);

– strategic competencies (use of digital technologies to achieve personal and professional goals).

In Ukraine, since 2010, as part of the large-scale analytical project "Digital Literacy Index of Ukrainian Citizens," the digital literacy index has been systematically evaluated. This index aims to comprehensively measure the level of knowledge and skills of the population and businesses necessary for safe and effective use of information network communication technologies (ICT), digital

technologies (DT), and global Internet resources. Methodologically, the digital literacy index itself is an integral index based on three interconnected sub-indices: digital consumption (characterizing the use of Internet services), digital competencies (reflecting skills for effective technology use), and digital security (determining the ability to protect data and devices) [4].

Table presents the dynamics of the Digital Literacy Index (DLI) and sub-indices: digital consumption, digital competence, and digital security of citizens and businesses for the period 2012–2022.

Dynamics of the Digital Literacy Index for the period 2012–2022

Indicator	2012	2014	2016	2018	2020	2022
Index of Digital Literacy of Citizens	4.80	4.85	4.92	4.95	4.98	4.92
Index of Digital Literacy of Business	4.96	5.15	5.29	5.32	5.38	5.44
Subindices						
Digital Competencies of Citizens / Business	4.10	4.22	4.31	4.34	4.37	4.38
	5.26	5.29	5.38	5.42	5.46	5.53
Digital Consumption of Citizens / Business	5.50	5.52	5.64	5.68	5.70	5.68
	5.42	5.64	5.82	5.74	5.82	5.90
Digital Security of Citizens / Business	4.80	4.81	4.82	4.84	4.86	4.72
	4.19	4.54	4.66	4.80	4.86	4.88

Conducting an analysis of the calculated indicators of the digital literacy index and sub-indices for the period from 2012 to 2022 (Table), it can be reasonably noted that the digital literacy index has had steady growth in the segment of Ukrainian citizens and remained at the average world level (leaders in 2022 – USA, Japan, United Kingdom, Finland, Singapore, weighted average 9.12), while the business index in developed countries was 8.76, indicating significant potential for further improvement. A detailed analysis of this table shows that the development of digital competencies exacerbates the problem of information network security for consumers of digital services, which requires special attention. Therefore, a fundamental conclusion can be made that the growth of digital competence of consumers, both citizens and businesses, does not lead to an automatic proportional increase in the overall level of digital literacy due to the uneven development of its components.

Comparative analysis of Ukraine's digital literacy indices with international indicators demonstrates a certain delay in the domestic level in comparison to leading world countries, especially in the aspect of digital security. This situation requires the implementation of comprehensive digital education programs at various levels - from school to professional education and advanced training programs. Special attention should be paid to digital inclusion of vulnerable population groups – elderly people, rural residents, persons with disabilities, for whom access to digital services may be limited.

Regional Differentiation of Digital Literacy Level. An important aspect of digital literacy analysis is its territorial differentiation. Research demonstrates significant regional differences in the level of digital literacy among Ukrainian citizens, which is caused by a number of objective factors:

– uneven development of information and communication infrastructure. There are substantial differences in the availability of high-speed internet between urban and rural areas, which directly affects citizens' opportunities to improve digital skills;

– socio-demographic factors. The age structure of the population, education level, and employment form the basis for regional differences in digital literacy. Regions with a higher proportion of young and economically active population demonstrate higher indicators of digital competence;

– economic development of the territory. The level of economic development in a region determines opportunities for investment in digital infrastructure and education, and creates demand for digital skills in the labor market.

Analysis of statistical data allows us to identify the following patterns:

– the highest indicators of digital literacy are observed in large cities (Kyiv, Kharkiv, Odesa, Dnipro, Lviv) and their surrounding agglomerations;

– western and central regions demonstrate average indicators with positive dynamics;

– eastern and southern regions are characterized by lower digital literacy indicators, especially in rural areas.

Conceptualization of Digital Competence. It can be reasonably noted that possessing the necessary amount of digital competencies is nevertheless of fundamental importance for the effective use of services in digital form. Therefore, the theoretical concept of digital competence within the framework of digital transformation is actively developing and undergoes constant changes due to the accelerated development of information network communication technologies and growing trends in implementing the latest digital technologies in all spheres of human activity.

Methodological Approaches to Defining Digital Competence. In the author's opinion, when assessing the methodological quality of the definition of "digital competence," it is necessary to emphasize the complexity of this phenomenon, highlighting that the following are necessary:

– developed abilities and professional skills to effectively use digital technologies in business and everyday life at all levels of interaction;

– confident and critically creative use of information flows through the global Internet, taking into account information security;

– technical, marketing, financial, and information skills, most often associated with computer literacy and analytical thinking.

