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MANAGEMENT OF REGIONAL COMPETITIVENESS IN THE CONDITIONS OF DIGITAL TRANSFORMATION

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УПРАВЛІННЯ РЕГІОНАЛЬНОЮ КОНКУРЕНТОСПРОМОЖНІСТЮ В УМОВАХ ЦИФРОВОЇ ТРАНСФОРМАЦІЇ

This article examines the theoretical and applied aspects of the impact of digital transformation on the competitiveness of Ukraine's regions amid intensifying security challenges. It is argued that, under current conditions, the key determinants of regional competitiveness are the level of technological development, institutional capacity, digital infrastructure, and the effectiveness of strategic management of information technologies. Conceptual approaches to analyzing the relationship between digitalization and regional development are systematized, including the principles of endogenous growth theory, the concept of smart specialization, and institutional theory. The main mechanisms through which information technologies influence the enhancement of regional competitiveness have been identified, including the reduction of transaction costs, the stimulation of innovation, the development of digital services, and the improvement of public administration efficiency.

A comprehensive analysis of digital development disparities was conducted based on the Digital Transformation Index of Ukraine's regions for 2023 – 2025.

Leading regions and regions with critically low digital transformation indicators were identified. The results of the sub-index analysis revealed systemic asymmetries between the level of development of front-office digital services and back-office digitalization, as well as significant disparities in the digitalization of local communities.

Ward's hierarchical clustering method was used to classify the regions. As a result, four clusters were formed: digital leaders, developed regions, regions catching up, and regions facing particular challenges. Correlation analysis revealed a moderate positive relationship between the overall level of digital transformation in regions and the level of digitalization in local communities. Recommendations are provided for improving strategic management of digital transformation at the regional level, developing digital infrastructure, and strengthening the institutional capacity of local governments.

У статті досліджено теоретичні та прикладні аспекти впливу цифрової трансформації на конкурентоспроможність регіонів України в умовах посилення безпекових викликів. Обґрунтовано, що в сучасних умовах стрижневими детермінантами регіональної конкурентоспроможності виступають рівень технологічного розвитку, інституційна спроможність, цифрова інфраструктура та ефективність стратегічного управління інформаційними технологіями. Систематизовано концептуальні підходи до аналізу взаємозв'язку цифровізації та регіонального розвитку, зокрема положення теорії ендогенного зростання, концепції розумної спеціалізації та інституційної теорії. Визначено основні механізми впливу інформаційних технологій на підвищення конкурентоспроможності регіонів через зниження транзакційних витрат, активізацію інноваційної діяльності, розвиток цифрових сервісів і підвищення ефективності публічного управління.

Проведено комплексний аналіз диспропорцій цифрового розвитку на основі індексу цифрової трансформації регіонів України за 2023–2025 рр. Виявлено регіони-лідери та регіони з критично низькими показниками

цифрової трансформації. За результатами субіндексного аналізу встановлено наявність системних асиметрій між рівнем розвитку фронт-офісних цифрових сервісів і бек-офісної цифровізації, а також суттєві диспропорції у сфері цифровізації територіальних громад.

Для типологізації регіонів застосовано метод ієрархічної кластеризації Варда. У результаті сформовано чотири кластери: цифрові лідери, розвинені регіони, регіони, що скорочують відставання, регіони з особливими викликами. Кореляційний аналіз засвідчив наявність помірного позитивного зв'язку між загальним рівнем цифрової трансформації регіонів і рівнем цифровізації територіальних громад. Обґрунтовано рекомендації щодо вдосконалення стратегічного управління цифровою трансформацією на регіональному рівні, розвитку цифрової інфраструктури та посилення інституційної спроможності органів місцевого самоврядування.

Keywords: *information technologies, competitiveness, digitalization, strategic IT management, economic policy, local governments, public administration, region, territorial communities.*

Ключові слова: *інформаційні технології, конкурентоспроможність, цифровізація, стратегічне управління в інформаційних технологіях, економічна політика, органи місцевого самоврядування, публічне управління, регіон, територіальні громади.*

Statement of the problem. In the current context of the digital transformation of the economy and intensifying security challenges, the competitiveness of regions is increasingly determined not only by the availability of natural resources, production capacity, and concentration of capital, but above all by the level of technological development, institutional capacity, and the effective use of information technologies.

Digitalization creates new opportunities for the sustainable development of regions, contributes to improving the efficiency of public administration, reducing business transaction costs, stimulating innovation, and attracting investment. At the same time, in Ukraine, despite a certain intensification of state policy in the digital

sphere, significant interregional disparities persist in the level of digital infrastructure development and the readiness of local self-government bodies to implement IT solutions [1; 2; 3].

The asymmetry of regional development limits the ability of local communities to realize their potential and negatively affects their competitive positions in the context of modern economic competition. Under these conditions, research into the impact of information technologies on regional competitiveness takes on significant theoretical and practical importance.

