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Integration into global value chains: A management framework for Ukrainian enterprises

Abstract. The integration of Ukrainian enterprises into global value chains is a critical factor in economic development in the context of increasing globalisation and the need to restore post-war losses incurred as a result of Russia's full-scale invasion of Ukraine in early 2022. The purpose of the study was to develop a comprehensive management framework for evaluating and ensuring successful integration of Ukrainian enterprises into global value chains based on a comparative analysis of international models and empirical data. The study was based on a comparative analysis of four leading models of integration into global value chains (Chinese, German, Polish, and Vietnamese), analysis of 156 Ukrainian enterprises in various sectors, application of correlation and regression analysis methods, mathematical modelling for the development of the Integration Potential Index (IPI). The results of the study showed that technological capabilities ($r = 0.76$) and managerial international experience ($r = 0.71$) were the strongest predictors of successful integration into global value chains. An IPI-normalised equation (scale 0-1) was developed, which allowed quantifying the readiness of an enterprise for integration based on eight key factors with empirically determined weighting factors. Multiple regression analysis confirmed that a combination of eight factors explains 74% of the variation in the level of integration into global value chains ($R^2 = 0.74$, $F = 42.3$, $p < 0.001$). Cluster analysis allowed identifying three typological groups of enterprises by the level of integration readiness: "integration leaders" (18%, average IPI 0.82), "potential integrators" (43%, IPI 0.61) and "pre-integration companies" (39%, IPI 0.38). Sectoral-specific integration strategies for the IT sector, agro-industrial complex, and mechanical engineering are proposed, considering the specifics of the Ukrainian business environment. The practical significance of the study is to create tools for enterprise management to diagnose integration readiness and develop targeted strategies for entering international value chains

Keywords: integration strategy; index of integration prospects; international competitiveness; technological opportunities

INTRODUCTION

Global value chains (GVC) have become the dominant form of organisation of international production in the 21st century, covering more than 70% of world trade. The COVID-19 pandemic and the geopolitical turmoil of the 2020s significantly transformed the structure of global supply chains, calling into question established models of international production. In particular, L. Kano *et al.* (2020) summarised interdisciplinary approaches to GVC analysis, highlighting their complex multi-level nature and the need to integrate economic, managerial, and geographical approaches. In turn, R. Baldwin & R. Freeman (2022) focused on the vulnerability of global production networks to systemic shocks and identified key risks associated with excessive supply concentration and dependence on individual regions. B. Bonadio *et al.* (2021), using a quantitative model, demonstrated the scale of the impact of pandemic shocks on production networks in 64 countries. Their results showed significant heterogeneity of the impact of the pandemic between sectors, which highlights the importance of diversifying production links. OECD (2021) summarised the findings on the effectiveness and risks of GVC, emphasising the need to adapt national integration strategies. In particular, the organisation stressed the need to improve the sustainability of supply chains through the development of local production capabilities and flexible logistics solutions.

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For Ukraine, the issue of integration of enterprises into the GVC is becoming particularly relevant in the context of European integration processes and post-war reconstruction. A.M. Fernandes *et al.* (2022) identified key determinants of GVC participation at the firm level. The researchers proved that the decisive factors of integration are the productivity of enterprises, the level of human capital, access to international markets, and the institutional quality of the environment. This highlighted the importance of an integrated approach to improving the competitiveness of enterprises. R. Juhász *et al.* (2024) substantiated the need for a new industrial policy in the context of deglobalisation. Their study focused on the transition from passive integration to active government intervention to form strategic industries and strengthen countries' positions in global production networks. V. Venger *et al.* (2022) investigated Ukraine's integration into GVC, identifying key barriers and opportunities for Ukrainian enterprises. In particular, the researchers pointed out structural limitations associated with the low level of technological complexity of exports, while noting the potential of individual sectors to deepen participation in GVC.

Simultaneously, several key problems remain unresolved in current research. Firstly, there is no comprehensive management framework that would integrate international experience with the specifics of the Ukrainian business environment and consider the impact of martial law on integration processes. Secondly, there are not enough quantitative tools for diagnosing the integration readiness of enterprises in different sectors, which would allow comparing enterprises with each other and tracking the dynamics of readiness over time. Thirdly, sector-specific integration strategies have not been sufficiently developed for key sectors of the Ukrainian economy – the IT sector, the agro-industrial complex, and mechanical engineering – in the context of martial law and future post-war reconstruction.

