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Forms of economic proximity and their impact on innovation performance: A study of multidisciplinary commercial organisations in industry

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Abstract

This article analyses the influence of different types of economic proximity (geographical, organisational, technological and social) of business units of multidisciplinary organisations on the effectiveness of their innovative activities. The conducted research is based on a survey of a sample of 83 holdings belonging to 27 MCOs (a total of 189 respondents). The analysis confirmed that most of the companies surveyed associate increased efficiency of innovation activities with organisational and technological proximity, while geographical and social proximity are significantly underestimated by respondents. It was also possible to identify separate profiles of different types of economic proximity of the business units in the sample. Thus, the net profit from the sale of new products is more influenced by technological and social proximity, the introduction of new products to the market is influenced by technological and geographical proximity, and the growth in the number of patents registered is influenced by organisational, technological and social proximity.

Based on econometric estimates, our results suggest that while all types of proximity have a positive effect on the introduction of new products to the market, only organisational and technological proximity have a direct effect on net profits from the sale of new products.

Keywords: geographical proximity, social proximity, technological proximity, cognitive proximity, organisational proximity, multidisciplinary organisations, industry, efficiency of innovation activity.

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经济亲密度形式及其对创新效率的影响：对工业中多元化商业组织的研究

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简介

本文分析了多元化组织的业务单位在地理、组织、技术和社会等不同类型经济亲密度对其创新活动效率的影响。所进行的研究基于对27个多元化商业组织中83家控股公司的问卷调查（共189名受访者）。分析结果表明，大多数受访公司将创新活动效率的提高与组织和技术亲密度联系在一起，而地理和社会亲密度则被受访者显著低估。 此外，研究还成功识别了多元化商业组织中不同类型经济亲密度的独特影响模式。例如，新产品销售净利润更受技术和社会亲密度的影响，新产品市场推广则更受技术和地理亲密度的影响，而专利数量增长则主要受组织、技术和社会亲密度的共同作用。

我们基于计量经济学评估的结果表明，尽管所有类型的经济亲密度对新产品上市都有积极影响，但只有组织和技术亲密度直接影响新产品销售的净利润。

关键词： 地理亲密度、社会亲密度、 技术亲密度、认知亲密度、组织亲密度、多元化组织、工业、创新活动效率。

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Introduction

The competitiveness of multi-industry organisations is largely determined by their innovation efficiency, which in turn depends on the success of continuous knowledge creation and management, as well as the construction of an effective communication strategy between them.

For example, [Villasalero, 2013] shows that knowledge spillovers have a positive impact on productivity. Similar conclusions were reached by the authors of [Agarwal et al., 2009, Ding et al., 2013], who used transnational companies as their empirical base, and [Villasalero, 2014], who studied diversified companies. At the same time, the researchers note the difference between multi-industry organisations and transnational corporations, pointing out that the division of business units in multi-industry organisations mainly corresponds to industries, while in transnational corporations it is based on geographical location. As a result, the design of business unit communication and knowledge flow will differ significantly: in multi-industry companies, the key issue is crossing technological boundaries, whereas in multinational companies, the main issue concerns geographical boundaries. [Miller et al., 2007]. In both cases, intra-organisational communication and knowledge transfer takes place through an internal knowledge network, but in the first, it operates across product divisions, while in the second, it spans geographical branches.

Research also shows that when a business unit is actively involved in knowledge outflow, it indicates the presence of a rich resource base within the division. On the contrary, a lack of key resources and a weak resource base is indicated by the fact that a business unit is actively involved in the inflow of knowledge [Gupta, Govindarajan, 2000]. The authors of [Monteiro et al., 2008] demonstrate this using data from transnational corporations and argue that foreign subsidiaries that actively participate in knowledge transfer to the rest of the corporation have higher competencies and valuable potential. Similar conclusions are drawn in [Harzing, Noorderhaven, 2006]: foreign affiliates with high knowledge outflows have higher relative capabilities than foreign affiliates with high knowledge inflows. The authors of the study [Cho, Lee, 2004] also argue that the greater the competitive advantage of a foreign business unit, the greater the opportunities it has to acquire and create new knowledge through the sharing or recombination of knowledge located within

the divisions of a multinational corporation [Manolopoulos et al., 2007].

For knowledge absorption to be optimal, the inflow and outflow of knowledge and resources must be simultaneously high in all business units of multi-industry organisations, since the recombination of resources and knowledge requires the mutual exchange of knowledge between units [Galunic, Eisenhardt, 2001].