Analysis of recent studies and publications. The conceptual foundation of this study is based on the works of domestic and foreign scholars in the fields of regional economics, digital transformation, and public administration. D. Mosiychuk and M. Shashina analyzed the issue of institutional support for regional spatial development in the context of economic digitalization [4]. The role of information technologies in enhancing the effectiveness of public management of a region's innovative development was studied by I. Oliichenko and M. Ditkovska [5]. The relationship between the development of IT infrastructure and the investment attractiveness of regions was analyzed by K. Chrobocińska [6]. The potential of digitalization tools in the context of stimulating regional competitiveness was assessed by N. Popadynets, M. Pityulich, O. Graftska, R. Bilyk, and N. Sembay [14].

At the same time, issues of systematic strategic management of information technologies at the regional level as a comprehensive tool for enhancing competitiveness remain insufficiently covered in the scientific literature, which underscores the relevance of conducting a separate study in this area.

The purpose of this article is to investigate the impact of digital transformation on regional competitiveness and to substantiate mechanisms for the strategic management of digital development at the regional level. This article is a continuation of the research initiated by scholars V. Humeniuk and A. Betlej in a previous publication [11, pp. 50–79], which deepens the analysis of the mechanisms through which digital transformation influences the stimulation of regional competitiveness.

The information base of the study consists of official statistical and analytical materials from the Ministry of Digital Transformation of Ukraine, annual editions of the Digital Transformation Index of Ukraine's Regions for 2023 – 2025, regulatory and legal acts, analytical reports from international organizations, and the results of the authors' own calculations and generalizations.

The methodological basis of the study consists of general scientific and specialized methods of inquiry, in particular: methods of theoretical generalization and systems analysis—to study the essence of digital transformation and regional competitiveness; statistical and comparative analysis—to assess interregional disparities in digital development; the cluster analysis method (Ward's Method) – to classify regions; correlation analysis – to determine the relationship between indicators of digital transformation and the digitalization of local communities; and graphical methods—to visualize the study's results

Presentation of the main material. In modern economic science, a region's competitiveness is viewed as a territory's ability to ensure sustainable growth in household income, offer an attractive environment for attracting investment, and retain human capital in the context of global and national competition [8].

A triad of conceptual approaches serves as the theoretical foundation for analyzing the role of information technologies in regional development.

1. Paul Romer's theory of endogenous growth, which argues that technological knowledge and innovation are internal drivers of economic growth, and that investments in digital infrastructure generate positive externalities for the entire regional economy [16, pp. 71–102].

2. The concept of “smart specialization,” developed within the framework of EU cohesion policy, involves the targeted use of digital technologies to build competitive advantages for regions in priority sectors [13, p. 1291–1302].

3. Institutional theory emphasizes the importance of the quality of public administration and digital institutions as a prerequisite for the effective implementation of IT solutions at the regional level [15, p. 1291–1302].

Information technologies stimulate regional competitiveness through several interrelated factors:

- increased labor productivity and production efficiency through process automation and the digitalization of the business environment [18];
- reduction of transaction costs for economic entities through the development of electronic administrative services and digital platforms [18];
- stimulation of innovation processes through the formation of regional IT clusters and digital hubs [7, pp. 1785–1799];
- improving the quality of public administration through the implementation of e-government systems and open data, which enhances the transparency and accountability of local self-government bodies [17].

The process of digitalizing the regional economy is implemented through a system of interconnected elements covering the infrastructural, institutional, and managerial dimensions. The infrastructure component of this process involves the development of broadband communication networks, data centers, public Wi-Fi, and “smart” urban infrastructure (IoT networks, sensor-based monitoring systems). The level of digital infrastructure directly correlates with indicators of the region’s investment attractiveness and the concentration of IT companies [3].

The institutional aspect of the region’s digitalization process includes not only the development of a regulatory framework that must be flexible and adapted to the rapid pace of change in the digital space [4, p. 507], but also the creation of digital development agencies, technology parks, and innovation centers, as well as the development of public-private partnerships in the field of digitalization.

The managerial aspects of the digitalization process involve the implementation of e-governance systems, digital registries, open data platforms, and automated management decision-making systems. Effective strategic IT management at the regional level requires coordination of digital initiatives among local governments, businesses, and civil society [9].

The interaction of these vectors of digital transformation and their impact on the components of regional competitiveness are summarized in Table 1.

