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MANAGING THE EFFICIENCY OF REGIONAL DIGITALIZATION UNDER MODERN CONDITIONS

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УПРАВЛІННЯ ЕФЕКТИВНІСТЮ ЦИФРОВІЗАЦІЇ РЕГІОНУ В СУЧАСНИХ УМОВАХ

The article examines scientific and methodological approaches to managing the efficiency of regional digitalization under modern socio-economic transformations. Digitalization is interpreted as a complex process of technological, institutional, and social modernization ensuring sustainable territorial development. It is substantiated that effective management of digital processes requires the integration of innovative tools, analytical assessment methods, and a system of indicators reflecting digital maturity and e-government performance.

Based on the generalization of international experience (Estonia, Poland, South Korea, and the Nordic countries), the key factors for enhancing digitalization efficiency are identified: digital culture, human capital development, institutional capacity of public authorities, and citizen participation in decision-making. The article analyzes the state of digital infrastructure and e-governance in the Dnipropetrovsk region, one of Ukraine's leaders in digital service integration. The main challenges include uneven access to digital resources, insufficient digital skills of public employees, and limited financing of innovation projects.

A scientific and methodological approach is proposed for assessing the effectiveness of regional digitalization through an Integrated Digital Development Efficiency Index (IDDEI), which encompasses infrastructural, institutional, social, and technological components. Directions for improving the management of digital processes are substantiated: establishing regional digital transformation councils, creating digital competence centers, developing public-private partnerships, and implementing a Regional Digital Performance Dashboard.

The research results have practical value for public administration bodies and local governments aiming to increase transparency, efficiency, and innovation in governance. Managing the efficiency of digitalization is emphasized as a decisive factor for regional competitiveness and social cohesion amid wartime and post-war recovery in Ukraine.

У статті досліджено науково-методичні підходи до управління ефективністю цифровізації регіону в сучасних умовах соціально-економічних трансформацій. Розкрито сутність цифровізації як комплексного процесу технологічного, інституційного й соціального оновлення, що забезпечує сталий розвиток територій. Обґрунтовано, що ефективне управління цифровими процесами передбачає інтеграцію інноваційних інструментів, аналітичних методів оцінювання, системи показників цифрової зрілості та результативності е-урядування.

На основі узагальнення міжнародного досвіду (Естонія, Польща, Південна Корея, країни Скандинавії) визначено ключові чинники підвищення ефективності цифровізації — цифрова культура, розвиток людського капіталу, інституційна спроможність органів влади та участь громадськості у прийнятті рішень. Проведено аналіз стану цифрової інфраструктури та е-урядування у Дніпропетровській області, яка входить до п'ятірки лідерів за рівнем інтеграції електронних послуг. Виявлено основні проблеми — нерівномірність доступу до цифрових ресурсів, низький рівень цифрових компетенцій службовців, недостатнє фінансування проєктів.

Запропоновано науково-методичний підхід до оцінювання ефективності цифровізації регіону на основі інтегрального індексу ефективності цифрового розвитку (ІЕЦР), що включає інфраструктурну, інституційну, соціальну та технологічну компоненти. Обґрунтовано напрями вдосконалення управління цифровими процесами: формування регіональної ради з цифрової трансформації, створення центрів цифрових компетенцій, розвиток публічно-приватного партнерства та впровадження Regional Digital Performance Dashboard.

Результати дослідження мають практичну цінність для органів державної влади та місцевого самоврядування, спрямованих на підвищення прозорості, ефективності та інноваційності управління. Підкреслено, що управління ефективністю цифровізації є визначальним чинником конкурентоспроможності регіональної економіки та соціальної згуртованості в умовах воєнного й поствоєнного розвитку України.

Keywords: regional digitalization, efficiency management, digital maturity, e-government, public-private partnership, digital infrastructure, Dnipropetrovsk region.

Ключові слова: цифровізація регіону, управління ефективністю, цифрова зрілість, е-урядування, публічно-приватне партнерство, цифрова інфраструктура, Дніпропетровська область.

Formulation of the Problem in General Terms and Its Connection with Important Scientific or Practical Tasks.

The modern economy of Ukraine is undergoing an active stage of digital transformation that encompasses all spheres of social life. Digitalization is becoming a fundamental instrument for modernizing public administration, developing business, and improving citizens' quality of life.

The regional dimension of digitalization is of special significance, as it is at the level of regions and local communities where the core initiatives of e-governance, digital learning, smart logistics, and e-healthcare are introduced. In this context, a key challenge lies in improving the effectiveness of regional digitalization management — through developing a comprehensive system of indicators, ensuring constant monitoring of progress, and forming a flexible governance model that maintains the consistency and stability of digital transformation processes within each region.