If the level of knowledge inflow in a business unit is high and the level of knowledge outflow is low, this means that the receiving unit plays a more passive role in the exchange process and the results are not comparable to those observed in the optimal scenario [Markides, Williamson, 1994]. Finally, if a business unit has a low level of both knowledge inflow and outflow, the result is that virtually no new knowledge is created in the unit, i.e. the business unit ceases to be innovative.

In order to develop a communication strategy and the process of knowledge transfer between the business units of a multi-industry organisation, i.e. to create the conditions for optimal knowledge acquisition by the business units, it is important to analyse the economic proximity.

The concept and forms of economic proximity related to types of inter-organisational relationships were first proposed in [Boschma, 2005], which argued that it is precisely these forms of economic proximity that facilitate effective joint learning and collective innovation between business units of a multi-industry trading organisation. R. Boschma classifies the types of economic proximity as geographical, cognitive, social, institutional, and organisational. Empirical evidence suggests that indeed all forms of closeness tend to be associated with higher levels of collaborative innovation, with distance in one dimension offset by closeness in another [Autant-Bernard et al., 2007; Balland, 2012].

The article aims to analyse the influence of different forms of economic proximity on innovation performance indicators of multi-industry commercial organisations.

1. Theoretical overview and research hypotheses

Geographical proximity. In research, geographical proximity is most often understood in terms of territorial (spatial) proximity. [Howells, 2002]. Geographical proximity was first described in [Bellet et al., 1992]. The article states that the geographical proximity of enterprises (business units) determines the effectiveness of business strategies and the success of innovative activities. In the results of their study, the authors proposed, for the first time, the organisation of scientific and technological parks for industrial enterprises in connection with the identified effectiveness of geographical proximity.

The measurement of geographical proximity varies between studies: some authors define the degree of geographical proximity as the absolute geographical distance separating participants, while others use the distance relative to transport (travel time) or the perception of these distances by companies. There are also differences in the scale at which geographical proximity is defined. Some studies look at the distance between two interacting organisations (dyadic distance), while others look at the presence of groups of firms in a geographical area (agglomerations).

The effect of geographical proximity is based on the concepts of knowledge spillovers by A. Marshall and tacit knowledge by M. Polanyi. According to them, geographical proximity allows for a reduction in the communication gap between participants, thereby facilitating technology transfer. Geographical proximity plays a special role in the transfer of tacit knowledge, as short distances facilitate personal interaction [Gilly, Torre, 2000].

More recent research has introduced the concept of dynamic geographical proximity (see e.g. [Gallaud, Torre, 2004; Kautonen, Hyypia, 2009; Rallet, Torre, 2009; Torre, Gallaud, 2022]), which implies that actors do not necessarily need to be in constant proximity to each other - temporary visits, meetings, and temporary co-existence in close proximity may be sufficient. In [Kautonen, Hyypia, 2009] it is shown that if participants manage to build other forms of proximity (e.g. organisational), they will enable companies to cooperate successfully across any geographical distance. Furthermore, [Gallaud, Torre, 2004; Torre, Gallaud, 2022] argue that geographical proximity is only necessary at certain stages of (innovative) collaboration, such as knowledge creation, basic research, while at the prototyping or commercialisation stage, geographical proximity is irrelevant.

Although the concept of temporal geographical proximity is supported by many authors, it has not been empirically confirmed.

There are many studies showing the relationship between geographical proximity and innovation performance, including in multi-industry organisations (see for example [Sidhu et al., 2007]), where the task of managing multi-industry organisations is to combine the knowledge of geographically distant business units to develop new technologies, processes, or products.

Research shows that business units tend to rely on the knowledge of geographically proximate partners [Rosenkopf, Almeida, 2003], as interpersonal communication between employees of nearby firms expands opportunities for formal and informal knowledge exchange and promotes the development of relational trust [Kale et al., 2000; Capaldo, 2007]. However, when business units are geographically distant, collaboration between them is difficult.

Therefore, the first hypothesis of this study is as follows:

Hypothesis 1. In multi-industry commercial enterprises, geographical distance between business units negatively affects the overall innovative performance.

Proximity between business units is essential for building and maintaining collaboration [Mattes, 2012]. For a long time, studies of proximity focused on geographical proximity [Belussi, Caldari, 2009], but over time researchers have come to the conclusion that business units of a multi-industry organisation can be co-located without interacting with each other and, conversely, can interact without being located close to each other [Knoben, 2009]. Thus, the origi-

nal concept of geographical proximity has been extended to other dimensions, i.e. cognitive, organisational, institutional, and social proximity [Boschma, 2005]. Moreover, it has become clear that one or more types of proximity can compensate or replace other types of closeness [Huber, Huber, 2012; Mattes, 2012]. The main motives for business units to initiate cooperation are their cognitive and organisational proximity.

