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Industrial Applications

Socio-economic development in conditions of digital transformations: regional features, strategic analysis, and prospects

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Abstract — The article's purpose is to study socio-economic development in the conditions of digital transformations, the implementation of strategic analysis, and the determination of further prospects. Approbation of the proposed methodological approaches and the corresponding mathematical toolkit was carried out, which allows calculating the economic potential of the IT sector's development in Ukraine. With the help of systematic approaches, the authors have singled out the regions with the highest prospects for socio-economic development based on SMART specializations. It has been proven that when forming strategies for the socio-economic development of regions, an essential element is to determine their SMART disciplines. The conducted analysis made it possible to assess the possibility of implementing SMART specialization in the IT regions of Ukraine, which can become a crucial priority direction of their strategic development.

Keywords— digital transformation, socio-economic development, strategic analysis, regions

I. INTRODUCTION

Current conditions of the development of the national economy are characterized by significant structural and qualitative shifts in all spheres of socio-economic relations under the influence of the processes of globalization in all its manifestations, the development of science and technology, climate changes, and the emergence of various kinds of unpredictable threats, require qualitatively new approaches to the management of social, economic systems of all levels. The

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basis of the new regional policy in Ukraine, which will be implemented in 2021-2027, is "the transition from a predominantly territorially neutral to a territorially directed policy of the development of territories based on stimulating the use of their potential, providing support to certain territories characterized by special problems of socio-economic development". Depending on the territory's available type, this means a departure from a single approach to supporting depressed territories and a differentiation of the tools for regulating regional development. Among other innovations: strengthening the role of regional development agencies, increasing attention to "soft" development projects, developing regions based on the inclusion of all economic entities, recognizing communities as subjects of regional policy, securing 1/3 of the funds of the State Fund for Regional Development implementation of regional development programs of the Strategy, capable of strategically planning development and effectively managing resources for development" [1].

Today, most scientists consider the formation of socio-economic development strategies from the standpoint of SMART technologies in the conditions of global transformations and war [2; 5;7-8; 10].

The digital transformation of the economy and management is currently recognized as one of the priority vectors of the strategic development of regions and united territorial communities. It is designed to contribute to the formation of a single transparent, safe, and functionally convenient digital environment as the leading platform for the interaction of authorities, businesses, and the population in the direction of increasing the efficiency of the development of all elements of regional systems, reducing corruption, increasing regional cohesion, ensuring a balance of interests, increasing the competitiveness of territories and creating conditions for quality human development.

The teams of authors believe that “The implementation of these projects is the basis for strengthening state competitiveness. However, simultaneous digitalization which is not controlled at the regulatory level, the lack of domestic software, hardware and development projects can affect national security. The most dangerous cross-border and political threats to the state’s information security have been studied for a long time within the framework of the information war problem. Therefore, digitalization projects should be considered in the context of ensuring information security at various levels of public life” [13].

Arsakaev I. and Khatsieva L. offered the author's concept of creating a service integrator for the digital transformation of socio-economic systems on the basis of a universal digital platform is proposed and substantiated, which is a service-oriented outsourcing company that has a set of digital management competencies in the field of platformization and service integration, allowing it to realize a full life cycle of a universal digital platform in order to accelerate the digital transformation of users - socio-economic systems of various types and levels, while achieving a number of competitive advantages enhanced by the synergy effect, expressed in a number of effects, including the development of the domestic market for digital products, software and services based on disruptive digital technologies [14].

The authors note “Thus, modern society is gradually moving to the digital stage of its development. Digitalization has already become an integral part of the functioning of various social systems. Digitization processes have a significant impact on the development of national economies around the world. Accordingly, given the effects of such operations, the behaviour of economic agents, especially businesses, changes” [15].

Ha, L.T. carried out contributes to the literature by providing a comprehensive analysis of digital public services’ socioeconomic and environmental impacts. By using an international sample of 24 European countries, the socioeconomic and resource efficiency influences of digital transformation in the public sector in European countries are confirmed in this study. Using various econometric techniques, we find that digital public services have a positive impact on the economy and society [16].

In present-day conditions, a critical portion of the progression of the economy is played by the country's move to a digital transformation, which can altogether progress the circumstance and offer assistance to reach the progressed level. It is important to consider that, unlike the traditional economy, the main resource in the digital economy is innovation and inexhaustible, reliable and timely information [17].