**Table 1. Vectors of digital transformation and their impact
on regional competitiveness**

Vectors of digital transformation	Key Tools	Impact on Competitiveness	Implementing of implementation
Infrastructure	Broadband Internet, IoT, data centers	Attracting investment, IT business location	Local governments, telecommunications companies
Institutional	Technology parks, digital agencies, PPPs	Innovation, development of IT clusters	Regional administrations, business
Administrative	E-governance, open data, digital registries	Reduction of transaction costs, transparency	Public administration bodies
Human resources	Digital education, reskilling, IT schools	Human capital development, talent retention	Universities, business, local governments,
Financial	Digital grants, IT funds, crowdfunding	Innovation funding, startup ecosystem	Government, international donors

Source: compiled by the authors based on [1, 2, 3; 4; 9; 14]

An analysis of the state of digital development in Ukraine's regions reveals significant interregional disparities that affect their competitiveness. The study is based on the annual editions of the Digital Transformation Index of Ukraine's Regions (DTI) for 2023 –2025 [1; 2; 3]. At the same time, the methodology for calculating the DTI underwent changes during the study period, which must be taken into account when interpreting the results and conducting a comparative analysis. Specifically, in 2023, the DTI comprised 8 sub-indices and 88 indicators on a scale of 0 to 1 [1]; in 2024, the “CDTO (Chief Digital Transformation Officer) Individual Projects” sub-index was introduced with a weight of 60% [2]; in 2025, the methodology was adapted to the goals of the EU Digital Decade by transitioning to a 5-component structure, a 100-point rating scale, and the use of 126 indicators [3].

To assess interregional differences in digital development, the values of the overall *Digital Transformation Index (DTI)* for Ukraine's regions for 2023–2024 were analyzed. Table 2 presents the DTI indicators, as well as the absolute and relative dynamics of their changes. The regions were ranked according to their DTI levels in 2024.

Table 2. Dynamics of the DTI for regions of Ukraine, 2023 – 2024

Regions	DTI 2023	DTI 2024	Δ abs.	Δ %
Lviv Region	0,891	0,850	-0,041	↓ 4,6
Dnipropetrovsk Region	0,908	0,844	-0,064	↓ 7,0
Odesa Region	0,785	0,804	+0,019	↑ +2,4
Vinnysia Region	0,777	0,755	-0,022	↓ 2,8
Volyn Region	0,831	0,711	-0,120	↓ 14,4
Zakarpattia Region	0,732	0,647	-0,085	↓ 11,6
Poltava Region	0,833	0,640	-0,193	↓ 23,2
Rivne Region	0,727	0,632	-0,095	↓ 13,1
Kharkiv Region***	0,787	0,617	-0,170	↓ 21,6
Kherson Region***	0,316	0,582	+0,266	↑ +84,2
Cherkasy Region	0,610	0,538	-0,072	↓ 11,8
Kyiv Region	0,684	0,474	-0,210	↓ 30,7
Ivano-Frankivsk Region	0,685	0,436	-0,249	↓ 36,4
Sumy Region***	0,178	0,435	+0,257	↑ +144,4
Kirovohrad Region	0,531	0,407	-0,124	↓ 23,4
Luhansk Region**	0,404	0,404	N/C****	N/C
Chernihiv Region	0,553	0,362	-0,191	↓ 34,5
Zhytomyr Region	0,560	0,343	-0,217	↓ 38,8%
Ternopil Region	0,827	0,341	-0,486	↓ 58,8%
Chernivtsi Region	0,546	0,254	-0,292	↓ 53,5%
Khmelnyskyi Region	0,620	0,230	-0,390	↓ 62,9%
Zaporizhzhia Region***	0,289	0,209	-0,080	↓ 27,7%
Mykolaiv Region	0,441	0,180	-0,261	↓ 59,2%
Donetsk Region***	0,359	0,129	-0,230	↓ 64,1%
Crimea*	N/C	N/C	N/C	N/C

*Note. *Crimea is Ukraine. **The index value for Luhansk Region is as of February 24, 2022.*

****In regions where active hostilities are taking place, values are calculated for communities controlled by the Ukrainian government. ****N/C - No Change.*

Source: calculated by the authors based on [1; 2]

Analysis of the data in Table 2 reveals a number of key trends. In particular, Lviv Region (0,850) and Dnipropetrovsk Region (0,844) maintained their leading positions in terms of the DTI level despite a change in the index calculation methodology. The highest growth rates were recorded in Sumy Region (+144,4%) and Kherson Region (+84,2%), which is associated with the intensified implementation of individual CDTO projects. At the same time, a significant decline in indicators was observed in the Ternopil (-58,8%) and Chernivtsi (-

53,5%) regions due to low activity in the implementation of digital projects. The largest decline was recorded in the Donetsk region (-64,1%), largely due to the impact of active hostilities. Fig. 1 illustrates the significant polarization of regions in terms of digital development.