Cognitive proximity reflects the extent to which partners have similar knowledge in terms of technical language, know-how, and depth of knowledge (see, for example, [Huber, Huber, 2012]). With cognitive proximity, business units find opportunities for innovation by combining their knowledge [Boschma, 2005].

Organisational proximity reflects the similarity between business units in their organisational goals (see, for example, [Werker et al., 2016]). There is currently no established understanding of organisational proximity. Some authors define it as 'participants who are in the same field of relations' [Oerlemans, Meeus, 2005]; others as 'actors who have a similar value system and whose interaction is governed by the same rules and procedures' [Rallet, Torre, 2017].

[Balland et al., 2014] define organisational proximity as a parameter consisting of geographical proximity and a scale of proximity of general business turnover, where business turnover is defined by the authors as 'fast, reliable, and well-adapted turnover of stocks and information, as well as effective mobilisation of external resources'.

In this regard, [Balland et al., 2014] define organisational proximity as 'the closeness between employees of a multi-industry organisation who identify themselves by belonging to the same organisation and by their knowledge of specific procedures' [Balland et al., 2014]. This means that business units that are part of the same group share the same organisational rules and procedures. This encourages interaction between them, making work easier than with external organisations [Rallet, Torre, 2017] and, in particular, facilitates knowledge flow and assimilation [Phene, Almeida, 2008]. In fact, multi-industry organisations (business groups) become platforms for knowledge sharing [Ratcheva, 2009], where collaboration and knowledge transfer tend to develop easily, facilitating the combination of knowledge from affiliated business units and their ability to co-create innovations even across large geographical distances. The existence of group links between distant business units of a multi-industry organisation appears to be particularly important for the transfer of complex and tacit knowledge that characterises knowledge-intensive collaboration, which requires strong links between organisations.

This presents the second hypothesis of this study:

Hypothesis 2. In multi-industry commercial enterprises, organisational proximity has a positive effect on overall innovative performance.

Although cognitive and organisational proximity stimulate collaboration in innovation activities between business units, some empirical studies (e.g. [Caniëls et al., 2014; Werker et al., 2016]) suggest that personal and social proximity also play an important role in collaboration.

Although personal and social proximity both reflect the human factor in collaboration and are therefore often considered as the same concept (e.g. in [Boschma, 2005; Knoben, Oerlemans, 2006]), these types of closeness are distinct from each other [Caniëls et al., 2014; Werker et al., 2016]. Employees who are personally close and similar to each other are more likely to work together [Caniëls et al., 2014]. Thus, personal proximity influences cooperation at the individual level. Social proximity enables cooperation because (potential) partners belong to the same professional or social networks [Caniëls et al., 2014]. Because these networks provide common informal rules, such as shared habits and a common socialisation process, social proximity ensures trusting interactions between partners [Boschma, 2005].

Initially, personal and social closeness were only analysed as separate variables, but then the researchers suggested that the human factor at the individual level, i.e. personal proximity, is crucial for collaboration and the creation of knowledge networks. For example, a study [Casciaro, Lobo, 2008] showed that professionals only collaborate with (potential) partners if they like them. At the same time, this research shows that the competence of (potential) partners is of little importance. This behaviour is observed in different organisational contexts and for different tasks [Casciaro, Lobo, 2008].

This is the third hypothesis of the study:

Hypothesis 3. In multi-industry commercial enterprises, social proximity has a positive effect on the overall innovative performance.

Technological proximity is based on shared technological expertise and knowledge bases. Technology can be defined as the tools, equipment, and knowledge that mediate inputs and outputs (process technology) and/or create new products or services (product technology) [Tushman, Anderson, 2018]. Technological proximity does not refer to the technologies themselves, but to the knowledge possessed by the owners of these technologies. Technological proximity between business units facilitates the acquisition and development of technological knowledge and the creation of new technologies [Anderson, Tushman, 2018].