The purpose of the study was to develop a comprehensive management framework for evaluating and ensuring successful integration of Ukrainian enterprises into GVC. To achieve the goal, three key tasks were identified: (1) to conduct a comparative analysis of leading international models of integration into the GVC and identify the most relevant elements for the Ukrainian context; (2) to identify key factors of integration capacity based on an empirical analysis of 156 Ukrainian enterprises and develop a quantitative index of integration prospects (IPI); (3) to develop sectoral-specific integration strategies for the IT sector, agro-industrial complex and mechanical engineering.

LITERATURE REVIEW

The theoretical foundations of GVC research were formed at the intersection of several scientific traditions. Transaction cost theory by O.E. Williamson (1985) explained the choice between hierarchical and market-based forms of coordination in international production, which is fundamental to understanding the structure of GVC. The enterprise's resource-based view, formulated by J.B. Barney (1991), focuses on the internal capabilities of an enterprise as a source of competitive advantages in global chains. D.J. Teece (2014) developed the concept of dynamic capabilities in the context of multinational enterprises, which is particularly relevant for analysing the integration capabilities of enterprises in developing countries. O. Cattaneo *et al.* (2010) developed a focus on GVC joining, upgrading, and adding value, proposing a systematic approach to analysing countries' participation in global production networks.

The current paradigm of GVC research is based on the studies by G. Gereffi (2018), who defined the main contours of 21st-century capitalism through the prism of global value chains, and on the fundamental typology of GVC management. H.W.-C. Yeung & N.M. Coe (2015) developed the concept of Global Production Networks, which allows considering the spatial and institutional context of the organisation of production. M.P. Dallas *et al.* (2019) investigated the mechanisms of power relations in GVC and proposed analytical tools for assessing the distribution of power. W. Milberg & D. Winkler (2013) analysed the impact of intellectual monopoly on global value chains and the distribution of income among chain participants. A.S. Filipenko (2006) and G.V. Duginets (2018) focused on the specifics of the integration of Ukrainian enterprises into the global production system and the need to form adaptive management mechanisms.

The issue of technological capabilities as a factor of integration into GVC has been the subject of numerous studies. C. Pietrobelli & R. Rabellotti (2011) showed that technological learning and the interaction of GVC with national innovation systems are crucial for advancing the value chain. E. Brynjolfsson & A. McAfee (2014) substantiated the impact of digital technologies and automation on the transformation of global manufacturing processes, showing that digitalisation reduces barriers to entry for enterprises in developing countries. R. Koopman *et al.* (2014) proposed a method for measuring value added, which allows more accurately estimating the contribution of each GVC member country.

The problems of enterprise participation in GVC have been investigated by a number of researchers. J. Humphrey & H. Schmitz (2002) investigated the impact of GVC integration on upgrading in industrial clusters, identifying critical barriers to the transition of enterprises from simple to more complex functions. H.W.-C. Yeung & N.M. Coe (2015) developed a dynamic theory of global production networks that considered the processes of transformation and sustainability of value chains in a changing global environment. M.P. Dallas *et al.* (2019) proposed new analytical tools for assessing power relations in GVC, identifying five main types of management: market, modular, relational, managerial, and hierarchical. L. Kano *et al.* (2020) in a comprehensive review of the interdisciplinary literature identified five main theoretical approaches to the study of GVC. P. Pavlínek (2020) investigated the transformation of the automotive industry in the countries of the integrated periphery of Eastern Europe, identifying new opportunities and threats for participation in GVC.

The institutional context of integration into GVC was investigated by D. Acemoglu & J.A. Robinson (2019), who showed that the quality of institutions is a critical factor for successful economic development and participation in international production networks. R. Juhász *et al.* (2024) substantiated the need for a new industrial policy in the context of deglobalisation and regionalisation of production chains, emphasising the importance of combining market openness with support for domestic producers. P.A. Hall & D. Soskice (2001) investigated the institutional framework of comparative advantage within the concept of "varieties of capitalism", which is relevant for understanding the ability to adapt different integration models. D. Taglioni & D. Winkler (2016) developed practical recommendations for developing country governments to create an enabling environment for enterprise integration into GVC.