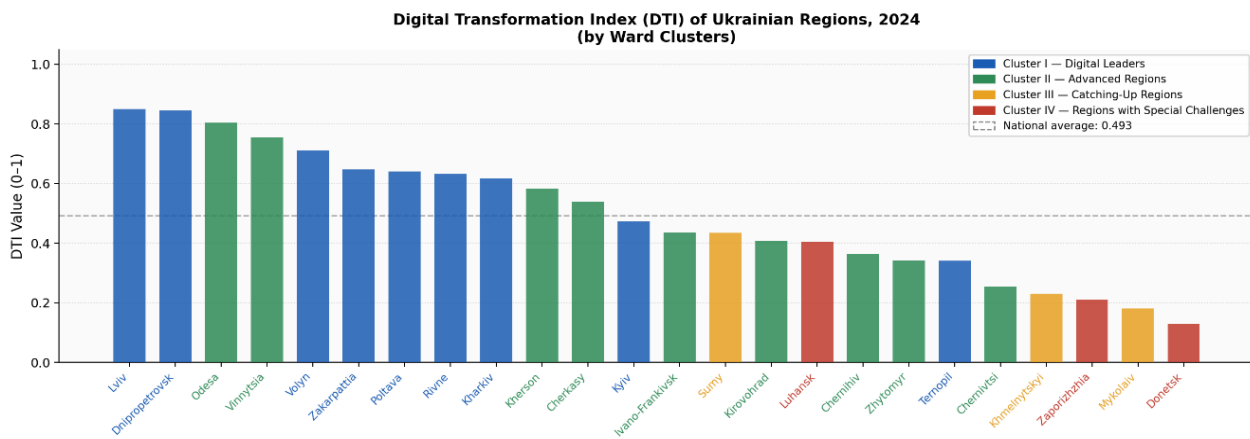


Fig. 1. Overall DTI Values for Ukrainian Regions in 2024

Note: Color coding of clusters: blue – Cluster I “Digital Leaders”; green Cluster II “Advanced Regions”; yellow – Cluster III “Catching-Up Regions”; red – Cluster IV “Regions with Special Challenges”. National average – 0,493.

Source: constructed by the authors based on [2] using Ward’s Method [12, p. 277].

The cluster of leading regions (blue) is concentrated in the range of 0,60–0,85, while the regions of Cluster IV (red) – Donetsk Region (0,129), Mykolaiv Region (0,180), and Zaporizhzhia Region (0,209) – exhibit significantly lower DTI values. The dotted line indicates the national average DTI value – 0,497. For an in-depth analysis of the structure of regional digital development, Table 3 presents the values of the nine DTI sub-indices for 2024. Color coding of the digital data is used to visualize the level of development by individual components: green indicates the leadership zone ($\geq 0,80$), red indicates critical lag ($< 0,35$), and black indicates intermediate values (0,35–0,79).

Sub-index analysis revealed a number of systemic asymmetries in the digital development of regions. In most regions, there is a significant gap between the “PBeP” and “PM” indicators ranging from 0,2 to 0,5 points, indicating the advanced development of front-office digital services compared to the level of back-office digitalization. Critically low values of the “IeP” subindex in Ternopil

Region (0,105), Khmelnytskyi Region (0,028), and Chernivtsi Region (0,028) were one of the key factors in the deterioration of their positions in the overall ranking.

Table 3. Subindex DTI Profile of Ukraine's Regions, 2024

Regions	IC	ID	ASC	PM	DE	RP	PBeP	SDT	IeP
Lviv Region	0,85	0,77	0,82	0,78	0,61	0,67	0,97	0,96	0,88
Dnipropetrovsk Region	0,90	0,79	0,81	0,75	0,76	0,76	0,89	0,65	0,88
Odesa Region	0,85	0,88	0,71	0,54	0,58	0,71	0,71	0,52	0,88
Vinnitsia Region	0,80	0,71	0,59	0,43	0,67	0,65	0,68	0,65	0,83
Volyn Region	0,60	0,72	0,61	0,67	0,64	0,79	1,00	0,66	0,71
Transcarpathian Region	0,90	0,81	0,53	0,45	0,63	0,76	0,89	0,38	0,63
Poltava Region	0,94	0,96	0,59	0,76	0,74	0,73	0,79	0,69	0,55
Rivne Region	0,85	0,80	0,52	0,39	0,51	0,78	0,80	0,47	0,63
Kharkiv Region***	0,49	0,51	0,57	0,54	0,90	0,94	0,98	0,55	0,57
Kherson Region***	0,78	0,35	0,37	0,20	0,57	0,51	0,67	0,41	0,65
Cherkasy Region	0,48	0,63	0,59	0,25	0,52	0,37	0,68	0,31	0,58
Kyiv Region	0,73	0,78	0,53	0,43	0,56	0,69	0,72	0,43	0,38
Ivano-Frankivsk Region	0,79	0,67	0,53	0,30	0,35	0,76	0,68	0,36	0,36
Sumy Region***	0,71	0,81	0,46	0,23	0,52	0,42	0,70	0,41	0,37
Kirovohrad Region	0,50	0,44	0,41	0,13	0,47	0,49	0,73	0,36	0,38
Luhansk Region**	0,09	0,10	0,74	0,46	0,26	0,40	0,62	0,22	0,00
Chernihiv Region	0,73	0,68	0,55	0,64	0,57	0,44	0,84	0,54	0,19
Zhytomyr Region	0,18	0,73	0,47	0,25	0,44	0,29	0,68	0,33	0,29
Ternopil Region	0,85	0,71	0,64	0,68	0,54	0,63	0,71	0,79	0,10
Chernivtsi Region	0,77	0,98	0,52	0,33	0,53	0,40	0,82	0,40	0,03
Khmelnytskyi Region	0,78	0,73	0,43	0,44	0,41	0,28	0,81	0,39	0,03
Zaporizhzhia Region***	0,63	0,46	0,25	0,08	0,55	0,20	0,51	0,24	0,10
Mykolaiv Region	0,33	0,68	0,28	0,24	0,32	0,76	0,71	0,29	0,00
Donetsk Region ***	0,34	0,17	0,25	0,17	0,53	0,29	0,53	0,30	0,00
Crimea*	N/C****	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C