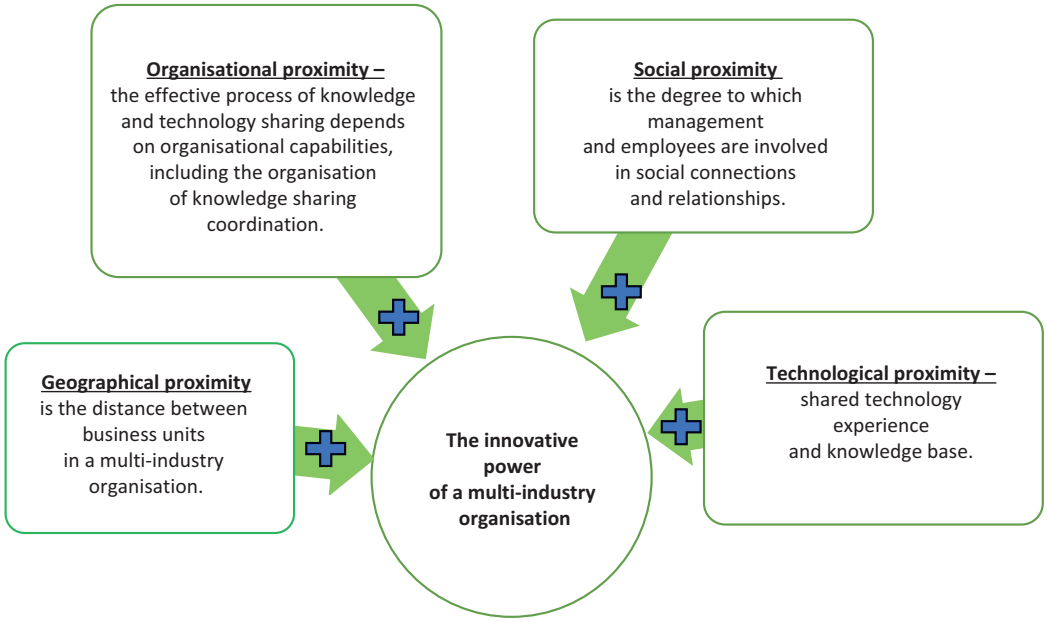
The importance of technological proximity is explained by the concept of relative absorptive capacity [Lane, Lubatkin, 1998]. In contrast to the general concept of absorptive capacity, which assumes that a firm's ability to learn depends only on the firm itself, the concept of relative absorptive capacity says that this ability also depends on the source of the knowledge being exchanged. Business units need to have comparable knowledge bases to ensure efficient and creative use of new knowledge [Colombo, 2003]. The knowledge base of firms is typically measured in terms of products they produce or the scientific or technological areas in which they file patents [Fung, 2003].

This leads to the fourth hypothesis of the study:

Hypothesis 4. In multi-industry commercial organisations, the technological proximity of business units has a positive effect on the overall innovative performance.

The conceptual model of the study is shown in the figure below.

Fig. 1. A conceptual model for studying the economic proximity of business units of multidisciplinary commercial organisations in industry



Source: compiled by the authors.

2. Reserch methodology

2.1. Description of the sample

The empirical testing of the proposed hypotheses was based on the analysis of data collected between January 2022 and February 2023.

A total of 28 multi-industry commercial organisations (MCOs) were selected for the analysis, including 83 holding companies and 2864 companies from various sectors. The number of companies included in the MCO ranges from 8 (YATEC) to 898 (Gazprom). Regions of presence - from 2 (YATEC) to 71 (Gazprom). A number of MCOs selected for analysis include sub-holdings. For all MCOs in the sample, the core enterprise is an industrial enterprise. More than half of the surveyed companies have been active in the market for more than 20 years; the age of the MCOs in the sample ranges from 18 to 83 years, with an average of 39 years. The characteristics of the MCOs in the sample are shown in Table 1.

The questionnaire was pre-tested in in-depth interviews with managers of 17 MCOs in order to clarify ambiguous interpretations of the questions. Data collection was carried out using a combination of online questionnaires and telephone interviews, which allowed the questionnaire questions to be clarified.

Questionnaires were then sent electronically to the 83 holdings that make up the MCO. The respondents were senior management and persons responsible for the development and innovation activities of the holdings. A total of 189 respondents representing 83 holdings participated in the study.

2.2. Research variables

The following indicators were used as dependent variables: the share of sales of innovative products in the total sales of the MCO; the number of new products launched during the year; the number of patents registered; the number of joint research projects between the business units of the MCO.

To measure geographical proximity, we used the number of cities in which each MCO's business units are located.

Organisational proximity was assessed using three questions aimed at measuring the ability of companies to build a well-coordinated system of interactions in the MCO innovation process, both between participants in the innovation process and within MCO companies.

Social proximity is measured by the ability of the MCO to engage employees of business units in direct interaction with each other, establish social ties and relationships, as well as the ability to build feedback loops with consumers and involve them in co-creating value (customer active paradigm).

