UDC 339.924:334.021
DOI 10.33111/iep.eng.2022.36.04

Modelling of Business Integration in Global Innovation Networks

OLEG SHVYDANENKO,
KATERYNA BOICHENKO[1]

ABSTRACT. The article aims to identify the drivers of effective business development in global innovation networks and determine the determinants of its performance after mergers and acquisitions in the context of resource integration. The study demonstrates the relationship between the similarity and complementarity of resources in the context of business integration based on mergers and acquisitions, considering its development in global innovation networks. It is established that companies can use a high level of integration only if there is a certain level of similarity of resources between them. It is proved that the scale of integration depends on the level of development of the company and the efficiency of its activities, but not on the brand or culture of the enterprise. Similarity of resources is more important for integration and management of innovative development of companies, which is associated with the level of development of countries, significant cultural distance and management practices that cannot be transferred to mature markets. The results contribute to a deeper understanding of post-merger business integration, revealing the ways of integrating resources and their impact on the spread of innovation in today's networked economy.

The study contributes to the understanding of the possibilities of innovation diffusion in mergers and acquisitions by emphasizing the important role of the global network position held by the company and its impact on the inter-organizational diffusion of innovations after mergers and acquisitions. The study proves that the post-merger integration stage is more important than the M&A transaction, as it creates opportunities for realizing network synergies. Mergers and acquisitions using network technologies are an effective way for companies from emerging markets to quickly gain access to innovative developments and valuable resources. The article proves that, when applied in an appropriate way of integration, mergers and acquisitions are an effective means of improving the position of acquiring companies to obtain innovations, network concentration or structural breaks. The proposed model of structural equations, combines multiple regression, analysis of alternatives, factor and quariation analysis, which form a comprehensive methodological approach and compensate for the shortcomings of traditional statistical methods. The study proves the existence of a stable effect of the company's position in the global network on the relationship between the method of integration and the spread of innovation in the process of business development.

KEYWORDS. Global network, mergers and acquisitions, innovation network, business integration, integrated development, model, factor analysis.

[1] **Oleg Shvydanenko** — Doctor in Economics, Professor, Professor of the International Economics Department, Director of the Institute of Global Economic Policy of the Kyiv National Economic University named after Vadym Hetman. Sphere of scientific interests: international economic integration, global networks, globalization of economic development, global competitiveness, innovative business development. E-mail: oleg_shvydanenko@kneu.edu.ua ORCID: https://orcid.org/0000-0001-7369-1762

Kateryna Boichenko — PhD in Economics, Associate Professor, Associate Professor of Business Economics and Entrepreneurship. Research interests: enterprise development, network economy, business integration, global economy, international economic integration, management of global business value chains. E-mail: kateryna.boichenko@kneu.ua ORCID: https://orcid.org/0000-0003-4636-067X

IEP, No. 36 (2022) pp. 74–91

ISSN 1811-9832/2022/No. 1 (36)

Introduction

Mergers and acquisitions activity of multinational corporations in emerging markets has increased dramatically in recent decades. Thanks to advanced technologies and innovations, as well as attractive markets, corporations are actively pursuing cross-border mergers and acquisitions to gain access to developed economies, with Europe and the United States being the most popular destinations[2]. Through mergers and acquisitions involving foreign sources of technology, acquiring companies can access the R&D resources of their acquisition targets in other countries. This accelerates the spread of innovation and technological spillovers in the home country industry of the acquiring company. Post-merger integration is key to generating synergies and accelerating the diffusion of innovation in mergers and acquisitions. When merging and acquiring abroad, corporations use a soft integration strategy, emphasizing the importance of absorptive capacity and cultural differences. In addition, such companies may experience more problems and difficulties in managing the personnel and innovation of acquisition targets abroad than their competitors in developed countries[3]. In mergers and acquisitions, a transnational corporation in an emerging market can significantly affect the management of innovative development in the context of backward integration[4]. There is a need to determine how and to what extent the location of the global innovation network can influence the spread of innovation in the context of integrated business development. All this indicates the relevance of the study.

Although the research on the transfer of innovations in mergers and acquisitions has become widespread, a consensus has not yet been reached, so the relationship between the level of integration and the transfer of innovations should be substantiated and empirically studied. In addition, studies by Valentino A., Matteo C. and Ulrike M. show that mergers and acquisitions involve the formation of network embedding behavior[5]. Kim D., Zhu P., Xiao W. and Lin Y. also point out that previous studies of global mergers and acquisitions have largely ignored the reactions of actors outside organizational boundaries, such as customers, suppliers and partners, as the main findings focused only on the level of integration of top management

[2] *Wójcik D., Keenan L., Pažitka V., Urban M., Wu W.* The Changing Landscape of International Financial Centers in the Twenty-First Century: Cross-border Mergers and Acquisitions in the Global Financial Network. *Economic Geography*. 2022. Vol. 98. No. 2. — p. 98.