Digital transformations that have occurred in socio-economic development of entire society have been proven, so that direct consumers of digital products and services are population gaining access to the Internet, certain applications, programs and databases that help to improve the quality of life, make it more comfortable in conditions of turbulent development and quarantine restrictions caused by the COVID-19 pandemic. [18].

Pasqualino, R., Demartini, M., Bagheri, F. believe that “Sustainability and digitalization are essential duties for companies to perform in the current socio-economic landscape due to risks caused by traditional manufacturing practices, and rules imposed by stakeholders and governments” [19].

Technology innovation and digital transformation as well as the economic change they enabled are already changing much of our lives in economic, social, policy, and cultural areas. These changes are still ongoing today. Some of them may or may not improve the current state. Overall, the result of this study supports the fact that innovations in individual sectors do not stand alone but coevolve as they have a mutual influence on one another [20].

The article's purpose is the process of strategic analysis and justification of the prospects of socio-economic development in the conditions of digital transformation.

II. MATH

Of course, the presence of scientific schools, research institutions, and IT clusters in the regions is an essential

prerequisite for implementing this field as one of the SMART specializations. However, taking into account the peculiarities of this type of economic activity, which is innovative and characterized by a sufficient level of labor mobility, the most important indicators for determining the potential of its development in the regions are the presence of established economic ties, cooperation with other areas of economic activity and the organization of exports services. In this context, we proposed to determine the economic potential of IT development based on three indicators of industry concentration in the region (gross added value, export of services, and the number of employees) adjusted for their growth rates over the past three years and to determine the overall economic potential of IT development in the region, which can be used as an additional justification when defining smart specialization projects.

To calculate the economic potential of the development of the IT sector in the region, as an element of the justification of its SMART specialization, the following formula is proposed:

$$EP_{IT} = CVA_{IT} + CE_{IT} + CEN_{IT} \quad (1)$$

Where EP_{IT} is the economic potential of the IT sector in the region

CVA_{IT}- the coefficient of concentration of added value of the IT sector in the region;

CE_{IT}- coefficient of concentration of export of IT services in the region;

CEN_{IT} - employment concentration coefficient in the region.

Suppose each of the above components of the economic potential of the industry in the region is higher than one or their sum exceeds 3.

In that case, we can talk about the priority of this area as a development based on SMART because, according to the proposals of the Ministry of Development of Communities and Territories, the types of economic activities defined in this category have significant advantages in attracting state funding, access to other resources, preferential lending and various methods of stimulating their development in the regions.

To determine the concentration coefficient for each of the components of the economic potential, the following formula is proposed:

$$CI_{IT} = \frac{RWI_{IT} \times \Delta RI_{IT}^{t}}{NWI_{IT} \times \Delta NI_{IT}^{t}} \quad (2)$$

CI_{IT} is the concentration factor of the IT sector in the region according to the 1st component;

RWI_{IT}– the specific weight of the IT sector in the regional economy according to the 1st component;

ΔRI_{IT}^{t} – the specific weight of the IT sector in the national economy according to the 1st component;

NWI_{IT}- rates of growth of the IT sector in the regional economy according to the Ith component for the period t;

ΔNI_{IT}^{t}- growth rates of the IT sector in the national economy according to the Ith component for the period t.

The proposed methodological approach can also be used to determine the economic potential of other types of economic activity in the regions and be used in the process of deciding SMART specialization or economic development priorities of regions, cities, and individual territories.

III. The results

At the first stage of the study, the specific weight of the IT sector and its growth rates at the national level and in the regions of Ukraine were calculated. The results of the calculations are given in table 1.

Considering the indicators of the development of the IT sector in the regions, it should be noted that today the specific weight of this type of economic activity in the GDP of the regions is very low and is on average 1-2%. The highest percentage is observed in Lviv, Kharkiv, Vinnytsia regions and the city of Kyiv. This indicates that in these regions the field of information and telecommunications has already developed at a faster pace and has certain centers in the form of representative offices of IT companies, IT clusters, etc. During the period of 2016-2019, the increase in the volume of production of products and services of this type of economic activity is observed in all regions without exception, which indicates the gradual disclosure of domestic potential in this area in connection with the spread of general trends regarding the digitalization of ever wider segments of the socio-economic environment .