Technological proximity is measured as the level of knowledge and competence of the MCO business unit. The higher the technological proximity of the business units, the greater their absorptive capacity.

The questions used to measure the degree of economic proximity of business units are shown in Table 2.

When responding to questions about social and technological proximity, MCOs showed a low ability to bring business units closer together and to create interactions within the framework of social and technological proximity.

Table 1
Characteristics of multidisciplinary commercial organisations in the sample

MCO	Structure of multi-industry commercial organisations		Regions of presence	Sub-holdings	Revenue, 2022 (billion roubles)
	Number of industries	Number of enterprises			
Severgroup	30	121	28	Sveza Severstal Power Machines Lenta AVA-Peter	22.5
Interros	33	98	9	Norilsk Nickel Pervovaks Rosbank	243
Gazprom	70	898	71	Gazpromneft Slavneft Gazprombank TGC-1 Gasstroyprom Centrenergoholding Gazprom Mezhregiongaz Centrenergoholding Mosenergo Moscow United Energy Company SOGAZ Gazprom Teploenergo Stroytransneftegaz (STNG)	100
Rosneft	40	221	37	Slavneft	—
Novatek	13	36	11	—	—
EuroChem	15	47	10	—	209
Sibur	23	75	17	Nizhnekamskneftekhim KOS NIPIGAS	39
RusHydro	24	66	31	Yakutskenergo	206
Yatec	7	8	2	—	—
Rusal	15	66	10	—	3.3
Safmar	20	43	6	A101 Development Neftisa	99
USM Holding	19	150	12	Udokancopper Metalloinvest Megafon Akkerman Cement ICS Holding LLC	—
Svyazinvestneftekhim	28	197	9	Tatneft KOS Tatneftkhiminvest Tatenergo Tattelecom Tatspritprom Centre for Technology Transfer Investneftekhim	138
Ural Mining and Metallurgical Company (UMMC)	42	148	17	Petropavlovsk Kuzbassrazrezugol Vostochny Port Uralelectromed (Ural Mining and Metallurgical Company) Susumanzoloto	
Cable Alliance	72				
Transmashholding	10	61	13	Locomotive Technologies	—
Independent Oil and Gas Company	3	43	9	Alliance Oil	25
Etalon	14	148	11	YIT (Finland)	0.244
Novolipetsk Metallurgical Plant (NLMK)	12	43	8	—	95
UralChem	11	33	7	Uralkali BMF	—

Table 1 *(ending)*

MCO	Structure of multi-industry commercial organisations		Regions of presence	Sub-holdings	Revenue, 2022 (billion roubles)
	Number of industries	Number of enterprises			
AEOH	31	107	28	AEOH-Development Azot Novaport AEOH-Agro Geoprommining	1.5
Russian Copper Company (RCC)	11	36	6	—	—
Magnitogorsk Iron and Steel Works (MMK)	13	44	6	—	0.481
Siberian Business Union (SBU)	14	53	5	SDS-Ugol	0.01
Evraz	21	47	5	—	—
Alrosa	17	33	8	—	1.4
United Metallurgical Company (OMK CJSC)	11	20	6	—	—
Industrial Metallurgical Holding (IMH)	8	22	4		2.8

Source: compiled by the authors.

The calculation of the main resulting indicators was based on three questions to measure each aspect of the MCO's economic proximity, as well as to measure the performance indicators of the MCO's innovative activities: net profit from the sale of innovative products as a percentage of the MCO's total net profit, the number of new products launched during the year, the number of patents registered, and the number of new products launched.

Control variables: the size of the MCO in terms of the number of enterprises belonging to the group, the volume of investment in the modernisation of equipment, the presence of the own research and development department in the structure of the MCO business units.

2.3. Data analysis procedure

To assess reliability, Cronbach's alpha coefficients were calculated, which met the recommended level of at least 0.75 (Table 3). A factor analysis using principal components (Varimax) was then performed on 13 questions describing four types of innovation: product, technological, organisational,

Table 2
Frequency of respondents' answers on the level of economic proximity

		Share of mentions (% of respondents)
	Geographical proximity	
1	MCO has several sub-holdings in different regions.	74.1
2	MCO business units in one region are located in several cities	67.3
3	MCO business units are located in more than one region	99.8
	Organisational proximity	
1	MCO business units have a knowledge base accumulation system	64.8
2	MCO business units have a unified knowledge sharing system	56.9
3	Business processes of the innovation process of the business units of the MCO are adapted to each other	76.9
4	Business processes of the innovation process are aligned only for business units of the MCO that are integrated along the value chain	
	Social proximity	
1	MCO has a corporate university	29.7
2	MCO conducts training programmes for specialists of the same category from different business units	24.9
3	MCO business units have acceleration programmes	62.8
4	MCO business units collaborate with consumers to create new products	76.4
	Technological proximity	
1	All MCO business units have their own R&D departments	27.9
2	MCO has a single centre for managing innovation activities	49.4
3	MCO reconfigures its organisational structure to better match existing competencies with the conditions for developing new markets or launching new products.	38.1

Source: compiled by the authors.