Analysis of Recent Research and Publications. The issue of managing the efficiency of regional digitalization is becoming increasingly relevant as countries transition to a digital economy and seek to improve the effectiveness of public administration. Modern scientific approaches encompass both the concept of digital maturity (Digital Maturity Models) and methodologies for assessing the effectiveness of digital policy at the regional level.

A substantial input into the advancement of digital governance theory was provided by Å. Waara [20], who examined eighteen maturity models of digital government and concluded that the most successful frameworks combine technological, institutional, and societal indicators. In his publication [10], M. Mishchenko contends that the system of personnel recruitment and development in the digital economy must integrate managerial, economic, and psychological dimensions. He highlights that digital transformation reshapes employees' motivational structure and obliges management to implement competency-based methods for evaluating performance in digital environments. Such a comprehensive approach strengthens organizational efficiency and promotes the

growth of human capital within regions. Especially relevant to our study is the finding that the success of digitalization is directly linked to staff readiness for innovation and managers' capacity to design flexible motivational systems—serving as the foundation for assessing the human factor in managing regional digital transformation. The noted researcher C. Yang [21] revealed that the effectiveness of digitalization is determined more by cross-sectoral collaboration than by the extent of technological investment, whereas F. Febiri [3] empirically established a relationship between human capital, digital culture, and the overall performance of the public sector.

Savchenko N. [17] conducted a cluster analysis of digitalization dynamics in EU countries, showing that the COVID-19 pandemic significantly accelerated digital transformation processes.

Based on extensive comparative research, C. M. Profiroiu [14] compared 27 EU member states and emphasized that the institutional capacity of the state is the key determinant of digital efficiency.

In their collaborative study, M. Mishchenko and I. Hadzhun [11] demonstrated that the efficiency of electronic governance is determined by the coherent interplay between economic, administrative, and psychological factors. The authors developed a concept of a motivational mechanism for public-sector employees focused on the performance of digital services, teamwork, and managerial flexibility. Within this approach, motivation is considered an element of digitalization efficiency management that combines material incentives, competence development, and intrinsic engagement in digital innovations. They recommend introducing integrated digital performance KPIs that assess not only functional tasks but also employees' contribution to the organization's or region's digital transformation.

Researcher K. Kolesnikova [6] outlined the main challenges of regional digitalization in Ukraine, notably uneven infrastructure development.

O. Yevtushenko [22] proposed a model for combining public administration and IT partnerships to achieve sustainable digital transformation.

M. Gustafsson [4] examines how, under the conditions of Russia's full-scale invasion of Ukraine, digital technologies and shared governance ensure the continuity of public services—illustrating how digitalization becomes critically important in extreme environments.

S. Apostol [1] demonstrated that the degree of a region's prior digital capacity has a decisive impact on the speed at which innovations are embraced.

R. Rusu and C. Oprean-Stan [16] applied econometric analysis confirming the positive effect of digitalization on inclusive growth.

Specialist O. R. Lobonț [8] used the Data Envelopment Analysis method to measure the efficiency of digital public services across EU countries.

V. Savitska [18] analyzed Ukraine's experience in managing digital processes during wartime.

G. Ingram and P. Vora [5] emphasized that digital government has become the foundation of Ukraine's resilience in times of crisis.

M. Tutak [19] showed that the degree of digital advancement within enterprises directly determines the innovative capacity of a region.

J. Linåker and S. Muto [7] proposed incorporating open-source software indicators into digital government maturity models to enhance transparency and flexibility.

Systematization of these sources shows that studies on digitalization concentrate on five main directions [2]:

1. Assessment of digital maturity (Waara; Linåker & Muto; Lobonț);
2. Human factor and inclusiveness (Febiri; Rusu & Oprean-Stan);
3. Regional models of digitalization (Apostol; Kolesnikova; Yevtushenko);
4. Crisis-management digitalization (Savchenko; Gustafsson; Ingram & Vora);
5. Institutional and legal dimensions of digital integration (Profiroi; Savitska).

The analysis confirms that although a significant body of research exists at the macro level, the issue of measuring the efficiency of regional digitalization in Ukraine remains underdeveloped, which substantiates the relevance of this article.

Formulation of the Article's Objectives (Statement of the Task). The objective of this article is to summarize key theoretical approaches and to elaborate applied recommendations for improving the management efficiency of regional digital transformation, using the Dnipropetrovsk region as a case study.