The impact of the COVID-19 pandemic and subsequent geopolitical upheavals on GVC has been the subject of active research. S. Miroudot (2020) investigated the impact of the pandemic on global supply chains and made recommendations to improve their sustainability. R. Baldwin & R. Freeman (2022) systematised the risks associated with global supply chains and identified priority areas for minimising them. B. Bonadio *et al.* (2021) used a quantitative model to assess the impact of pandemic shocks on global production networks in 64 countries, showing significant heterogeneity of impacts between sectors and regions. OECD (2021) summarised findings on the effectiveness and risks of GVC in the context of COVID-19.

A comparative analysis of national models of integration into GVC has been widely presented in the literature. P. Pavlínek (2020) investigated the transformation of the automotive industry in Central and Eastern Europe, identifying specific patterns of integration of peripheral economies. K. Lee & F. Malerba (2017) analysed the cycles of catch-up development and leadership change in technology sectors, which is important for understanding "window of opportunity" strategies for developing countries. A.M. Fernandes *et al.* (2022) identified key determinants of GVC participation at the firm level in different countries, highlighting the importance of institutional quality and human capital.

International organisations have also made significant contributions to GVC research. The World Bank (2020) in its World Development report comprehensively analysed the role of trade and GVC in promoting economic development. UNCTAD (2020) presented data on the current state of global investment and its impact on the structure of GVC. W. Milberg & D. Winkler (2013) in fundamental research explored the economics of outsourcing through the prism of GVC, analysing the implications for capitalist development. R. Kaplinsky & M. Morris (2001), in their methodological guide, emphasised the need to adapt the methodology of GVC analysis to the specifics of individual countries and sectors. However, despite a significant amount of research, a comprehensive management framework for assessing the integration readiness of Ukrainian enterprises, considering sectoral specifics and the impact of martial law, remains undeveloped, which determines the relevance and scientific originality of this study.

MATERIALS AND METHODS

The study was based on a mixed methodology combining qualitative comparative analysis and quantitative empirical research. This methodological triangulation provided a more complete picture of the phenomenon under study and increase the validity of the results through mutual confirmation of the conclusions obtained by different methods. The empirical base of the study included data from 156 Ukrainian enterprises from three key sectors of the economy: Information Technology (n = 62.39.7% of the sample), agro-industrial complex (n = 54.34.6%), and mechanical engineering (n = 40.25.6%). The selection of enterprises to participate in the survey was carried out based on the State Statistics Service of Ukraine (n.d.), IT Ukraine Association (n.d.), Ukrainian Grain Association (n.d.), The Association of Industrial Automation Enterprises of Ukraine (n.d.), and commercial databases Youcontrol (n.d.). The criteria for inclusion in the sample were: (1) the year of foundation no later than 2020, (2) the annual turnover of at least UAH 5 million, (3) the presence of export activities or potential for export. The sample was formed using the stratified selection method to ensure the representativeness of different sizes of enterprises and regional representation. By size, enterprises were distributed as follows: small (up to 50 employees) – 38%, medium (50-250 employees) – 47%, large (more than 250 employees) – 15%. Financial and trade indicators were verified according to the State Statistics Service of Ukraine (n.d.).

The response rate was 31.2% (156 completed questionnaires out of 500 invitations sent out), which is an acceptable level for research by business organisations. To test the possible systemic bias, a comparison of early and late respondents was made by key characteristics (size, sector, financial indicators), which did not reveal statistically significant differences (t-test, $p > 0.05$). The collection of primary data was carried out in the period from March 2022 to February 2025 through structured questionnaires filled out by top managers of enterprises (CEOs, CFOs, development directors), and analysis of open financial statements of companies. The questionnaire contained 45 closed and semi-closed questions grouped into eight blocks according to hypothetical integration capacity factors: technological capabilities (6 questions), international management experience (7 questions), financial resources (5 questions), innovation activity (6 questions), product quality (5 questions), market reputation (4 questions), logistics capabilities (6 questions), and organisation adaptability (6 questions). The study did not involve direct work with respondents: all data was collected through structured questionnaires and open financial reports of companies.