Table 3
Factor analysis: questionnaire, factor load and reliability test (Cronbach's alpha coefficient)

Questionnaire	Factor loadings sum of squares	Model 1 for the 'geographical proximity' factor	Model 2 for the 'social proximity' factor	Model 3 for the 'organisational proximity' factor	Model 4 for the 'technological proximity' factor
Geographical proximity - Cronbach's alpha = 0.89					
MCO has several sub-holdings in different regions	0.628	0.824	0.311	0.276	0.258
MCO business units in one region are located in several cities	0.534	0.728	0.254	0.196	0.221
MCO business units are located in more than one region	0.664	0.733	0.329	0.247	0.253
Organisational proximity - Cronbach's alpha = 0.84					
MCO business units have a knowledge base accumulation system	0.718	0.221	0.741	0.346	0.258
MCO business units have a unified knowledge sharing system	0.639	0.198	0.824	0.298	0.221
Business processes of the innovation process of the MCO business units are adapted to each other	0.784	0.237	0.889	0.307	0.253
Business processes of the innovation process are aligned only for MCO business units that are integrated along the value chain	0.639	0.273	0.914	0.193	0.242
Social proximity - Cronbach's alpha = 0.7					
MCO has a corporate university	0.548	0.414	0.271	0.761	0.398
MCO conducts training programmes for specialists of the same category from different business units	0.671	0.363	0.259	0.695	0.401
MCO business units have acceleration programmes	0.528	0.423	0.164	0.727	0.314
MCO business units collaborate with consumers to create new products					
Technological proximity - Cronbach's alpha = 0.83					
All MCO business units have their own R&D departments	0.618	0.184	0.241	0.406	0.831
MCO has a single centre for managing innovation activities	0.522	0.215	0.262	0.321	0.779
MCO reconfigures its organisational structure to better match existing competencies with the conditions for developing new markets or launching new products.	0.563	0.173	0.309	0.307	0.693
Efficiency of innovation activities					
Net profit from new product sales - Cronbach's alpha = 0.85					
Increase in relative level of net profit from new product sales compared to industry average	0.768	0.804	0.451	0.166	0.632
Increase in the profitability of new product sales	0.534	0.722	0.369	0.191	0.587
Growth in the market share of new products	0.664	0.463	0.581	0.287	0.713
Number of new products launched during the year (Cronbach's alpha coefficient = 0.84)					
Entering new sales markets	0.793	0.621	0.239	0.564	0.783
Expanding the range of new products	0.814	0.793	0.303	0.383	0.732
Number of registered patents - Cronbach's alpha = 0.87					
Number of patent applications	0.748	0.824	0.311	0.676	0.258
Number of registered patents	0.884	0.728	0.254	0.896	0.221

Source: compiled by the authors.

and managerial. The analysis confirmed the presence of four factors with values greater than one according to the Kaiser criterion. Overall, the four types of economic proximity explained 73.6% of the variation in responses to the questions (this result corresponds to the recommended value of at least 70%) (Table 2). Similarly, factor analysis using the principal components method (Varimax) was used for the indicators of the effectiveness of MCO innovation activities: the share of net profit from the sale of new products, the number of new products introduced to the market, and the number of patents registered. The analysis confirmed the three performance factors identified, which together accounted for 72.6% of the variation in the questions (Table 3).

The values of the indicators obtained were then used in a regression analysis carried out using a mathematical model:

$$Y_i = \beta_0 + \beta_1 GEOGR_i + \beta_2 TECHN_i + \beta_3 ORG_i + \beta_4 SOC_i + \\ + \beta_5 MODERN_i + \beta_6 SIZE + \beta_7 RD_i + \varepsilon_i \quad (1),$$

where $GEORG_i$ – geographical proximity, $TECHN_i$ – technological proximity, ORG_i – organisational proximity, SOC_i – social proximity, $SIZE$ – MCO size, $MODERN_i$ – equipment modernisation, RD_i – own research and development department. The indicators of MCO size, equipment modernisation, and the presence of an in-house R&D unit were introduced to control for characteristics that might affect the effectiveness of MCO innovation activities.