Based on the conducted research, we can propose the following refined definition of "digital competence" – it is not only an integrated sum of general-purpose functional and professional knowledge, skills, and abilities, which are represented in various theoretical models of ICT and DT competence; information network competencies; marketing and logistics competencies of small and medium-sized business entities, but also a holistic mindset for effective activity within the framework of electronic commercial activity and the personal attitude of business entities and users, based on a sense of professional and social responsibility.

European Digital Competence Framework (DigComp). When analyzing international approaches to structuring digital competence, special attention should be paid to the European Digital Competence Framework for Citizens (DigComp), which is one of the most comprehensive and methodologically sound tools for defining, measuring, and developing digital competence of citizens.

DigComp identifies 5 key areas of digital competence:

First. Information and data literacy:

– browsing, searching, and filtering data, information, and digital content;

– evaluating data, information, and digital content;

– managing data, information, and digital content.

Second. Communication and collaboration:

– interacting through digital technologies;

– sharing information through digital technologies;

– engaging in citizenship through digital technologies;

– collaborating through digital technologies;

– netiquette (online behavior);

– managing digital identity.

Third. Digital content creation:

– developing digital content;

– integrating and re-elaborating digital content;

– copyright and licenses;

– programming.

Fourth. Safety:

– protecting devices;

– protecting personal data and privacy;

– protecting health and well-being;

– protecting the environment.

Fifth. Problem solving:

– solving technical problems;

– identifying needs and technological responses;

– creatively using digital technologies;

– identifying digital competence gaps.

For each of these areas, proficiency levels (from basic to highly specialized) are defined, allowing for detailed assessment of digital competence and the development of individual trajectories for its improvement.

Digital Competence in Professional Context. It is important to note that digital competence has specific features depending on the professional context. Different fields of activity have distinctive requirements for digital knowledge, skills, and abilities.

In the field of education, digital competence of educators includes:

– using digital technologies for learning and teaching;

– creating and modifying digital educational resources;

– using digital technologies for assessment;

– using digital technologies to enhance students' capabilities;

– promoting digital competence among students.

In the healthcare sector, digital competence of medical professionals encompasses:

– using electronic health records;

– telemedicine and remote consultations;

– medical data analysis;

– cybersecurity and protection of patients' medical data.

In the business environment, the following is important:

– digital marketing and customer relationship management;

– big data analytics for decision-making;

– E-commerce skills;

– remote collaboration and project management.

This differentiation emphasizes the need for a sector-specific approach to the formation and development of digital competence, which should be taken into account when developing educational programs and digital transformation strategies.

Features of Digital Transformation in the Service Sector. Digital transformation, which is intensively taking place in various spheres of public life and in entrepreneurial activity, affects different categories of consumers unequally and involves people in this technological process with varying intensity. Such "involvement" based on the principles of convergence in the social sphere and in the service, sector has special characteristics related to the fact that a person receiving a service (final consumer), in the case of digital transformation of this sphere, still maintains certain direct contact with the organization, particularly with small and medium-sized businesses in the service sector, which creates special challenges for the digitalization process.

The service sector demonstrates specific features of digital transformation, as the very nature of service as an intangible good implies a high degree of personalization and direct interaction with the client. The transformation of business processes in this area must take into account not only technological capabilities but also psychological aspects of service perception by consumers of different age and social groups. This is especially true for services that have high social significance, such as medical, educational, administrative, and social security.

Based on the conducted research, critical features that need to be additionally considered when implementing technological transformation of the service sector should be highlighted. In particular, in our opinion, it is objectively necessary to ensure:

– significant enhancement of analytical attention to the detailed consumer profile, as digital transformation in the long term should lead to deep personalization (targeting and individualization) in the consumption of services according to the unique needs of each client;

– comprehensive consideration of the technical and cognitive readiness of the consumer (client) to consume services under conditions of digital transformation (without this, the consumer - a person will not be able to fully and effectively use the service, regardless of its quality and formal availability);