Table 1. Source data for calculating the concentration coefficients of the IT sector in the regions of Ukraine

Regions	Specific gravity in the Airborne Forces, fraction of a unit	Growth index 2019 to 2016	Specific weight in employment, unit share	Growth index 2019 to 2016	Specific weight in employment, unit share	Growth index 2019 to 2016
Ukraine	0,05	1,55	0,19	2,44	0,02	1,06
Vinnytsia	0,03	1,53	0,65	1,61	0,01	1,03
Volynsk	0,01	1,66	0,02	0,97	0,01	1,00
Dnipropetrovsk	0,02	1,64	0,47	1,89	0,02	1,15
Donetsk	0,02	1,43	0,03	0,69	0,01	1,00
Zhytomyr	0,02	1,49	0,20	1,25	0,01	1,01
Zakarpattia	0,02	1,69	0,03	2,31	0,01	0,97
Zaporizhzhia	0,02	1,64	0,14	1,90	0,01	1,03
Ivano-Frankivsk	0,02	1,77	0,08	1,36	0,01	1,00
Kyivska	0,02	1,83	0,07	3,31	0,02	1,06
Kirovohradsk	0,01	1,64	0,14	1,56	0,01	1,02
Luhansk	0,02	1,10	0,03	1,93	0,01	1,05
Lviv	0,07	1,62	0,42	1,77	0,02	1,01
Mykolayivska	0,02	1,67	0,01	1,37	0,01	0,97
Odesa	0,03	1,63	0,02	0,94	0,01	1,00
Poltava	0,01	1,70	0,13	2,05	0,01	1,02
Rivne	0,02	1,73	0,08	22,00	0,01	1,00
Sumy	0,02	1,64	0,08	1,21	0,01	1,07
Ternopilsk	0,02	1,83	0,03	1,44	0,01	0,97
Kharkivska	0,06	1,60	0,64	1,34	0,02	1,15
Khersonsk	0,02	1,59	0,03	2,50	0,01	1,00
Khmelnytska	0,01	1,74	0,03	0,99	0,01	0,95
Cherkassy	0,02	1,81	0,59	1,92	0,01	1,06
Chernivtsi	0,02	1,65	0,21	1,80	0,01	1,03
Chernihivska	0,02	1,59	0,20	1,55	0,01	1,07
m. Kyiv	0,11	1,50	0,41	1,42	0,03	1,24

Source: Calculated by the authors based on the data of the State Statistics Service [3]

As for the specific weight of IT in the export of services, it can be said that this indicator shows significant interregional differentiation. The highest specific weight of IT services in the total export of services (more than 50%) in Vinnytsia, Kharkiv and Cherkasy regions. A high share of this sector in the exports of Lviv and Dnipropetrovsk regions. For comparison, in some regions, the export of IT sector services in the total export of services does not exceed 1-3%, in particular, Mykolaiv, Volyn, Ternopil, Zakarpattia, Odesa. Kherson, Donetsk and Luhansk regions. The rate of increase in the export of services in the information and telecommunications sector over the past 3 years also fluctuates significantly across regions. For example, in the Rivne region, the volume of export of IT services increased 22 times during the analyzed period. This is explained primarily by the fact that, until 2017, IT services were not typical for the export of this region. On average in the country, over the last 3 years, the export of IT services has increased by 2.5 times, which is a positive factor and indicates the growth of Ukraine's international competitiveness in this field.

Using the proposed methodological approaches and formulas 1.-2. the calculation of the economic potential of the development of the IT sector by the regions of Ukraine was carried out, the results of which are illustrated in table 2

Table 2. Concentration coefficients and economic potential of the IT sector in the regions of Ukraine

Regions of Ukraine	CVA_{IT}	CE_{IT}	CEN_{IT}	EP_{IT}
Vinnytsia	0,70	2,26	0,46	**3,4**
Volynsk	0,31	0,04	0,36	0,7
Dnipropetrovsk	0,56	1,91	1,13	**3,6**
Donetsk	0,30	0,05	0,57	0,9
Zhytomyr	0,44	0,53	0,72	1,7
Zakarpattia	0,36	0,13	0,27	0,8
Zaporizhzhia	0,47	0,58	0,59	1,6
Ivano-Frankivsk	0,42	0,25	0,30	1,0
Kyivska	0,63	0,49	1,03	2,2