Statistical analysis of empirical data included several stages. At the first stage, descriptive analysis was performed to characterise the sample and identify general trends. In the second stage, Pearson correlation analysis was used to identify relationships between integration capacity factors and actual participation in international value chains. At the third stage, multiple regression analysis (least squares method) was used to determine the relative significance of each factor when controlling for the influence of other variables. The basic assumptions of regression analysis were tested: normality of the residue distribution (Shapiro-Wilk Test), absence of multicollinearity (VIF < 5 for all variables), and homoscedasticity (Breusch-Pagan test). Cluster analysis (k-means method) was used to identify typological groups of enterprises by the level of integration readiness. The optimal number of clusters was determined using the "elbow" method and silhouette analysis, which indicated three different groups. Based on the results of correlation and regression analysis, a mathematical model of the IPI was developed. The IPI equation included eight factors with weighting factors determined based on standardised regression coefficients and was normalised to a scale of 0-1:

$$IPI = 0.22 \times TC + 0.19 \times ME + 0.15 \times FR + 0.13 \times IA + 0.11 \times PQ + 0.09 \times MR + 0.07 \times LC + 0.04 \times OA, \quad (1)$$

where *TC* – technological capabilities, *ME* – international management experience, *FR* – financial resources, *IA* – innovative activity, *PQ* – product quality, *MR* – market reputation, *LC* – logistics opportunities, *OA* – organisational adaptability.

A comparative analysis of international models of integration into GVC was carried out based on secondary data for four case countries: China, Germany, Poland, and Vietnam. The data sources were academic publications, reports of international organisations (World Bank, 2020; UNCTAD, 2020; OECD, n.d.), statistical databases (UN Comtrade Database, n.d.) and government strategic planning documents, in particular: Export strategy of Ukraine (Ministry of Economy, Environment and Agriculture of Ukraine, 2017), National Economic Strategy of Ukraine until 2030 (Resolution of Cabinet of Ministers of Ukraine No. 179, 2017), and the "Made in China 2025" programme for the Chinese case study (State Council of People's Republic of China, 2015). The reliability of the measuring scales was checked using the Cronbach's alpha coefficient, which for all eight constructs exceeded the threshold of 0.70 (range 0.74-0.89). Convergent validity was confirmed by high factor loads (>0.60) in exploratory factor analysis. All statistical procedures were performed in the SPSS Statistics 27.0 and R 4.2.1 software packages. The level of statistical significance is set at $\alpha = 0.05$.

RESULTS AND DISCUSSION

An empirical analysis of 156 Ukrainian enterprises revealed significant variability in the level of readiness for integration into GVC. Correlation analysis showed that the strongest predictors of successful integration are technological capabilities ($r = 0.76$, $p < 0.001$) and international management experience ($r = 0.71$, $p < 0.001$). The results of correlation analysis for all eight factors are shown in Table 1.

Table 1. Correlation analysis of integration capacity factors

Factor	*r*	*p*	Interpretation
TC	0.76	<0.001	Strong
ME	0.71	<0.001	Strong
IA	0.64	<0.001	Moderate-strong
FR	0.58	<0.001	Moderate
PQ	0.53	<0.01	Moderate
MR	0.47	<0.01	Moderate
LC	0.38	<0.05	Weak-moderate
OA	0.29	<0.05	Weak

Source: calculated by the author based on empirical data (n = 156)

Technological capabilities included the availability of state-of-the-art equipment, the use of advanced manufacturing technologies, the digitalisation of business processes, and the ability to adapt technologies to the specific requirements of international partners. International management experience covered previous cooperation with foreign companies, knowledge of international quality standards (ISO 9001, ISO 14001), knowledge of foreign languages by top management, and understanding of the specifics of doing business in foreign markets. The results showed that enterprises where at least 30% of top management had international experience showed a 45% higher probability of successful integration compared to companies without such experience.