*Note: *Crimea is Ukraine. **The index value for Luhansk Region is as of February 24, 2022.*

****In regions where active hostilities are taking place, values are calculated for communities controlled by the Ukrainian government. ****N/C – No Change. Color coding of numerical data is used to visualize the level of development across individual components: green indicates a leading position, red indicates a critical lag, and black indicates intermediate values.*

Legend: IC – Institutional Capacity; ID – Internet Development; ASC – Administrative Services Center Development; PM – Paperless Mode; DE – Digital Education; RP – Regional Profile; PBeP – Penetration of Basic e-Services; SDT – Sectoral Digital Transformation; IeP – Individual Projects Chief Digital Transformation Officer. Color coding: green $\geq 0,80$; red $< 0,35$; black – intermediate values. N/C – No Change.

Source: compiled by the authors based on [2, p. 20]

At the same time, the Kharkiv region demonstrates the highest level of digital education (“DE” – 0,900) with a relatively lower value of the “IC” subindex (0,491), indicating an imbalance between the level of digital competencies and the

region's managerial capacity for digital transformation. To assess the structure of digital development in Ukraine's regions, we will examine the values of the five sub-indices and the DTI composite index for 2025 (Table 4).

Table 4. Subindex DTI Profile of Ukraine's Regions, 2025

Regions	DSk	Dserv	DI	DTC
Dnipropetrovsk Region	85.2	73.4	72.5	36.1
Lviv Region	89.8	72.5	65.9	52.8
Ternopil Region	100.0	65.5	63.1	35.4
Rivne Region	98.5	58.6	64.9	29.7
Poltava Region	96.1	60.1	61.1	29.1
Kyiv Region	39.9	63.3	81.8	38.2
Kirovohrad Region	76.6	54.5	77.3	13.6
Kharkiv Region***	69.1	64.3	59.6	38.5
Volyn Region	72.3	61.7	62.0	32.9
Transcarpathian Region	53.1	62.7	64.3	35.1
Chernihiv Region	70.0	61.4	58.9	28.1
Ivano-Frankivsk Region	66.3	56.9	55.7	30.2
Sumy Region***	90.0	50.0	48.2	32.9
Kherson Region***	72.0	48.3	49.5	21.3
Khmelnyskyi Region	78.9	48.2	58.0	29.7
Mykolaiv Region	76.4	47.1	55.6	32.6
Vinnytsia Region	63.3	54.8	47.4	30.1
Zhytomyr Region	60.1	57.7	53.9	18.5
Odesa Region	59.0	57.3	47.9	30.3
Cherkasy Region	31.4	54.9	57.0	30.1
Chernivtsi Region	32.5	56.1	49.8	28.0
Donetsk Region***	40.0	50.1	27.2	14.6
Zaporizhzhia Region***	53.8	44.7	28.8	11.9
Luhansk Region **	44.1	40.6	36.1	11.4
Crimea*	N/C****	N/C	N/C	N/C

Note: *The Autonomous Republic of Crimea is part of Ukraine. **The index value for Luhansk Region is as of February 24, 2022. ***In regions where active hostilities are taking place, the values are calculated for communities controlled by the Ukrainian government. ****N/C – No Change. Color coding of digital data is used to visualize the level of development across individual components: green indicates a leading position, red indicates a critical lag, and black indicates intermediate values.

Legend: DSk – Digital Skills; DServ – Digital Services; DI – Digital Infrastructure; DTC – Digitalization of Territorial Communities.

Source: compiled by the authors based on [3]

To classify the regions, we will use Ward's Method [12, p. 277], which ensures the formation of compact, homogeneous clusters. The feature space includes five variables: the overall DTI 2024 index and four DTI 2025 sub-indices—digital skills, digitalization of public services, digital infrastructure, and digitalization of local communities. Prior to clustering, all features were standardized using the z-score method to eliminate scale effects. The optimal number of clusters, $k=4$, was selected based on dendrogram analysis and the criterion of meaningful interpretability of the results.