[3] *Christofi M., Vrontis D., Thrassou A., Shams S. R.* Triggering technological innovation through cross-border mergers and acquisitions: A micro-foundational perspective. *Technological Forecasting and Social Change*. 2019. Vol. 146. — p. 152.

[4] *Fu X., Sun Z., Ghauri P. N.* Reverse knowledge acquisition in emerging market MNEs: The experiences of Huawei and ZTE. *Journal of Business Research*. 2018. Vol. 93. — p. 206.

[5] *Valentino A., Caroli M., Mayrhofer U.* Establishment modes and network relationships of foreign subsidiaries. *International Business Review*. 2018. Vol. 27. No. 6. — p. 1256.

decision-making authority[6]. Chaudhry A., Alexandros K. and Evangelos V.-N. believe that the study of information flow in mergers and acquisitions should not be limited to the boundaries of the acquiring and target companies, but should also consider its distribution through global networks[7].

Studies by Dhir S., Ongsakul V., Ahmed Z. and Rajan R. show that integrated companies face challenges related to their newly created responsibilities, as they are often the first generation of enterprises to go beyond their countries, which largely depends on the size of the market of the country of origin, as well as on industrial development and cooperation. As a result, the spread of information in local industries through mergers and acquisitions can be crucial for a company to participate in global competition[8].

In the presence of close ties with the governments of the countries of origin, the threat of financial protectionism, the loss of key national strategic assets and the possibility of transferring management practices from developed economies, development commitments and the country of origin are studied from different points of view. In the context of such commitments, the research of Khan Z., Wood G., Tarba S. Y., Rao-Nicholson R. and Frattaroli M. on the post-merger integration of companies indicates that retaining staff and providing autonomy to the top management teams of target enterprises can help corporations to gain legitimacy in host markets[9], [10]. Due to the significance of cultural differences and lack of absorption capacity, companies in developed countries often use a «soft» approach to the integration of acquired subsidiaries. At the same time, current research mainly focuses on the degree of structural integration and autonomy granted to target companies. Thus, the understanding of the resource interactions that occur between the target companies during the post-merger integration phase is rather limited. In addition, it is very important to establish the relationships between critical success points at each stage of the M&A process, as well as between the pre- and post-merger stages. Zhang W., Wang K., Li L., Chen Y. and Wang H. in the study of post-merger integration use an innovation-based approach, bearing in mind that one of the main goals of integration is to enhance the transfer of knowledge between

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[6] *Kim D. Y., Zhu P., Xiao W., Lin Y. T.* Customer degree centrality and supplier performance: the moderating role of resource dependence. *Operations Management Research*. 2020. Vol. 13. No 1. — p. 34.

[7] *Chaudhry A. N., Kontonikas A., Vagenas-Nanos E.* Social networks and the informational role of financial advisory firms centrality in mergers and acquisitions. *British Journal of Management*. 2022. Vol. 33. No. 2. — p. 965.

[8] *Dhir S., Ongsakul V., Ahmed Z. U., Rajan R.* Integration of knowledge and enhancing competitiveness: A case of acquisition of Zain by Bharti Airtel. *Journal of Business Research*. 2020. Vol. 119. — p. 679.

[9] *Khan Z., Wood G., Tarba S. Y., Rao-Nicholson R., He S.* Human resource management in Chinese multinationals in the United Kingdom: The interplay of institutions, culture, and strategic choice. *Human Resource Management*. 2019. Vol. 58. No. 5. — p. 483.

[10] *Frattaroli M.* Does protectionist anti-takeover legislation lead to managerial entrenchment? *Journal of financial economics*. 2020. Vol. 136. No. 1. — p. 126.

the acquiring and target companies to create synergies[11]. All this determined the purpose of this study — to identify the drivers of effective business development management in global innovation networks in the context of resource integration and to determine the determinants of its performance after the merger. This study aims to identify the post-merger integration effects that explain differences in post-merger performance by assessing the interaction of resources such as business integration as a result of mergers and acquisitions. This paper contributes to the analysis of mergers and acquisitions by linking the similarities and complementarities between pre-merger resources and post-merger integration modes to explain the success of innovation diffusion in global networks. By examining the impact of the form of integration on innovation diffusion from a network perspective, this study contributes to the management of integrated development in multinational M&A processes.