Financial resources showed a moderate correlation ($r = 0.58$, $p < 0.001$), indicating that access to capital was a necessary but insufficient condition for integration. Innovation activity showed a correlation of $r = 0.64$ ($p < 0.001$), which highlighted the importance of continuous improvement of products and processes to maintain positions in GVC. Product quality ($r = 0.53$, $p < 0.01$) and market reputation ($r = 0.47$, $p < 0.01$) were less critical factors in the sample dominated by B2B segment companies. Logistics capabilities ($r = 0.38$, $p < 0.05$) and organisational adaptability ($r = 0.29$, $p < 0.05$) showed relatively weak but statistically significant correlations, which indicated their auxiliary role in the integration process.

Multiple regression analysis ($R^2 = 0.74$, $F = 42.3$, $p < 0.001$) confirmed that a combination of eight factors explains 74% of the variation in the level of integration with GVC, which indicates the reliability of the developed model and its high predictive power. The developed IPI helped to classify enterprises into four categories with clear characteristics and recommendations for each group. Validation of the IPI in the test sub-sample (20% of the sample, $n = 31$) showed a high correlation with the actual participation of enterprises in international value chains ($r = 0.83$, $p < 0.001$), which confirmed the practical significance of the proposed index for the diagnosis of integration readiness. Sectoral analysis revealed significant differences in integration readiness between the three sectors of the economy studied. The main results of the sectoral analysis are shown in Table 2.

Table 2. Sectoral analysis of integration readiness of Ukrainian enterprises

Indicator	IT sector	Agro-industrial complex	Mechanical engineering
Average IPI	0.72	0.58	0.49
Number of enterprises	62 (39.7%)	54 (34.6%)	40 (25.6%)
TC	High	Low	Low
ME	High	Average	Low
Recommended strategy	Technological upgrade	Qualitative differentiation	Niche specialisation
IPI dynamics (2022-2025)	0.68 → 0.72 ↑	Heterogeneous	0.52 → 0.49 ↓

Source: calculated by the author based on empirical data ($n = 156$)

The IT sector showed the highest average IPI (0.72), which is explained by high technological capabilities, significant international management experience and low barriers to remote cooperation. The geography of IT services exports included the United States (42%), Western Europe (38%), Israel (12%), and other regions (8%). The level of English proficiency among specialists exceeded 85%, and most companies used Agile and DevOps methodologies. For the IT sector, the strategy of "technological upgrade" was recommended, which provided for the transition from outsourcing simple services to developing complex products and platform solutions. A critical factor in implementing this strategy is investing in R&D at the level of 15-20% of revenue and developing long-term partnerships with global technology companies.

The agro-industrial complex showed an average IPI of 0.58, with high product quality indicators, but limited technological capabilities and innovative activity. The main problem was that Ukrainian enterprises mainly exported raw materials and minimally processed products, receiving only 15-20% of the final cost of the product in the chain. For the agro-industrial complex, a strategy of "qualitative differentiation" was proposed, which was based on the development of organic production, certification according to European Food Safety Standards, investment in processing infrastructure and logistics modernisation.

Mechanical engineering was characterised by the lowest average IPI (0.49), reflecting outdated technologies (the average age of equipment is more than 20 years), insufficient international experience, and limited financial resources for modernisation. For mechanical engineering, a strategy of "niche specialisation" was proposed, which provided for focusing on specific components or processes where Ukrainian enterprises had unique technological competencies or access to resources. The implementation of this strategy required technological modernisation with an investment of 3-7% of revenue over 5 years, professional development of the workforce and the involvement of foreign consultants for knowledge transfer. Cluster analysis allowed identifying three types of enterprises by the level of integration readiness. The characteristics of each group are shown in Table 3.

Table 3. Characteristics of enterprise clusters by level of integration readiness

Indicator	Integration leaders	Potential integrators	Pre-integration processes
Sample share	18%	43%	39%
Average IPI	0.82	0.61	0.38
ME	6.5 years	2.3 years	0.4 years
International certification	92%	41%	12%
Internal market orientation	28%	56%	92%
Investing in training	3-5% PF	1-2% PF	<0.5% PF

Note: PF – payroll fund
Source: calculated by the author based on Cluster analysis ($n = 156$)

"Integration leaders" (18% of the sample, average IPI 0.82) – companies with high integration potential that have already actively participated in international value chains. These enterprises had formalised procedures for cooperation with foreign partners, ISO quality management systems, international certifications, and used PMI/PRINCE2 project management methodologies. The top management of integration leaders had considerable international experience (an average of 6.5 years per manager), and the companies themselves actively invested in staff development, allocating 3-5% of the salary fund for training.