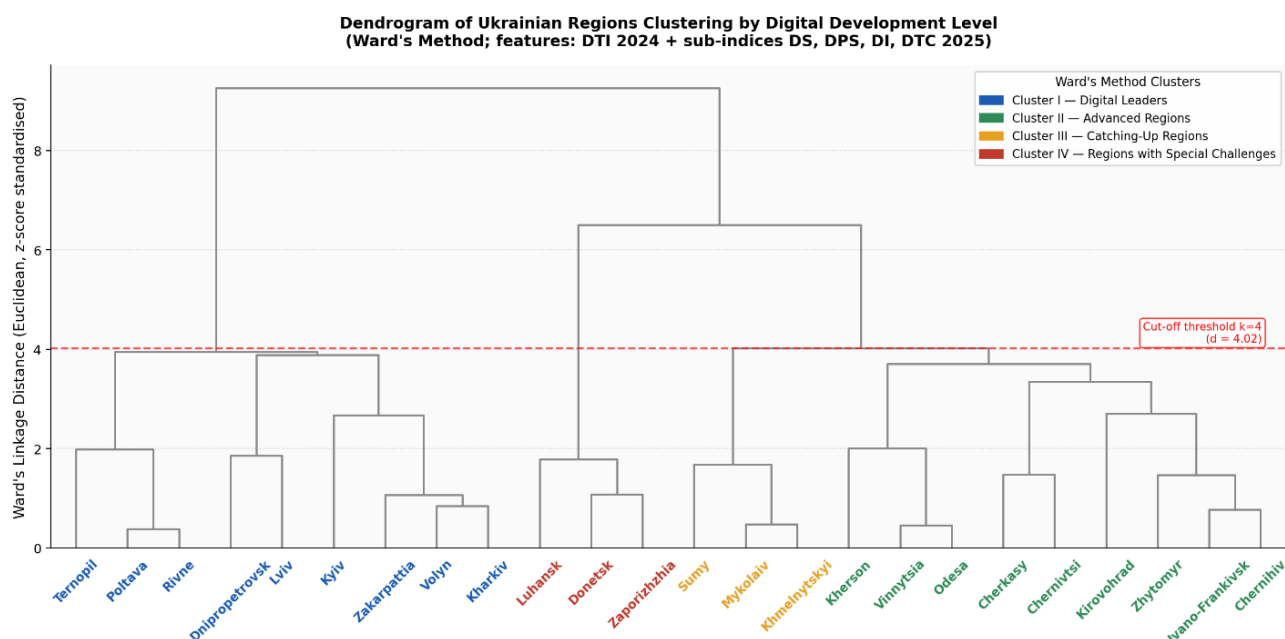


Fig. 2. Dendrogram of regional clustering by level of digitalization

*Source: calculated and constructed by the authors based on [2; 3]
using Ward's Method [12, p. 277].*

The dendrogram (Fig. 2) reflects the hierarchical structure of the clustering of Ukraine's regions based on digital development indicators. The red dotted line marks the threshold for division into four clusters ($k=4$) with the corresponding level of merging distance. Cluster IV, comprising the Donetsk, Zaporizhzhia, and Luhansk regions, demonstrates the highest level of internal homogeneity. These regions are grouped at the lowest levels of the dendrogram due to a combination of low DTI values in 2024 and minimal DTI subindex indicators in 2025. At the same time, Ternopil and Rivne regions occupy a peripheral position within Cluster I,

which is explained by the combination of relatively low DTI values in 2024 with a significant improvement in indicators in 2025.

To visualize inter-cluster differences in digital development, a radar chart of the average subindex values within the four regional clusters was constructed (Fig. 3). The largest gaps between Cluster I and Cluster IV were recorded for the DS subindex (about 45 points) and the DI subindex (approximately 40 points), indicating significant unevenness in the digital development of the regions. At the same time, the DTI subindex is characterized by critically low values across all clusters: even the leading regions do not exceed 36 points, confirming the systemic nature of the lag in the digital development of local communities.