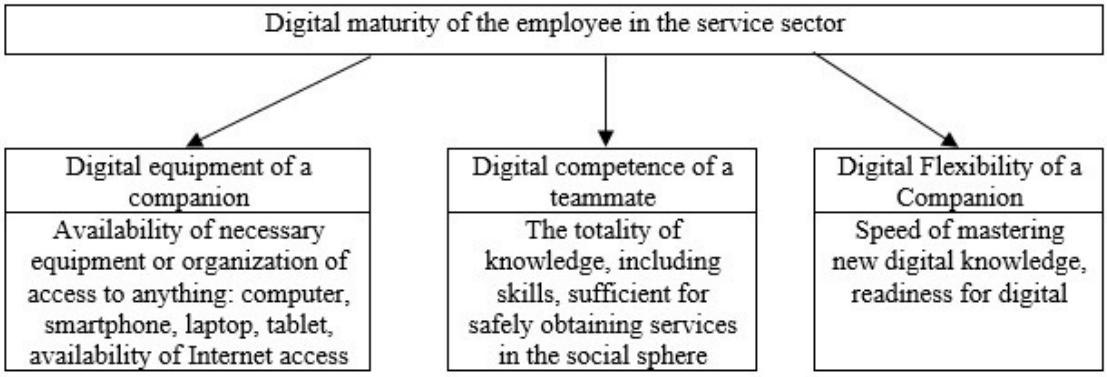
– strategic increase in the functional significance of points of contact with the consumer, since electronic interaction quantitatively reduces personal contact, it is important not to allow a decrease in the qualitative accessibility of social services for all categories of the population.

Digital transformation of the service sector leads to changes in traditional business models. There is a transition from linear models to platform solutions, where consumers can receive comprehensive services from different providers through a single digital platform. Approaches such as "Software as a Service" (SaaS), service marketplaces, and service aggregators are radically changing the ways service providers and clients interact. These changes require consumers to develop new skills in navigating the digital environment, managing personal data, and critically evaluating service quality.

Concept of Digital Maturity of Service Consumers. The author maintains a well-founded view that the duration of digital engagement of service consumers objectively requires a differentiated level of readiness among citizens and small and medium-sized business entities for the digitalization of various functional areas, and their digital competence can and should differ according to the specifics of their activities. Meanwhile, the digital transformation of the economy will be accompanied by a constant dynamic change in consumer readiness, based on the level of their digital maturity as an integrated indicator.

Digital maturity of service consumers, including social services, is a comprehensive multidimensional characteristic that includes three fundamental components: digital equipment (technical aspect), competence (cognitive aspect), and flexibility (adaptation aspect) (Figure).

For objective measurement of digital maturity, it is expedient to develop a system of quantitative and qualitative indicators that will allow monitoring changes and comparative analysis of different consumer groups. Such metrics may include: frequency of digital channel usage, level of trust in online transactions, ability to independently solve technical problems, speed of mastering new digital tools, and level of satisfaction with digital services.



Components for assessing the level of digital maturity of an employee in the service sector

For service consumers, digital maturity can also be defined as an integrated indicator that includes the following key components:

– digital equipment of consumers as the availability of technical means and infrastructure for accessing digital services. In this case, if technical means are available through common equipped centers of collective access, rather than in personal use, it is important to additionally consider the physical ability of elderly consumers and those with disabilities to reach the technical means unhindered in order to fully use digital services;

– digital competence as a set of knowledge, abilities, and skills. When systematically assessing this parameter, it is first necessary to clearly define "what exactly the consumer needs to know" to receive a particular category of service within a differentiated service market, taking into account their technological complexity;

– digital flexibility as the ability to adapt. This strategic parameter should quantitatively and qualitatively determine the necessary timeframe for updating the consumer's (client's) knowledge and skills so that their functional readiness to receive services under conditions of digital transformation remains stably at an optimal level for an extended period of time.

Development of digital maturity among consumers requires a systematic approach to digital education and awareness. This involves not only formal training but also the creation of accessible information resources, provision of consultations and trainings, development of clear instructions, and intuitively understandable interfaces for digital services. An important aspect is also psychological support for consumers, especially those of older age, to overcome «digital anxiety» and build confidence in their own abilities.

Factors Influencing Digital Maturity of Consumers. In the process of systemic digitalization of the service sector, including the social sphere, it is critically necessary to take into account the presence of direct multi-level interaction between the company providing the service and the consumer. Therefore, the level of technical and cognitive readiness of consumers – clients to effectively use services in new technological conditions (using ICT, DT, automation, adaptation, 3D visualization models) should be strategically the most important indicator of the success of digital transformation.