Business integration in innovative global networks

Innovation networks are an important approach for various companies to obtain external technological and innovation resources without having to leave their business[12]. Enterprises can gain a competitive advantage by integrating network innovations. Companies increasingly go beyond their own borders to facilitate learning activities within industries and enterprises, as well as at the national and international levels[13]. The experience of leading enterprises indicates that global networks are becoming increasingly complex and the dispersed nature of innovation makes companies in developing countries embedded in global innovation networks[14]. The theory of innovation networks was applied to analyze the inter-firm diffusion of innovations in the context of cooperation[15]. Enterprises that occupy a dominant position in the network exercise greater control over resources and have more advantages in innovation activities. Network concentration and structural gaps are the most significant indicators of the network position for technological innovation and knowledge dissemination, which is widely

[11] *Zhang W., Wang K., Li L., Chen Y., Wang X.* The impact of firms' mergers and acquisitions on their performance in emerging economies. *Technological Forecasting and Social Change*. 2018. Vol. 135. — p. 212.

[12] *Christofi M., Vrontis D., Thrassou A., Shams S. R.* Triggering technological innovation through cross-border mergers and acquisitions: A micro-foundational perspective. *Technological Forecasting and Social Change*. 2019. Vol. 146. — p. 156.

[13] *Čirjevskis A.* The role of dynamic capabilities as drivers of business model innovation in mergers and acquisitions of technology-advanced firms. *Journal of Open Innovation: Technology, Market, and Complexity*. 2019. Vol. 5. No. 1. — p. 12.

[14] *Isaac V. R., Borini F. M., Raziq M. M., Benito G. R.* From local to global innovation: The role of subsidiaries' external relational embeddedness in an emerging market. *International Business Review*. 2019. Vol. 28. No. 4. — p. 142.

[15] *Öberg C., Alexander A. T.* The openness of open innovation in ecosystems–Integrating innovation and management literature on knowledge linkages. *Journal of Innovation & Knowledge*. 2019. Vol. 4. No. 4. — p. 213.

confirmed by studies of network interaction[16]. Network concentration indicates the degree to which a company occupies a central position in terms of its ties with other network members and its ability to capture sources of innovation[17]. Compared to network concentration, structural gaps reflect the degree of access to other network members. They emphasize the strategic control of such access and the ability to connect to partners with heterogeneous resources[18].

Mergers and acquisitions cannot be considered as isolated bilateral relations. Network integration behavior should consider external actors located outside organizational boundaries — for example, customers, suppliers and partners[19]. Any changes that occur during post-acquisition integration bilateral relationships are likely to affect the actions of direct partners in the network. Then, the changes caused by the acquisition may spread further at the network level, i.e. to indirect relationships, changing the structure of the network. The balance of local and foreign networks can accelerate the speed of internationalization of enterprises. Foreign mergers and acquisitions are an effective means for companies to improve their positions that promote the spread of innovation and attract investment, such as concentration or structural gaps, to obtain network synergies[20].

The strategic knowledge that companies have through their global innovation networks, such as the diversity of technological standards, the demand for differentiation and R&D resources, can be shared among domestic companies in the same industry through internal technological cooperation, modular production, local supply chains and even reverse engineering. In addition, companies with a high concentration of networks, in particular «global network leaders», which combine their disparate supply, knowledge and customer bases into global or regional networks, can stimulate international innovation development, providing new opportunities for the development of local suppliers' capabilities in developing countries[21]. Under the pressure of central companies, local suppliers have a significant incentive to internalize the transferred knowledge through various forms of innovation integration. As a leading enterprise in the industry, the buyer company

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[16] *Yakob R., Nakamura H. R., Ström P.* Chinese foreign acquisitions aimed for strategic asset-creation and innovation upgrading: The case of Geely and Volvo Cars. *Technovation*. 2018. Vol. 70. — p. 62.

[17] *Zhang K., Qian Q., Zhao Y.* Evolution of Guangzhou Biomedical Industry Innovation Network Structure and Its Proximity Mechanism. *Sustainability*. 2020. Vol. 12. No. 6. — p. 452.

[18] *Mishra P.* How have Mergers and Acquisitions Affected Financial Performance of Firms in Indian Manufacturing Sector? *Eurasian Journal of Business and Economics*. 2019. Vol. 12. No. 23. — p. 82.

[19] *Sarala R. M., Vaara E., Junni P.* Beyond merger syndrome and cultural differences: New avenues for research on the «human side» of global mergers and acquisitions (M&As). *Journal of World Business*. 2019. Vol. 54. No. 4. — p. 312.

[20] *Hernandez E., Shaver J. M.* Network synergy. *Administrative Science Quarterly*. 2019. Vol. 64. No. 1. — p. 184.