The group of "potential integrators" (43% of the sample, average IPI 0.61) was characterised by the presence of basic technological capabilities and some experience in international cooperation, but faced barriers to deepening integration. The most common obstacles for this group were: insufficient understanding of the requirements of international quality standards (74% of respondents), weak marketing competencies (62%), inflexibility of the organisational structure (55%), and limited financial resources for certification and modernisation (68%). Overcoming these barriers required targeted investment in the development of competencies and institutional support from the state and industry associations. "Pre-integration companies" (39% of the sample, average IPI 0.38) needed fundamental transformations before joining the GVC. The majority of enterprises in this group were focused exclusively on the domestic market (92%), had no experience of international cooperation (87%), and used outdated technologies (78% did not have international certification). For this group, the first stage of integration should focus on basic modernisation: updating the technological base, teaching management the basics of international business, and gradually entering foreign markets through intermediaries or trade missions. A comparative analysis of international models of integration into GVC revealed four distinctive patterns, each of which was characterised by specific institutional mechanisms and strategic priorities. The main results of the comparative analysis are shown in Table 4.

Table 4. Comparative analysis of international models of integration into GVC

Characteristics	China	Germany	Poland	Vietnam
Key mechanism	State planning, SEZ	Technological excellence, Mittelstand	Geographical proximity, EU membership	Attracting FDI, export zones
Main sectors	Electronics, Mechanical Engineering	Cars, chemicals, equipment	Cars, electronics, BPO	Textiles, electronics, shoes
Role of the state	Dominant	Supporting	Institutional	Liberalising
Investment in R&D, % of GDP	2.4	3.1	1.4	0.5
Relevance for Ukraine	Limited	IT, mechanical engineering	High	Average

Note: SEZ – special economic zone, FDI – foreign direct investment, BPO – business process outsourcing
Source: compiled by the author based on P.A. Hall & D. Soskice (2001), O. Cattaneo *et al.* (2010), D. Taglioni & D. Winkler (2016), G. Gereffi (2018), P. Pavlínek (2020)

The Chinese model demonstrated the key role of government planning and large-scale investment in industrial infrastructure. The creation of special economic zones, targeted support for strategic sectors and large-scale technological transfer through attracting foreign investment have become the basis of the Chinese strategy for integration into the GVC. However, the Chinese model has limited applicability for Ukraine due to differences in the scale of the economy and political systems. The German model was based on technological excellence and long-term relationships in supply chains, which is consistent with the concept of a coordinated market economy (Hall & Soskice, 2001). The Mittelstand system (small and medium-sized enterprises), the dual education system, and the focus on Industry 4.0 created an institutional environment that promoted deep integration of enterprises into European and global value chains. The experience of supporting innovative SMEs and developing technical education is relevant for Ukraine.

The Polish model illustrated the importance of geographical proximity to developed markets and institutional integration through EU membership. Similar to the conclusions of P. Pavlínek (2020) for Central Europe, after joining the EU in 2004, Poland has rapidly integrated into European production networks, especially in the automotive, electronics, and food sectors. This experience is most relevant for Ukraine, given its geographical proximity and common historical context. The Vietnamese model showed the possibilities of rapid integration through attracting foreign direct investment and creating export zones. Participation in trade agreements (CPTPP, EVFTA) has significantly accelerated the integration of Vietnamese businesses into global chains, especially in the electronics and textile industries. For the Ukrainian context, the most relevant elements were the Polish model (focusing on European value chains, using geographical proximity, institutional harmonisation with the EU), and the Vietnamese model (attracting FDI for technological transfer, creating specialised industrial zones). Comparative analysis also revealed the critical role of the institutional environment in shaping successful integration models (Acemoglu & Robinson, 2019). R. Juhász *et al.* (2024) emphasised that new industrial policies should combine market incentives with targeted support for strategic sectors.