Kirovohradsk	0,29	0,48	0,53	1,3
Luhansk	0,24	0,12	0,38	0,7
Lviv	1,52	1,59	0,81	**3,9**
Mykolayivska	0,52	0,03	0,30	0,9
Odesa	0,71	0,04	0,70	1,4
Poltava	0,23	0,58	0,42	1,2
Rivne	0,39	3,91	0,49	**4,8**
Sumy	0,37	0,21	0,48	1,1
Ternopilsk	0,49	0,10	0,36	0,9
Kharkivska	1,37	1,86	1,13	**4,4**
Khersonsk	0,36	0,15	0,35	0,9
Khmelnytska	0,36	0,07	0,30	0,7
Cherkassy	0,57	2,45	0,47	**3,5**
Chernivtsi	0,54	0,83	0,43	1,8
Chernihivska	0,46	0,68	0,55	1,7
m. Kyiv	2,25	1,26	1,66	**5,2**

Source: calculated by the authors

The calculations made it possible to identify regions with sufficient economic potential for the development of the IT sphere on the basis of SMART specialization. These are regions whose economic potential by the sum of all coefficients is more than 3 points, namely: Kyiv (5.2), Rivne (4.8), Kharkiv (4.4), Lviv (3.9), Dnipropetrovsk (3,6), Cherkasy (3.5) and Vinnytsia (3.4) regions. The correctness of the selected methodological approaches and conducted calculations is also confirmed by the fact that in all the listed regions, the development of IT business is chosen by experts as one of the key priorities of SMART specialization, which has already been approved in the relevant regional strategies for 2021-2027.

According to the results of the analysis in the region, an appropriate strategy for the implementation of SMART specialization projects is formed. In order to provide information on the process of determining the SMART specialization of regions, the Ukrainian Institute of International Policy, together with the consultants of the European Commission research center, developed methodological recommendations that should be taken into account in the process of choosing the SMART specialization of the region, developed strategies for the development of relevant types of economic activity on the basis of innovation and the implementation of programs . As stated that "the strategy of SMART specialization requires some structural changes that can be triggered by one of the following, not mutually exclusive processes:

- the transition from an existing industry to a new one, based on the activities of jointly operating institutions and processes (meaning the scientific community of R&D, engineering and production capabilities), which form the knowledge base for the creation of new activities;
- modernization: this is a process of technological improvement of the existing industry, including the development of specific areas of application of Key Enabling Technologies to improve the efficiency and quality of already existing industries;
- diversification: this is a potential synergy (reduction of costs due to diversification of production and transfer of knowledge) that can occur between an existing and a new branch of economic activity;
- establishment of a completely new type of activity: R&D can turn previously low-growth spheres of economic activity into attractive and profitable ones. This can happen if R&D activity is combined with entrepreneurial activity [4].

Despite the researched conditions under which the potential of the IT sector as a basis for SMART specialization of regions or individual cities of Ukraine has the greatest prospects, in our opinion, given the innovative nature of the industry itself and its unconditional impact on the socio-economic development of the regions, the strategy of comprehensive support for the IT sector should be developed in each region.

A feature of the IT sector development strategy is its end-to-end nature, covering all areas of regional development planning: social sphere, business, energy, housing and communal services, etc. This means that each direction, type of activity or industry reflected in the strategic plan of socio-economic development of the region, territory or individual community must include the factor of digital support, ICT implementation models and establishing interaction with other elements of the economy. This approach will ensure manageability and a certain level of security of the digital transformation of the region, will allow to take advantage of all its advantages for the population and business.

IV. DISCUSSION.

As stated on the official website of the administrative services of Ukraine, "The Regional Development Strategy until 2027 contains more than 60 tasks of digital transformation. The priority goals are:

- provision of unhindered access to high-speed Internet for all settlements (primarily rural and small towns) and social institutions;

- the possibility of receiving electronic services through a smartphone;

- increasing the level of digital literacy of the population;

- introduction of electronic document flow;

- provision of electronic interaction between national registers, registers of local self-government bodies;

- transfer of priority public services to electronic form;

- implementation of the power of open data by regional bodies;

- development of electronic democracy tools" [6].

Among the main directions of the digital development of the regions for the medium-term perspective, identified as priorities are: the introduction of innovative technologies in the system of managing the development of cities based on the concept of a smart city, increasing the institutional capacity in the regions regarding the implementation of digital development projects, the development of IT infrastructure, the creation of digital platforms and industry solutions, open data and others. In each of these areas, a complex of necessary tasks is being developed for different levels of settlements [9].