[21] Rospopchuk, T. M., Voitko, S. V. Inversiia zasad zlyttia i pohlynannia v umovakh Industry 4.0. *Pidpryiemnytstvo ta innovatsii,* Vol. 8. — 2019. — pp. 29–33. [In Ukrainian].

promotes the spread of innovation within the industrial network and the use of high technology and process standards[22]. The internationalization of small and medium-sized enterprises is influenced by the organizational ethical misomorphism of their partners[23]. Thus, a large global network concentration of the buyer company contributes to the effective spread of innovations in various industries.

Methodological tools for diagnosing the efficiency of business integration into global innovation networks

This study aims to better understand the diffusion of innovations achieved by companies through mergers and acquisitions by using a methodological approach that implements diagnostics of the impact of brand management, servitization and reverse transfer of innovations in the context of mergers and acquisitions. The analysis was conducted using a sample of corporations who participated in technology-based M&A transactions involving manufacturing enterprises abroad between 2010 and 2021. We started the analysis in 2010 since the 2008 global financial crisis had an effect on the quantity of worldwide M&As. It has been demonstrated that M&As' effectiveness lags behind their implementation, hence we decided to stop the study in 2021. Therefore, a two- to three-year window is required to monitor the dissemination of innovation following a merger. The sample contains finished mergers and acquisitions. We also followed the accepted literature on technology acquisitions and selected our sample according to various criteria in order to prioritize M&As involving technology and innovation. We limited our sample to certain company operations and eliminated M&As that were not blatantly technology-focused based on our searches of news feeds and M&A announcements. The selection criteria for the target corporations for M&A targeting technology sourcing were based on the IMF's classification of developed countries. To ensure that the acquirer held control over the target firm in our M&A sample, the equity ratio had to be higher than 50 %. Using these filters, a final sample of 54 mergers and acquisitions is produced. The industry, dates, and countries of the M&A companies in our sample were listed in Table 1.

The criteria for grouping companies are similarity and complementarity of resources. In this study, the structural equation model was used for empirical testing. Wang L. and Zajac E. functions were used to measure the similarity and complementarity of resources. The North American Industrial

[22] *Álvarez I., Torrecillas C.* Interactive learning processes and mergers and acquisitions in national systems of innovation. *Transnational Corporations Review*. 2020. Vol. 12. No. 1. — p. 74.

[23] *Bai H., He W., Shi J., McColl J., Moore C.* Internationalization strategies of emerging market multinationals in luxury fashion retailing — Case study of Shandong Ruyi Group. *Thunderbird International Business Review*. 2021. Vol. 63. No. 3. — p. 324.

Classification System (NAICS) was utilized to gauge the degree of resource similarity across the M&A-related organizations. It was discovered that the resource similarity of any pair of businesses can be equivalent to:

1 if their NAICS codes' first four digits match;
0.75 if the first three digits were the same;
0.5 if the first two digits were the same;
0.25 if the first digit was the same;
0, if otherwise.

Table 1

DESCRIPTION OF THE SAMPLE OF COMPANIES TO STUDY THEIR INTEGRATION IN GLOBAL INNOVATION NETWORKS

№	Characteristics of the sample	Sample size	Share by selection criterion
1	Period in which mergers and acquisitions took place	—	—
1.1	2010-2013	17	0,315
1.2	2014-2017	12	0,222
1.3	2018-2021	25	0,463
2	The sphere of the company's functioning	—	—
2.1	Construction and real estate	5	0,093
2.2	Extractive industry	5	0,093
2.3	Agriculture	9	0,167
2.4	IT and telecommunications	12	0,222
2.5	Food industry	5	0,093
2.6	Others	18	0,333
3	Country of the company participating in the merger and acquisition	—	—
3.1	USA	4	0,074
3.2	China	5	0,093
3.3	Switzerland	3	0,056
3.4	Netherlands	5	0,093
3.5	France	4	0,074
3.6	Germany	6	0,111
3.7	Poland	8	0,148
3.8	Azerbaijan	4	0,074
3.9	Armenia	5	0,093
3.10	Others	10	0,185

Source: formed by the authors

The method used to calculate the complementarity of resources as a variable assumes that more complementary businesses are more likely to be merged within the same company because they have potential synergies. This method assumes that related activities are more likely to be combined within the same corporation. If those companies that are engaged in one type of activity are almost always engaged in another type of activity, then they complement each other significantly. In order to quantify the indirect resource complementarity between each pair of organizations, we looked at how similar their NAICS codes were. In order to create a sample of 54 companies, we chose all acquiring companies with more than one NAICS code that participated in international mergers and acquisitions in the technology search sector between 2010 and 2021. We can assume that the two operations linked to these NAICS codes were complementary if the acquiring company possessed the same set of codes. The simultaneous occurrence of the same pair of NAICS codes in multiple businesses led us to the conclusion that the connected activities were highly complementary. The complementarity score for such codes was calculated as follows:

$$Com_{ij} = (J_{ij} - \mu_{ij}) \ / \ \delta_{ij}, \quad (1)$$

where J_{ij} — the number of times that two NAICS codes occurred in the same company;

i and j identify the two codes;

$$\mu ij = (Ni \times Nj)/K, \quad (2)$$

where Ni — number of companies with the code NAICSi;