Analysis of the dynamics of integration capacity of enterprises during the study period (2022-2025) revealed several important trends related to martial law. The IT sector showed a steady increase in integration readiness (an increase in the average IPI from 0.68 to 0.72). Many

IT companies were able to quickly adapt to new conditions, refocusing on completely remote work and diversifying the geography of customers (the share of the United States increased from 38% to 42%, new markets appeared in Australia and Latin America). The agro-industrial sector showed heterogeneous dynamics: enterprises of the western regions actively increased exports to the EU (an increase of 35% in 2022-2023), taking advantage of new opportunities created by the abolition of duties on Ukrainian products, while companies of the southern and eastern regions faced significant difficulties due to military operations and logistics restrictions. Mechanical engineering was going through the most difficult period (the decline in the average IPI from 0.52 to 0.49), but some enterprises that reoriented themselves to the production of defence products showed improvements in financial and technological indicators.

A study of the dynamics of integration processes by individual clusters showed that the "integration leaders" showed the highest resistance to external shocks: their average IPI decreased by only 3% in the first months of a full-scale invasion and fully recovered within a year. "Potential integrators" suffered large losses (-12% of the IPI), with the recovery occurring unevenly depending on the sector and region. "Pre-integration companies" were the most vulnerable: 23% of enterprises in this group completely stopped or significantly reduced their activities. These results were consistent with the findings of K. Lee & F. Malerba (2017) that crisis periods create "windows of opportunity" for some businesses and threaten the existence of others.

The role of public policy in promoting the integration of Ukrainian enterprises into the GVC is critical (OECD, 2021). The results of the study indicated the need for an integrated approach that combines tools for financial support, infrastructure development, and institutional reforms. In particular, it is considered appropriate to create a specialised export support fund (capitalisation of USD 500 million), support of industry clusters based on the Triple Helix model (association of enterprises, research institutions, and educational institutions), harmonisation of technical regulations with European directives (currently only 65% of the regulatory base is harmonised), and development of transport and logistics infrastructure (Taglioni & Winkler, 2016; Bonadio *et al*., 2021).

Digitalisation proved to be a key factor in increasing the competitiveness of Ukrainian enterprises in GVC: companies with a higher level of digital maturity showed 35% better integration results. The educational policy should be consistent with the needs of integration into GVC: 68% of enterprises experienced a shortage of managers with international experience, 54% – specialists with knowledge of foreign languages at the C1-C2 level. It is recommended to develop training programmes for international business managers at leading universities, internships for students at European enterprises (200-300 people, 3-6 months), twinning programmes, and technical assistance from the EU.

Comparison of the results obtained with international studies showed both general and specific patterns for Ukraine. Similar to the conclusions of J. Humphrey & H. Schmitz (2002), the study confirmed the critical role of technological capabilities for successful GVC upgrades. In contrast to the research by P. Pavlínek (2020) in relation to Central Europe, where large multinational corporations played a key role, medium-sized technology-oriented enterprises (50-500 employees) showed greater potential in the Ukrainian context, which could flexibly adapt to the requirements of international partners. The results are also consistent with the findings of UNCTAD (2020) on the growing role of digital technologies in shaping new models of GVC participation. A.M. Fernandes *et al*. (2022) identified key determinants of GVC participation at the firm level, highlighting the importance of institutional quality, access to finance, and human capital, as confirmed by the results of this study.

An important conclusion of the study was the identification of the "paradox of institutional inefficiency". Despite the formal introduction of market institutions, real institutional support for integration into GVC remained insufficient due to the practice of institutional mimicry, when formal institutions were created without filling them with real content and implementation mechanisms (Acemoglu & Robinson, 2019). Overcoming this paradox requires not only legislative changes, but also a transformation of the management culture and strengthening control and reporting mechanisms.

CONCLUSIONS

The study developed a comprehensive management framework for assessing and ensuring the integration of Ukrainian enterprises into global value chains, based on a comparative analysis of international models and an empirical study of 156 Ukrainian companies from three key sectors of the economy. The key result was the identification of technological capabilities and managerial international experience as the dominant factors of integration success, explaining the 74% variation in the level of enterprise participation in international value chains. The developed index of integration prospects provides management with a practical tool for systematic self-assessment of readiness to join the GVC and priority areas of development. Cluster analysis allowed identifying three typological groups of enterprises: "integration leaders" (18%), "potential integrators" (43%) and "pre-integration companies" (39%). Differentiated approaches to the development of integration capacity are proposed for these groups.