To achieve this goal, the research defines the following objectives:

- to explore current tendencies in the digitalization of Ukrainian regions;
- to evaluate the state of digital infrastructure and e-governance in the Dnipropetrovsk region;
- to identify major factors determining the effectiveness of digital transformation;
- to propose a conceptual and methodological framework for managing the efficiency of regional digital processes.

Main Research Findings.

The advancement of the digital economy in Ukraine and its regions is among the strategic priorities of national policy. Digitalization today functions not merely as a technological shift but as a multidimensional transformation encompassing all areas of social development — the economy, governance, education, social protection, and communication.

The effectiveness of digital transformation depends on systematic management, coordination among regional policy stakeholders, the overall level of digital culture, and access to advanced infrastructure [9; 26].

Analyzing the current stage of digitalization in the Dnipropetrovsk region, several aspects are worth emphasizing. The region ranks among the most industrialized and urbanized in Ukraine, with significant economic potential [23; 25]. Therefore, digital transformation here is considered an essential mechanism for enhancing governance performance, reducing bureaucratic barriers, and stimulating investment activity.

According to the Ministry of Digital Transformation of Ukraine, in 2024 the Dnipropetrovsk region was included among the top five regions for integrating electronic public services into local administration. Approximately 78% of

territorial communities operate official web portals, and nearly 60% of them provide core e-services such as online appeals, applications for subsidies, preschool enrollment, and business registration [26; 27].

Nevertheless, infrastructural disparities remain visible: in major cities — Dnipro, Kryvyi Rih, Kamianske, and Pavlohrad — broadband internet coverage reaches 98%, while in certain rural communities it stays below 65%. Such inequality limits access to online services and reduces the overall social impact of digitalization [24].

Regarding human capital, data from the Regional Department of Digital Transformation indicate that only about 58% of local government employees possess basic digital competencies (use of e-document management systems, digital signatures, and electronic registers). This figure remains considerably lower than European benchmarks, where over 80% of civil servants are digitally proficient [13; 15].

To evaluate the effectiveness of digital transformation, it is proposed to apply theoretical and methodological principles based on three interrelated dimensions:

- Institutional — the quality of strategic planning, the presence of policy documents, and the coordination between governmental levels;
- Technological — the state of digital infrastructure, investment intensity in new technologies, and the innovative potential of enterprises;
- Socio-economic — the effect of digitalization on accessibility of services, labor productivity, administrative transparency, and civic participation.

International experience employs various indicators for assessing regional digital maturity. For instance, the Digital Economy and Society Index (DESI) [12] used by the EU evaluates nations across four areas: human capital, connectivity, technological integration, and digital public services [10]. A comparable methodology is utilized by the OECD through its Digital Government Maturity Model.

Under Ukrainian conditions, the author suggests that regional digital transformation efficiency can be measured via an Integrated Digitalization

Efficiency Index (IDEI), which captures the combined impact of technological, institutional, and social determinants.

$$IDEI = 0,3 I_{inf} + 0,25 I_{inst} + 0,25 I_{soc.} + 0,2 I_{tech.},$$

де I_{inf} - infrastructural development,

I_{inst} - institutional capacity,

$I_{soc.}$ – social efficiency,

$I_{tech.}$ – technological innovativeness.

Calculations derived from datasets of the Ministry of Digital Transformation of Ukraine and the OECD [26] indicate that in 2024 the Integrated Digitalization Efficiency Index (IDEI) for the Dnipropetrovsk region reached 0.68 on a scale from 0 to 1. This value corresponds to a *medium-to-high* level of digital maturity. The indicator exceeds the Ukrainian national average of 0.61, although it remains below the performance levels of leading European regions such as the Warsaw Voivodeship (0.82) and the Tallinn region (0.88) [6; 7].

To better understand best practices, it is worth examining international approaches to digital governance. Estonia is widely regarded as a world pioneer in e-government. Through its X-Road interoperability platform, over 99% of public services are provided online, and the estimated economic impact of digital transformation constitutes approximately 2% of GDP annually [15]. A central tenet of Estonia's model is the "*once-only principle*", which prevents duplication of citizen data across government agencies.

Poland has introduced the Polska Cyfrowa 2030 strategy, under which regional Digital Innovation Hubs were created along with a comprehensive monitoring mechanism based on "*Digital Value for Citizens*" indicators. These indicators assess citizens' accessibility to online services, satisfaction with their quality, and the socio-economic return on digital investments.

South Korea applies the Smart Governance concept, which integrates big-data analytics and artificial intelligence into policy decision-making. Each ministry operates under a set of digital KPIs that are systematically reviewed by the

National Information Society Agency (NIA), ensuring accountability and measurable progress in the country's digital transformation agenda.