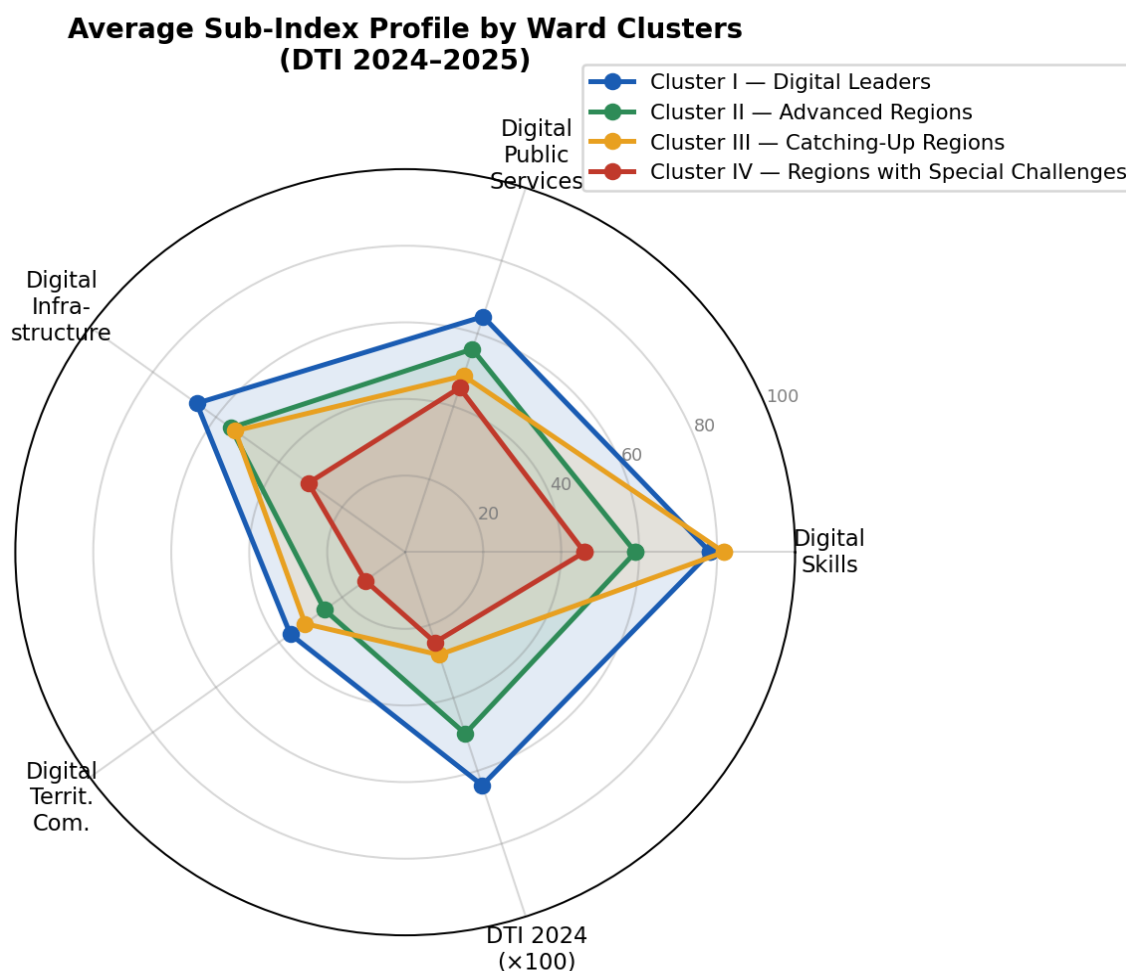


Fig. 3. Comparative profile of DTI 2025 sub-indices by cluster

Source: constructed by the authors based on [2; 3] using Ward's Method [12, p. 277].

To assess the relationship between the regional level of digital transformation and the digital capacity of local communities, a correlation analysis

was conducted between the DTI 2024 and DTC 2025 indicators (Fig. 4). The results revealed a moderate positive correlation ($r = 0,548$). Kyiv Region, with a DTI 2024 value of 0,474, demonstrates the highest DTI score (38,2), which is associated with the concentration of managerial and organizational resources. In contrast, Kirovohrad Region, with a DTI 2024 of 0,407, scores only 13,6 points on the DTC subindex, indicating a structural lag in the digital development of local communities despite a relatively acceptable level of regional digital capacity.