It should be noted that in conditions of decentralization, the forms and methods of public administration are changing and the approaches to the processes of strategizing the development of regions and individual territories are expanding. In this context, we agree with the opinion of the authors of the monograph that "Changes taking place in the distribution of power and approaches to strategizing the development of regions and communities necessitate a revision of approaches and principles of state regional policy formation. Decentralization should form a new configuration of relations between the central government and subnational governing bodies based on relations of cooperation and coordination of actions. This requires changes in the organizational structure, practices and management culture of the government. The implementation of information and communication technologies plays a significant role in the implementation of new management models. Digital tools change the processes of providing public services, allow more efficient management of local resources and ensure control of this efficiency, create new forms of communication between the central and subnational governments" [11, p.76].

The basic document defining the main priorities, directions and conditions of development of the region (community) is the Strategy and the corresponding plan of socio-economic development. The development strategy of the region (community) is based on a detailed analysis of the available potential, competitive advantages of the region and determines the most optimal in terms of opportunities provided by the environment and internal potential of ways to achieve goals, the main ones of which are ensuring the economic growth of the region and creating conditions for a dignified life of citizens and their development.

The main features of an effectively formulated community development strategy include:

- Inclusiveness, which means embedding in the community development strategy a common vision of its future by the residents of the given territory. That is, the strategy must reflect, first of all, the needs and prospects for the development of the territories as seen by residents, and also as seen by government officials or other management subjects;

- Analyticality. The strategy should be developed taking into account real indicators reflecting the opportunities (potential) and weaknesses of the community.

- Designability. The effectiveness of the implementation of the strategy requires the development of clear and consistent work plans, defined by the executor and resources, and not just a declaration of intentions, as is the case in most cases. That is, the strategy should be supplemented with specific projects, plans and programs that reflect its content and serve to achieve goals.

- Intermunicipal (interregional) cooperation is considered as one of the resources or potentials for solving important development problems, joint construction of infrastructure and other projects.

- Taking into account the interests of external partners (stakeholders). It is one of the advantages of the strategy, which allows attracting additional resources, investments, grants or other forms of external assistance for the development of communities.

- Relevance. The strategy should take into account the main modern trends, in particular the directions of development of the world economy, the spread of innovative technologies,

migration trends and others that increase the attractiveness of the strategy and make it more adapted to modern conditions.

- Consideration of the spatial aspect. The community development strategy should be based not only on sectoral, but also on spatial analysis, formed promising lines of territorial development, placement of infrastructure facilities, etc.

Thus, the main strategic objectives of digital transformation in the concept of economic security can be formulated as a creation of innovative development of the information security system, information technology and electronic industry; creation and implementation of information technologies initially resistant to various types of threats; conducting research and experimental development in order to create promising information technologies and tools; improving the security of the information infrastructure and the stability of its functioning, developing mechanisms for detecting and preventing information threats and eliminating the consequences of their manifestation; improving methods and methods of production and safe use of products, providing services based on information technology using developments that meet security requirements [17].

V. Conclusion

It was determined that the number of elements that SMART specialization should become to form strategies for socio-economic development of the regions. The authors analyzed the possibilities of the regions of Ukraine regarding the introduction of SMART specializations in the IT field. Thus, an appropriate economic-mathematical toolkit was proposed, which allows for the sum of the concentration coefficients of three components (gross added value, export of services, and the number of employees) to evaluate the possibility of implementing digitalization in individual territories. It was also emphasized that the proposed toolkit for defining SMART specialization projects could be used to evaluate types of economic activity as additional justification.

The economic potential of the IT sector's development in Ukraine was calculated by testing the proposed methodological approaches and the corresponding mathematical tools. The conducted analysis made it possible to single out the regions where the studied type of economic activity has the highest level of digitalization and the prospects of its release as one of the critical SMART specializations. It was emphasized that these regions (the economic potential of which, by the sum of all indicators, exceeds 3 points) include: Kyiv (5.2), Rivne (4.8), Kharkiv (4.4), Lviv (3.9), Dnipropetrovsk (3.6), Cherkasy (3.5) and Vinnytsia (3.4) regions. It was determined that one of the critical priorities of SMART specializations, which has already been approved in the relevant regional strategies for 2021-2027, is the selection of experts in some areas of IT business development. This leads to the correctness of the chosen methodical approaches and the performed calculations for assessing the level of digitization in forming socio-economic strategies in the regions.

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