Nj — number of companies with the code NAICS j;

K — total number of companies.

$$\delta_{ij} = \sqrt{\mu_{ij} \cdot (1 - \frac{Ni}{K}) \cdot (\frac{K}{K-1}) \cdot (1 - \frac{Nj}{K})}. \quad (3)$$

The sample mergers and acquisitions were divided into four groups according to the median similarity of resources and complementarity of their constituent pairs of companies:

group 1 — with significant similarity and insignificant complementarity (11);

group 2 — with insignificant similarity and significant complementarity (14);

group 3 — with significant similarity and significant complementarity (19);

group 4 — with insignificant similarity and insignificant complementarity (10).

Based on the comparison of the available features, coefficients of integration and diffusion of innovations in the selected groups, it was found that the fourth group does not have much research value, since with a weak similarity of resources and complementarity between the acquired and acquired companies, the potential synergistic effect of mergers and acquisitions is not noticeable.

The number of patent applications is the most widely used indicator to diagnose the level of diffusion of innovations[24]. At the same time, it is necessary to consider the share of acquiring companies to describe their contribution to the diffusion of innovations from the global pool to the local industrial sector after a foreign merger and acquisition:

$$Dissemination\ of\ innovations\ through\ patents\ = \frac{n\sum_{j=1}^{n} b_{ij}}{\sum_{i=1}^{n}\sum_{j=1}^{n} b_{ij}} \cdot p\ , \qquad (4)$$

where p — number of industry patent applications filed at the beginning of the merger and acquisition;

$\frac{n\sum_{j=1}^{n} b_{ij}}{\sum_{i=1}^{n}\sum_{j=1}^{n} b_{ij}}$ – share of companies-buyers;

$\sum_{j=1}^{n} b_{ij}$ – is the main income from the sale of the buyer company;

n — number of companies in the industry;

$\sum_{i=1}^{n}\sum_{j=1}^{n} b_{ij}$ — average sales revenue in the industry.

The level of diffusion of innovations through new products is measured based on the revenue from sales of new products in the industry multiplied by the share of the acquiring company, and is determined considering the average growth rate in the first two years after the merger and acquisition. Information related to the acquisition was collected from the companies' annual reports.

Innovation network formation and evaluation assumes that patent collaboration is a research tool that is widely used in building innovation networks. It uses patent citation as an alternative measure of knowledge flow for the formation of an innovation network[25]. Patent data obtained from the U.S. Patent and Trademark Office (USPTO) contain the most complete and accurate global information on patent applications and citations, and are widely used in studies on international technology diffusion and innovation networks of technology diffusion and innovation networks.

The level of innovation network concentration is defined as follows:

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[24] *Bai, H., He, W., Shi, J., McColl, J., Moore, C.* «Internationalization strategies of emerging market multinationals in luxury fashion retailing—Case study of Shandong Ruyi Group.» *Thunderbird International Business Review* 63.3 (2021). — p. 323.

[25] *Chen F., Li X., Meng Q.* «Integration, network and industrial innovation in technology sourcing overseas M&A: a comparison between China and South Korea.» *Technology Analysis & Strategic Management* 31.10 (2019). — p. 1169.

$$\text{Network concentration} = \frac{n-1}{\sum_{i=1}^{n} d(p_i,p_k)}, \quad (5)$$

where n — number of companies in the network, $d(p_i, p_k)$ — is the distance between companies i and j.

Network intensity implies: if a node is connected to another node with a higher intensity, then its level for the first node also increases:

$$Network\ intensity\ = \sum Aij\ (\alpha\ +\ \beta c_j), \quad (6)$$

where A — the adjacency matrix is given;

c_i — intensity of nodes related to the buyer company;

α and β — fixed parameters.

The structural gap of the global innovation network implies that the limitedness of the network is the state in which it is directly or indirectly concentrated on one link. The higher the network constraint, the less structural gaps in the node[26].

$$p_{ij} = \frac{a_{ij}+a_{jl}}{\sum_k (a_{ik}+a_{kl})}, \quad (7)$$

where a_{ij} — is the weight of the relationship between i and j;

p_{ij} — is the intensity of the relationship between i and j.

It is assumed that in the network node i is bounded by node j:

$$c_{ij} = (p_{ij} + \sum_{q,q\neq i,q\neq j} p_{iq}\ p_{qi})^2, \quad (8)$$

The sum of the constraints is equal to $c_i = \sum_i c_{ij}$. The structural gap with the limitation is as follows: $s_i = 1 - c_i$.