Standardised and unstandardised coefficients were obtained using the maximum likelihood method, with standardised coefficients used to determine the strength of the influence of the factors on the resulting indicator, and unstandardised coefficients used to test the research hypotheses.

3. Research findings

Tables 4-6 present the results of the regression analysis reflecting the influence of different types of economic proximity (geographical, social, organisational, and technological) on the effectiveness of the innovative activities of multi-industry commercial organisations. Overall, the results of the regression analysis confirmed the hypotheses of the study. Models based on equation (1) were able to explain 28% of the variation in MCO profits from new products, 17% of the variation in the number of products launched, and 24% of the variation in patent activity.

When analysing the growth of net profit from new products (Table 4), technological proximity ($\beta = 0.437$; $p < 0.01$) and social proximity ($\beta = 0.123$; $p < 0.01$). had the largest positive effect. At the same time, organisational ($\beta = 0.06$; $p < 0.10$) and geographical ($\beta = 0.092$; $p < 0.05$) proximity have no significant effect on this indicator. The variables of having an in-house R&D unit ($\beta = 0.061$; $p < 0.05$) and the size of the MCO ($\beta = 0.073$; $p < 0.05$) also have no effect on this indicator. At the same time, the indicator of the level of modernisation of equipment ($\beta = 0.248$; $p < 0.05$) has a negative effect on the level of net profit. Thus, technological and social proximity are key factors in increasing net profit from the sale of new MCO's products in the sample studied.

Table 4
The impact of various types of economic proximity on the level of net profit from the sale of new MCO products

Independent indicators	Unstandardised coefficients	Standardised coefficients
Constant (β_0)	0.227 (0.117)	
Geographical proximity ($GEORG_i$)	0.092** (0.094)	0.098***
Technological proximity ($TECHN_i$)	0.437*** (0.107)	0.444 **
Organisational proximity (ORG_i)	0.060* (0.047)	0.069*
Social proximity (SOC_i)	0.123*** (0.019)	0.143***
Level of investment in equipment modernisation ($MODERN_i$)	–0.248** (0.069)	–0.235**
MCO size ($SIZE$)	0.073** (0.029)	0.082**
In-house R&D (RD_i)	0.061** (0.053)	0.058**
Corrected R^2	0.28	
Number of observations	189	

Note. * – $p < 0.10$; ** – $p < 0.05$; *** – $p < 0.01$. Standard errors are given in brackets.
Source: compiled by the authors.

Table 5
The impact of different types of economic proximity on the number of new MCO products launched in the reporting year

Independent indicators	Unstandardised coefficients	Standardised coefficients
Constant (β_0)	0.384 (0.093)	
Geographical proximity ($GEORG_i$)	0.192** (0.011)	0.198**
Technological proximity ($TECHN_i$)	0.174** (0.028)	0.183**
Organisational proximity (ORG_i)	0.138** (0.051)	0.149**
Social proximity (SOC_i)	0.131** (0.072)	0.139**
Level of investment in equipment modernisation ($MODERN_i$)	–0.125** (0.069)	0.131**
MCO size ($SIZE$)	0.119** (0.039)	0.122**
In-house R&D (RD_i)	0.133** (0.067)	0.138**
Corrected R^2	0.17	
Number of observations	189	

Note. * – $p < 0.10$; ** – $p < 0.05$; *** – $p < 0.01$. Standard errors are given in brackets.
Source: compiled by the authors.

An analysis of the number of new products launched on the MCO market in the reporting year (Table 5) shows that all types of business proximity have a positive impact: geographical proximity has the largest impact (β = 0.192; $p < 0.05$), followed by technological (β = 0.174; $p < 0.05$), organisational (β = 0.138; $p < 0.05$) and social (β = 0.131; $p < 0.05$) proximity. The level of investment in equipment modernisation (β = 0.125; $p < 0.05$) has a negative effect on the number of new products, while the size of the MCO (β = 0.119; $p < 0.05$) and the presence of its own R&D department (β = 0.138; $p < 0.05$) have a positive effect on the introduction of new products.