The readiness to effectively receive services, based on the specifics of their nature, level of technological complexity, and socio-economic accessibility, objectively depends on the integral level of consumer-client's digital maturity. The author believes that the necessary level of digital maturity of the consumer-client for comfortable consumption of both social and intellectual services, in turn, systematically depends on the following critical factors:

– the specific social sphere, its functional specifics and technological features, the services of which the consumer wants to use;

– the achieved level of automation and digitalization of business processes in a particular social and intellectual sphere, taking into account regional characteristics;

– the depth and duration of digital information communications in the process of receiving services, including social, intellectual, and business spheres, which determines the intensity and complexity of interaction.

In addition to these factors, the level of digital maturity of consumers is also influenced by demographic characteristics (age, education level, place of residence), socio-economic status (income, employment), cultural characteristics, and previous experience with technology. Research shows that psychological factors also have a significant impact – motivation to master new technologies, level of digital anxiety, risk perception, and trust in digital services.

Conclusions

The results of the comprehensive study conducted allowed for scientifically substantiating the features of technological transformation in the service sector and proposing methodological approaches to measuring consumer readiness for digitalization. The theoretical identification and conceptual differentiation of the notion of "digital competence" in conjunction with the author's concept of "digital maturity of service consumers" has made it possible to argue that these are multi-component integrated characteristics that indicate the set of objective requirements for modern consumers in the context of transformation of the service sector, and on the other hand - to identify factors that may significantly prevent consumers from fully utilizing social services under conditions of digitalization.

We believe that for further studying of theoretical concepts and practical implementation of digital transformation strategies are needed specialized sectoral studies of the service sphere, which are taking into account their specifics, technological complexity, and socio-economic accessibility within the integrated strategy of increasing the level of digital maturity both from the business side and from the side of the consumer of digital services. This will ensure harmonious development of the digital economy, taking into account the interests of all interested parties.

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ТЕХНОЛОГІЧНА ТРАНСФОРМАЦІЯ ЦИФРОВОЇ КОМПЕТЕНТНОСТІ СФЕРИ ПОСЛУГ

Лихопьок Д. П.

Технологічна трансформація суспільства висуває підвищені вимоги до готовності споживачів використовувати послуги, зокрема соціальної сфери, у новому цифровому форматі. Поступова діджиталізація всіх аспектів соціально-економічної взаємодії створює нові виклики як для надавачів послуг, так і для їх споживачів. Процеси цифровізації вимагають переосмислення традиційних підходів до взаємодії між учасниками ринку послуг та формування нових компетенцій. У роботі надано теоретико-методологічні підходи до визначення фундаментальних понять «цифрова грамотність», «цифрова компетентність» та досліджено особливості цифрової трансформації у сфері послуг з урахуванням інтересів споживачів і впливу цифровізації на доступність послуг різним верствам населення. Вводиться концептуально нове авторське поняття «цифрова зрілість» споживача послуг соціальної сфери, що дозволяє комплексно оцінити не лише когнітивну та технічну готовність, але й функціональні можливості споживача отримати повний спектр послуг в цифровій формі з максимальною ефективністю. Даний концепт виходить за межі традиційного розуміння цифрової грамотності та формує інтегрований показник готовності до функціонування в цифровому середовищі, враховуючи динамічні зміни технологічного ландшафту. Обґрунтовується з позицій системного аналізу, що необхідний рівень цифрової зрілості споживача для комфортного споживання соціальних послуг залежить від множини взаємопов'язаних факторів: поточного стану соціальної сфери, послугами якої планує скористатися споживач, досягнутого рівня автоматизації та цифровізації бізнес-процесів у відповідній галузі, а також тривалості інформаційно-мережевої комунікації у процесі отримання послуг. Актуальність дослідження посилюється сучасними глобальними викликами, зокрема пандемічними обмеженнями, які прискорили темпи цифровізації та загострили проблему цифрової нерівності серед різних верств населення, виявивши недостатню готовність споживачів до використання цифрових сервісів.

Ключові слова: цифрова економіка, цифрова трансформація, технологічна трансформація, цифрова зрілість споживача, цифрова компетентність, інформаційно-мережеві комунікації, соціальна сфера.

TECHNOLOGICAL TRANSFORMATION OF DIGITAL COMPETENCE IN THE SERVICE SECTOR

Lykhopok Denys*

Alfred Nobel University, Dnipro, Ukraine

***e-mail: doka.mobil@gmail.com**

Lykhopok Denys ORCID: **https://orcid.org/0000-0002-3027-1587**

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