A structural gap with hierarchy demonstrates the level of concentration of network constraints on a single node:

$$h_i = \frac{\sum_j \left(\frac{c_{ij}}{C/N}\right) ln\left(\frac{c_{ij}}{C/N}\right)}{Nln(N)}, \quad (9)$$

where N — number of enterprises in the network;

C — is the sum of network constraints of all nodes.

The structural break with the hierarchy is as follows: $sh_i = 1 - h_i$.

To diagnose business integration based on post-merger public information through acquisition announcements, annual reports and related news, it is expressed as a binary variable. The level of business integration is defined as: 1 — if the target company's operations were integrated into the acquirer's operations; 0 — if it was maintained as an independent business unit or subsidiary of the acquirer.

[26] Verma S., Bhattacharyya S. S. «The intellectual core and structure of mergers and acquisitions literature: a co-citation analysis.» *International Journal of Business Innovation and Research* 20.3 (2019): 305–336. — p. 321.

Factor analysis, diagnostics of reliability and validity of business integration into innovative global networks

To test the reliability and validity of the model in this study, AMOS software was used, in particular, the Confirmatory Factor Analysis (CFA) model, which contains all the identified variables. The correlation coefficients for the proposed model are presented in Table 2.

Table 2

FORMED CORRELATION MATRIX FOR THE MODEL OF BUSINESS INTEGRATION INTO INNOVATIVE GLOBAL NETWORKS

Indicator	Mean	S.D.	X_1	X_2	X_3	X_4	X_5	X_6
Integration of business	0,410	0,477	1					
Brand autonomy	0,572	0,474	−0,606***	1				
Network concentration	0,190	0,246	0,586***	-0,446**	1			
Structural gaps	0,110	0,181	−0,542**	0,667***	−0,797**	1		
Spread of innovations	0,762	0,293	0,006	0,136	0,125	0,170	1	
Volume of investments in R&D	0,653	0,435	0,165	−0,112	−0,146	0,078	0,022	1

Note: ***$p < 0{,}01$;**$p < 0{,}05$.

Source: formed by the authors

The results of the CFA model in Table 3 show that the Chi-square value of the CFA model was statistically significant ($p < 0.001$), and the fit index was higher than the standard index — 0.9. The formed model is adequate. *Six* standardized factor loadings can be considered statistically significant ($p < 0.001$). Cronbach's alpha for all latent variables exceeds 0.6, which indicates the acceptability of the model. The average variance extracted (AVE), which measures the validity of the model, for all latent variables met the benchmark, as it exceeds 0.5.

After running the original model, we checked the fit of its structural equation. The Chi-square value of the original model is 333.72, CMIN/DF = 3.19 (> 2), and RMSEA = 0.149 (> 0.1). Thus, the original model does not meet the goodness-of-fit criteria, indicating the need for further adjustment to improve its fit with the actual data. According to the system, the structural equation model can be adjusted by means of modification indices to improve the level of model fit. Chi-square value of the modified model was 164.04 ($p < 0.001$), Chi-square coefficient was 1.79 (< 2), RMSEA = 0.0986 (< 0.1), CFI = 0.904 (> 0.9), IFI = 0.908 (> 0.9). Thus, the suitability of the modified model meets the standard.

Table 3

RESULTS OF THE CFA-MODEL OF BUSINESS INTEGRATION INTO INNOVATIVE GLOBAL NETWORKS

Latent variable	Measurement variables	Standardized factor loads	Cronbach's Alpha	Average Variance Extracted (AVE)
Concentration of the network	Approaching the center of the network	0,591***	0,668	0,518
	Intensity of the network	0,803***	–	–
Structural gaps	Structural gap with restriction	0,886***	0,866	0,788
	Structural gap with hierarchy	0,853***	–	–
Spread of innovations	Spread of innovation by patent	0,943***	0,887	0,825
	Spread of innovations by new product	0,834***	–	–

Note: *** $p < 0{,}001$; model CFA: CMIN/DF = 0,742 ; CFI = 0,968; NFI = 0,970; RFI = 0,926.

Source: formed by the authors

Table 4 shows the fit indices of the original and modified models, as well as the benchmark values. The fit indices of the structural equation model have improved as a result of the modification.

Table 4

SUITABILITY INDICES OF THE ORIGINAL AND MODIFIED MODELS OF BUSINESS INTEGRATION INTO INNOVATIVE GLOBAL NETWORKS

Model	Index of absolute suitability		Relative index of suitability		Contracted suitability index	
	CMIN/DF	RMSEA	IFI	CFI	AIC	BCC
Initial model	3,178	0,152	0,818	0,810	383,624	472,745
Modified model	1,826	0,094	0,906	0,918	312,976	448,890
Normative values	0-2	<0,1	>0,9	>0,9	Principle of minimum	Principle of minimum

Source: formed by the authors

The empirical results of the groups «Significant similarity — minor complementarity», «Insignificant similarity — significant mutual complementarity» and «Significant similarity and significant mutual complementarity» are shown in Table 5.