Finally, the analysis of the number of registered patents (Table 6) shows that organisational proximity (β = 0.318; $p < 0.01$), technological proximity (β = 0.282; $p < 0.01$), geographical proximity (β = 0.165; $p < 0.10$) and the presence of an in-house R&D unit (β = 0.268; $p < 0.67$) have a positive effect on the number of registered patents. At the same time, social proximity (β = 0.084; $p < 0.05$), the size of the MCO (β = 0.063; $p < 0.05$), and the level of investment in equipment modernisation (β = 0.071; $p < 0.05$) do not have a significant impact on the effectiveness of MCO innovation activities.

Table 6
The impact of different types of economic proximity on the number of patents registered by the MCO in the reporting year

Independent indicators	Unstandardised coefficients	Standardised coefficients
Constant (β_0)	–0.424* (0.066)	
Geographical proximity ($GEORG_i$)	0.165 *** (0.171)	0.179 ***
Technological proximity ($TECHN_i$)	0.282*** (0.127)	0.288***
Organisational proximity (ORG_i)	0.318*** (0.048)	0.324***
Social proximity (SOC_i)	0.084** (0.064)	0.079**
Level of investment in equipment modernisation ($MODERN_i$)	0.063** (0.009)	0.067**
MCO size ($SIZE$)	0.055** (0.013)	0.052**
In-house R&D (RD_i)	0.271** (0.067)	0.268**
Corrected R^2	0.24	
Number of observations	189	

Note. * – $p < 0.10$; ** – $p < 0.05$; *** – $p < 0.01$. Standard errors are given in brackets.
Source: compiled by the authors.

To test the first hypothesis regarding the relationship between geographical proximity and the effectiveness of MCOs' innovative activities, we can conclude that it is confirmed: geographical proximity has a positive effect on two of the three analysed indicators of the effectiveness of innovative activities - the number of new products launched on the market and the number of patents registered.

The second hypothesis, which describes the influence of organisational proximity on the innovative efficiency of MCOs, was partially confirmed for the indicators of the efficiency of innovative activities: the number of new products introduced to the market and the number of patents registered.

Interviews with MCO representatives revealed an association between organisational and social proximity ($\rho_s = 0.57$) supporting the notion that social closeness leads to higher levels of organisational proximity.

The third hypothesis about the influence of social proximity was partially confirmed for the indicators of the effectiveness of innovation activities: the amount of net profit from the sale of new products and the number of new products introduced to the market.

Finally, the fourth hypothesis on the impact of technological proximity was fully confirmed: technological proximity has the greatest impact on profits from the sale of new products, followed by the number of patents filed and the number of new products launched.

Thus, we have demonstrated the significance of the constructed model describing the influence of different types of economic proximity. We also confirmed the influence of different types of MCO business units' economic proximity on the efficiency of their innovation activities, expressed by indicators of increasing net profit from the sale of new products, the number of new products introduced to the market, and the number of patents registered.

According to the results obtained, when modelling the net profit from the sale of new MCO products, the key factor in the growth of net profit is technological and social proximity. In modelling the number of new product introductions, geographical and technological proximity emerged as key factors, followed by social and organisational proximity. When modelling the increase in the number of registered MCO patents, organisational, technological, and organisational proximity are significant factors. Social proximity is the least significant factor.

Conclusion

The article presents a comprehensive multifactorial study of the influence of different types of economic proximity of business units of multi-industry commercial organisations on the effectiveness of their innovative activities. The assessment of the effectiveness of innovation activities is linked to the possibility of implementing a number of tasks set by the State Programme of the Russian Federation 'Development of Industry and Improvement of its Competitiveness'. It is assumed that the MCOs will become key enterprises, competitive in the Russian and global markets, creating products with high added value, which will help maintain high rates of industrial production growth in 2025-2030 and increase the production of modern innovative products even in an unfavourable economic situation.

This study identified four types of economic proximity of MCO business units: geographical, technological, organisational, and social, which were measured as a result of a survey of a sample of 83 MCO member companies (189 respondents) and used to analyse the effectiveness of MCO innovation activities. The survey confirmed that the majority of companies surveyed associate increased efficiency of innovation activities with organisational and technological proximity, while geographical and social proximity are significantly underestimated by respondents.

The results of the quantitative analysis confirmed most of the hypotheses. It was also possible to identify individual profiles of different types of economic proximity of the business units of the MCO sample. For example, net income from the sale of new products is strongly influenced by technological and social proximity, the launch of new products is influenced by technological and geographical proximity, and the growth in the number of patents filed is influenced by organisational, technological, and social proximity.

In this way, depending on the objectives set by an MCO, it is possible to combine investments in certain types of economic proximity in order to achieve the objectives set.

By analysing the combination of different types of economic proximity on the performance indicators of MCOs, the study can be extended in the future.

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