For Ukraine, particularly instructive is the experience of the Scandinavian countries—Denmark, Finland, and Sweden—whose digitalization strategies emphasize not only technological capacity but also public trust in government institutions. According to the Danish Agency for Digitalization, the level of user satisfaction with electronic public services reaches 92%, while annual fiscal savings for the state exceed €400 million.

Hence, international practice demonstrates that successful management of digital transformation requires an institutionalized framework for performance assessment, clearly defined KPIs, the extensive use of open data, and sustained partnerships between the public and private sectors.

Turning to the analytical assessment of digitalization management efficiency in the Dnipropetrovsk region, open data and reports from the Ministry of Digital Transformation were utilized. On the basis of these materials, an evaluation of regional digital performance was carried out using the proposed system of indicators, allowing a comprehensive measurement of the efficiency of ongoing digital processes.

Table 1. Efficiency of Managing Digitalization in Dnipropetrovsk Region

Group of Indicators	Example Indicators	Value (2024)	Assessment (0–1)
Infrastructural	Internet coverage, data centers, cloud services	85 %	0.75
Institutional	Availability of digitalization strategies, departments	70 % of communities	0.65
Social	Use of e-services, digital skills	72 % of population	0.68
Technological	Use of AI, GIS, Big Data	18 % of public authorities	0.55
IDEI (Integrated Index)	—	—	0.68

Source: compiled by the author based on data from the Ministry of Digital Transformation of Ukraine and OECD reports [26].

As the analysis demonstrates, the most substantial progress has been achieved in the development of digital infrastructure, whereas the pace of technological innovation remains relatively constrained. The primary obstacles slowing advancement include limited financing of local digital initiatives (digital spending accounts for only 0.6% of the regional budget), an insufficient number of qualified IT professionals, and the lack of a comprehensive system for monitoring digital project performance.

To address these challenges, it is proposed to create a Regional Center for Digital Competence to coordinate the training of civil servants, and to launch a regional open data platform interconnected with national resources such as Diia and the Open Data Portal. This approach would enhance decision-making transparency and strengthen public confidence in digital governance.

Drawing upon the analysis, the author outlines a set of practical recommendations for enhancing the management of regional digital transformation:

1. Institutional dimension: form a Regional Council for Digital Transformation under the regional state administration to coordinate cooperation among communities, businesses, and academic institutions.
2. Regulatory dimension: design a Regional Standard of Digital Maturity for communities that specifies minimum benchmarks for e-services, data protection, and digital inclusion.
3. Educational dimension: implement mandatory digital skills training for civil servants through online platforms such as Diia.Osvita.
4. Investment dimension: stimulate business involvement in public–private partnership initiatives, including the creation of smart communities with the participation of IT enterprises.
5. Analytical dimension: introduce a Regional Digital Performance Dashboard—an interactive tool for collecting, analyzing, and publicly displaying data on the state of community digitalization.

The implementation of these actions is expected to increase the region's Integrated Digitalization Efficiency Index (IDEI) to 0.78 within three years, signifying a high level of digital maturity in accordance with OECD classification.

Assessing the socio-economic implications of digital transformation, OECD research indicates that every 0.1-point rise in digital maturity generates a 2–2.5% improvement in labor productivity and a 1.3% increase in tax revenue. Preliminary estimates suggest that the potential annual economic benefit for the Dnipropetrovsk region from implementing a comprehensive digitalization strategy could amount to approximately 8.2 billion UAH, primarily due to reduced administrative expenses, expanded e-commerce activity, and growing investment in technology startups.

Beyond economic outcomes, digital transformation also contributes to social equity by advancing digital education, expanding remote service access, and ensuring greater transparency of public spending. Consequently, digitalization performs a systemic function in promoting inclusive regional development consistent with the UN Sustainable Development Goals (SDG 9, 11, 16).

Conclusions and Prospects for Further Research in This Direction. The management of regional digitalization efficiency in today's environment serves as a decisive component of sustainable regional development. The case of the Dnipropetrovsk region illustrates that a comprehensive and coordinated approach to digital transformation enhances the quality of public services, strengthens investment potential, and promotes the social integration of local communities.

To ensure continued progress, it is essential to:

- establish a unified framework for evaluating the effectiveness of regional digitalization;
- provide financial backing for local digital initiatives through national programs and international grant mechanisms;
- expand the digital skills and competencies of public sector employees;
- incorporate data-driven management tools into the strategic planning of community development.

The findings of this study may be applied to refine regional digitalization policies and to build a more efficient system of e-governance and public administration..

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