Sector-specific strategies for IT, agriculture, and mechanical engineering are summarised in a short form: technological upgrade, qualitative differentiation, and niche positioning, respectively. A comparative analysis of international models revealed that the most relevant for Ukraine is the combination of elements of the Polish experience of European integration and the Vietnamese strategy for attracting foreign direct investment, adapted to the specifics of the Ukrainian institutional environment and geopolitical situation. The results of the study also revealed the "paradox of institutional inefficiency", overcoming which is a necessary prerequisite for successful integration. The practical significance of the study lies in the creation of evidence-based tools for management decisions on integration into GVC at the level of individual enterprises, industry associations, and public authorities. The IPI index can be used as a diagnostic and benchmarking tool, and to monitor the progress of integration efforts.

At the level of state policy, the results of the study substantiate the need to create a specialised export support fund, develop the Triple Helix cluster model, harmonise technical regulations with European directives, modernise the transport and logistics infrastructure, and reform the training system for international business. Prospects for further research include a longitudinal analysis of the dynamics of integration capacity of Ukrainian enterprises for 5-7 years, a study of the impact of artificial intelligence and automation on the transformation of models of participation in GVC, an analysis of the effectiveness of various tools of state support for integration processes, and a comparative study of the integration experience of Ukraine with other countries-candidates for EU membership (Moldova, Georgia, Serbia, Montenegro). A separate study requires the impact of digitalisation and the development of e-commerce on the models of participation of Ukrainian enterprises in global value chains.

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CONFLICT OF INTEREST

The author declares no conflict of interest.

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Інтеграція до глобальних ланцюгів вартості: управлінська рамка для українських підприємств

Анотація. Інтеграція українських підприємств до глобальних ланцюгів вартості є критичним фактором економічного розвитку в умовах посилення глобалізації та необхідності відновлення післявоєнних втрат, понесених внаслідок повномасштабного вторгнення росії на територію України на початку 2022 року. Метою дослідження було розроблення комплексної управлінської рамки для оцінки та забезпечення успішної інтеграції українських підприємств до глобальних ланцюгів вартості на основі порівняльного аналізу міжнародних моделей та емпіричних даних. Дослідження базувалося на порівняльному аналізі чотирьох провідних моделей інтеграції до глобальних ланцюгів вартості (китайської, німецької, польської та в'єтнамської), аналізі 156 українських підприємств різних секторів, застосуванні методів кореляційного та регресійного аналізу, математичного моделювання для розробки Індексу інтеграційної перспективності (IPI). Результати дослідження виявили, що технологічні можливості ($r = 0,76$) та управлінський міжнародний досвід ($r = 0,71$) є найсильнішими предикторами успішної інтеграції до глобальних ланцюгів вартості. Було розроблено нормалізовану IPI формулу (шкала 0-1), яка дозволяє кількісно оцінити готовність підприємства до інтеграції на основі восьми ключових факторів із емпірично визначеними ваговими коефіцієнтами. Множинний регресійний аналіз підтвердив, що комбінація восьми факторів пояснює 74 % варіації в рівні інтеграції до глобальних ланцюгів вартості ($R^2 = 0,74$, $F = 42,3$, $p < 0,001$). Кластерний аналіз дозволив виділити три типологічні групи підприємств за рівнем інтеграційної готовності: «інтеграційні лідери» (18 %, середній IPI 0,82), «потенційні інтегратори» (43 %, IPI 0,61) та «перед-інтеграційні компанії» (39 %, IPI 0,38). Запропоновано секторально-специфічні стратегії інтеграції для IT-сектору, агропромислового комплексу та машинобудування з урахуванням особливостей українського бізнес-середовища. Практична цінність дослідження полягає у створенні інструментарію для менеджменту підприємств щодо діагностики інтеграційної готовності та розробки цільових стратегій входження до міжнародних ланцюгів створення вартості

Ключові слова: інтеграційна стратегія; індекс інтеграційної перспективності; міжнародна конкурентоспроможність; технологічні можливості