Table 5

RESULTS OF MODELLING STRUCTURAL EQUATIONS OF BUSINESS INTEGRATION INTO INNOVATIVE GLOBAL NETWORKS

Modelling direction	Indicator	Significant similarity — minor complementarity		Minor similarity — significant complementarity		Significant similarity — significant complementarity	
		Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E
Network concentration	Integration of business	0,076**	0,036	0,024	0,031	0,384***	0,092
	Brand autonomy	−0,053*	0,031	−0,098	0,076	−0,015	0,105
Structural gap	Business integration	0,079	0,117	−0,375***	0,079	−0,057	0,073
	Brand autonomy	0,551***	0,123	0,369***	0,081	0,274***	0,053
Deepening of innovations	Network concentration	1,483**	0,480	0,852*	0,467	1,625*	0,934
Spread of innovations	Structural gap	0,233**	0,074	0,260*	0,153	0,161***	0,025
Deepening of innovations	Investments in R&D	−0,132	0,205	−0,100	0,304	−0,759	0,792
Level of proximity to the center of the network	Network concentration	1	–	1	–	1	–
Spread of innovation through new product	Spread of innovations	0,114***	0,030	0,158***	0,040	0,752***	0,026
Spread of innovation through patent	Diffusion of innovations	1	–	1	–	1	–
Structural gap with restriction	Structural gap	1	–	1	–	1	–
Structural gap with hierarchy	Structural gap	0,602***	0,042	0,660***	0,058	0,088**	0,032
Intensity of the network	Network concentration	1,895***	0,566	2,244	1,509	0,293**	0,113

Note: ***$p < 0{,}001$; **$p < 0{,}05$; *$p < 0{,}1$.

Source: formed by the authors

Network concentration and structural gap have a positive impact on the diffusion of innovation. In the «Significant similarity — insignificant complementarity» group, the level of business integration is positively correlated with network concentration ($\beta = 0.076$, $p < 0.05$), autonomy and network concentration are negatively correlated ($\beta = -0.053$, $p < 0.1$), and network concentration ($\beta = 1.483$, $p < 0.05$) and structural gap ($\beta = 0.233$, $p < 0.05$) have a significant positive impact on the ability to diffuse innovations. In the «Insignificant Similarity — Significant Complementarity» group, the level of business integration and structural gap have a significant negative correlation ($\beta = -0.375$, $p < 0.001$), autonomy and structural gaps have a positive correlation ($\beta = 0.369$, $p<0.001$), and network concentration ($\beta = 0$, $p < 0.1$) and structural gap ($\beta = 0.26$, $p < 0.1$) are positively correlated with the ability to diffuse innovations. In the «Significant Similarity and Significant Complementarity» group, the level of integration and network concentration have a positive correlation ($\beta = 0.384$, $p < 0.001$), autonomy and structural gap have a positive correlation ($\beta = 0.274$, $p < 0.001$), and network concentration ($\beta = 1.625$, $p < 0.1$) and structural gap ($\beta = 0.161$, $p < 0.001$) have a significant positive impact on the ability to diffuse innovation.

Thus, the degree of integration has no significant effect on the structural gap, and autonomy is positively correlated with the structural gap. This proves that for technology-enabled M&A abroad, domestic enterprises still lack the ability of integrated multi-channel management and heterogeneity information utilization needed to improve the structural gaps in their network. Purchasing companies rely more on targets to define and maintain their heterogeneous networks, which is not conducive to controlling the innovation network and optimally allocating network resources in the case of significant resource similarity. The level of integration and autonomy does not have a significant impact on network concentration. This demonstrates that the studied companies are more focused on absorbing and assimilating resources rather than on creating new networks. At the same time, when the complementarity of resources is significant, a low level of integration reduces the damage caused to the initial network ties and even prevents close interaction between the acquiring firm and the network. Thus, the relationship between the level of integration and network concentration is not significant.

To further verify the results of regression modelling, this study uses bootstrap method to confirm or reject the intermediate effect of global network on the relationship between the direction of integration and diffusion of innovation. Based on the test of significant relationships, the bootstrap sample size is set at 200 and the two-sided bias correction interval at 95 % (Table 6). In the presence of significant similarity and complementarity of resources between companies, the level of integration and the coefficient of diffusion of innovations based on network concentration is

positive (β = 0.037), and lower than in the presence of significant similarity and insignificant complementarity (β = 0.059). At the same time, brand autonomy had a positive correlation with the coefficient of diffusion of innovations through the network structure (β = 0.011), less than in the case of insignificant similarity and significant complementarity (β = 0.138).