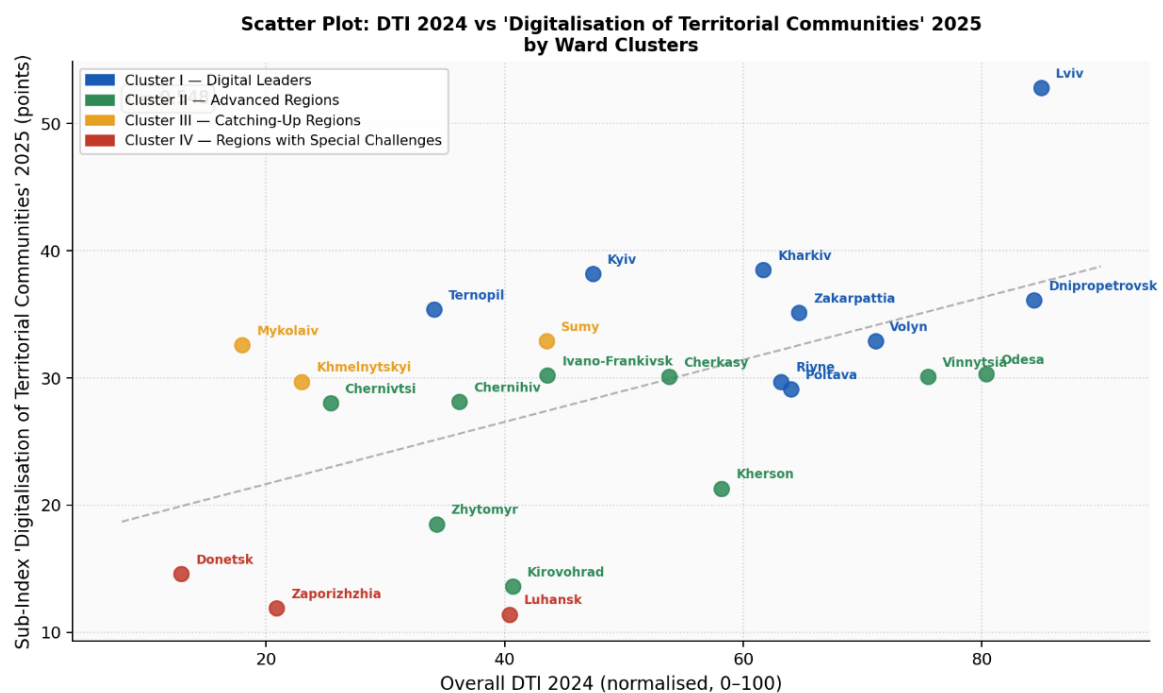


Fig. 4. Scatter plot of the relationship between DTI 2024 and the “Digitalization of Territorial Communities” subindex in 2025 by cluster

Source: constructed by the authors based on [2; 3] using Ward's Method [12, p. 277].

Correlation analysis revealed a moderate positive relationship between the DTI 2024 and DTI 2025 indicators ($r = 0,548$), indicating that the level of digitalization of local communities is partially dependent on the region's overall digital capacity (Fig. 4). Kyiv Region, with a DTI 2024 value of 0,474, demonstrates the highest DTC score (38,2), which is associated with the concentration of administrative resources and institutional capacity. In contrast, Kirovohrad Region, with a DTI 2024 of 0,407, has only 13,6 points on the DTI

subindex, indicating a structural lag in the level of digitalization of local communities despite a relatively acceptable level of regional digital capacity.

The results presented in Table 5 confirm the existence of a clear stratification of regions by level of digital development.

Table 5. Results of regional clustering by level of digital transformation

Clusters	Regions	n	DTIa 2024	DTIb 2025
Cluster I “Digital Leaders”	Volyn, Dnipropetrovsk, Zakarpattia, Kyiv, Lviv, Poltava, Rivne, Ternopil, Kharkiv	9	0,640	50,3
Cluster II “Advanced Regions”	Vinnytsia, Ivano-Frankivsk, Zhytomyr, Kirovohrad, Odesa, Kherson, Cherkasy, Chernivtsi, Chernihiv	9	0,498	43,4
Cluster III “Catching-Up Regions”	Mykolaiv, Sumy, Khmelnytskyi	3	0,282	43,7
Cluster IV “Regions with Special Challenges”	Donetsk, Zaporizhzhia, Luhansk	3	0,247	30,7

Note: DTIa 2024 – average value of the digital transformation index (scale 0–1); DTIb 2025 – average value of the total digital transformation index score (scale 0–100); n – number of regions in the cluster.

Source: calculated by the authors based on [2; 3] using Ward’s Method [12, p. 277].

The average value of the DTIa 2024 decreases sequentially from 0,640 in Cluster I to 0,247 in Cluster IV, indicating a 2,6-fold gap between the groups of leading and lagging regions. At the same time, Clusters II and III demonstrate similar average values for the 2025 indicators (43,4 and 43,7, respectively) despite significantly different 2024 DTI levels (0,498 versus 0,282).

Conclusions and prospects for further research. The study confirmed that digital transformation is one of the key factors in ensuring regional competitiveness amid intensifying security risks and the growing role of information technologies. It has been established that the level of digital development in Ukraine’s regions is characterized by significant asymmetry, manifested in the uneven development of digital infrastructure, institutional capacity, digital services, and the level of digitalization of local communities. The

change in the methodology of the Digital Transformation Index of Ukraine's Regions for 2023–2025 complicates the analysis of the evolution of digital trends over time, but allows for a more detailed assessment of the structural components of regional digital development.

The results of the sub-index analysis revealed systemic asymmetries in the digital transformation of regions. In most regions, front-office digitalization is ahead of the level of digitalization of internal management processes, indicating that institutional digital transformation remains incomplete. Significant disparities were also identified between the overall level of digital capacity in regions and the level of digitalization in local communities. A cluster analysis using Ward's Method identified four typological groups of regions, distinguished by their level of digital maturity, the structure of digital disparities, and institutional capacity for implementing digital policy. Leading regions demonstrate the highest level of digital resilience, while regions facing specific security challenges are characterized by critically low values for most digital indicators.

Correlation analysis confirmed the existence of a moderate positive relationship between the overall level of digital transformation in regions and the level of digitalization in local communities, indicating the interdependence of regional and local levels of digital development. It is argued that enhancing the competitiveness of regions requires the formation of a comprehensive system of strategic management of digital transformation, aimed at developing digital infrastructure, strengthening the institutional capacity of local self-government bodies, stimulating innovative activity, and reducing interregional digital disparities. The practical implementation of these directions will contribute to increasing the adaptability of regional economies and strengthening the competitive positions of Ukraine's regions in the context of the digital economy.

Prospects for further research are linked to the study of the energy transition in regional socio-economic systems as an independent and priority vector of macroeconomic transformation in the context of post-war recovery and European integration of Ukraine's regions.

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