Table 6

BOOTSTRAP TESTS OF BUSINESS INTEGRATION MODELLING INTO INNOVATIVE GLOBAL NETWORKS

Group	Integrated efficiency	Coefficient	P–value
Significant similarity — minor complementarity	Business integration — network concentration — ability to spread innovations	0,059	0,059*
	Brand autonomy — network concentration — ability to spread innovations	–0,042	0,019**
	Brand autonomy — structural gap — ability to spread innovation	0,003	0,810
Minor similarity — significant complementarity	Business integration — network concentration — ability to spread innovations	–0,163	0,076*
	Brand autonomy — structural gap — knowledge diffusion	0,138	0,045**
Significant similarity — significant complementarity	Business integration — network concentration — ability to spread innovations	0,037	0,041**
	Brand autonomy — structural gap — diffusion of innovations	0,011	0,043*

Note: ** $p < 0,05$; * $p < 0,1$.

Source: formed by the authors

On the basis of the study, the possibility of diagnosing the effectiveness of post-merger integration of companies in the context of foreign mergers and acquisitions using technological sources is generated, which improves the indicators of innovative development at the industrial level based on the concentration and structural gap of the global innovation network. Combining the theory of resource management and the theory of innovation network using structural equation modelling with several groups and bootstrap testing on a sample of manufacturing companies under study suggests that the level of proximity of the acquiring company to the centre in the global innovation network contributes to the ability to spread innovation after the merger. The size of the structural gap of the acquiring company in the innovation network increases its ability to spread innovations after the merger abroad. If there is a significant similarity of resources and their weak complementarity between the companies, it contributes to a high level of business integration and a decrease in autonomy in brand

management, stimulates the concentration of the acquirer's network. In the presence of insignificant similarity of resources and significant complementarity of resources between companies, a low level of business integration and a high level of autonomy in brand management contribute to the strengthening of the network structural gap of the buyer company. If there is a significant similarity of resources and a significant complementarity of resources between companies, a moderate level of integration is conducive to improving network concentration, and a moderate level of autonomy is more suitable for strengthening the network structural gap of the acquirer.

Conclusions

The study demonstrates the relationship between resource similarity and complementarity in the context of business integration into global innovation networks through mergers and acquisitions. The results show that companies can use a high level of integration, but considering a certain level of resource similarity between the participants of mergers and acquisitions. At the same time, the extent of integration relates only to operations, not to the brand or culture of the company. Similarity of resources is more important for integration and management of innovative development of companies, which is associated with the obligations of developing countries with significant cultural distance and management practices that cannot be transferred to mature markets. The results contribute to a deeper understanding of post-merger business integration by revealing the ways in which resources are integrated and their impact on the diffusion of innovation.

The study makes a scientific contribution to the understanding of the possibilities of diffusion of innovations in mergers and acquisitions, considering the network approach, emphasizing the important role of the company's position in the global network, its impact on the inter-organizational diffusion of innovations in the post-merger and acquisition stage. At the same time, M&A should not be seen as an isolated bilateral relationship, but it is necessary to recognize the behaviour of implementation in the network, considering actors outside the business, in particular, customers, suppliers and partners. Mergers and acquisitions allow acquiring companies to improve their position in networks that facilitate innovation, increase network concentration or reduce structural gaps through not only internal synergies with target resources, but also network synergies based on the involvement of network target relationships. The study establishes that the post-merger integration phase, which opens up possibilities for the realization of network synergies, is more significant than the M&A transaction.

Mergers and acquisitions using network technologies are an effective way for companies from emerging markets to quickly gain access to innovative developments and valuable resources. When selecting overseas targets,

companies should not only evaluate their own finances, management teams and technology, but also pay attention to external network resources such as innovation collaboration, supply chains and customers. Mergers and acquisitions allow companies to gain control over two types of resources: internal resources for achieving intrinsic synergies and external resources gained from acquiring network targets for achieving network synergies. Mergers and acquisitions are an effective means of improving the position of acquiring companies to obtain innovations, network concentration or structural breaks when the appropriate integration method is applied. Business integration can be carried out if there is a certain similarity of resources between the companies. The proposed model of structural equations, combines multiple regression, analysis of alternatives, factor and quariation analysis, which compensate for the shortcomings of traditional statistical methods. The study proves the existence of a stable effect of the company's position in the global network on the relationship between the way of integration and the spread of innovation in the process of business development.

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Received on: March 3, 2022
Accepted on: April 22, 2022
Released on: July 15, 2022