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## Reconfiguration of relations within the business ecosystem: response to the COVID-19 pandemic

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### ABSTRACT

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The crisis caused by the COVID-19 pandemic brought about abrupt changes to demand in many sectors, which resulted in the polarization of the market situation of enterprises. Some of them became big winners as demand increased, while others were losers due to the decline in demand; there was also a small group of companies that did not feel any changes in demand for their products. To date, research on the consequences of the COVID-19 pandemic for enterprises has focused on identifying bilateral relations. In this article, the authors undertake an analysis of the reconfiguration of the business ecosystems of enterprises depending on their market situation caused by the COVID-19 pandemic. The article deals with the relations between businesses and their suppliers, customers, competitors, financial institutions, scientific and research centres, and public administration institutions. The study was conducted on a sample of 170 companies and utilized the method of a multidimensional analysis of correspondence. The companies which benefited from the pandemic enlarged their business ecosystems by expanding short-term relations with new suppliers and customers, maintaining unchanged cooperation with the current ones. The willingness to cooperate with competitors (cooperation), financial, scientific and research institutions, and public administration has been on the rise. The biggest losers made their business ecosystems smaller by reducing the number of suppliers and customers, protecting contacts with their key partners; however, relations with financial institutions, public administration, and scientific and research institutions deteriorated. Rivalries with competitors became fiercer. The deterioration of relations also resulted from the demanding attitude of the surveyed companies and the expectation of support from members of their business

ecosystems. Companies which did not experience any market changes as a result of the COVID-19 crisis did not undertake any reconfiguration in their business ecosystems. The research shows that the dynamics and directions of changes in the business ecosystems of enterprises as a result of the COVID-19 pandemic depended on changes in their demand situation.

**Keywords:** business ecosystem, COVID-19 pandemic, supplier relations, competitor relations, customer relations, public administration relations, relations with financial institutions, relations with universities and research institutes

**JEL Classification:** D220, D810, D850, L100, L140, L220, L130, L250, P130

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## Introduction

The COVID-19 pandemic began at the end of 2019 as a result of the SARS-CoV-2 virus escaping from a laboratory in the city of Wuhan (China). A characteristic feature of this crisis was the speed of its spread. It covered 231 countries and infected over 7 million people in a few months [WHO, 2024]. Given the scope and scale of the consequences of the COVID-19 pandemic, it is considered the largest crisis since World War II [Gross, Stampat, 2022; Susskind, Vines, 2020]. According to research by Ernst & Young [E&Y, 2021], the COVID-19 crisis was associated with strong global turbulence, the effects of which were recorded in trade, finance, healthcare, financial systems, business and social life. Research has shown that only 2% of the surveyed companies declared they were fully prepared for the pandemic. Furthermore, 72% of the surveyed companies indicated negative effects of the COVID-19 pandemic on their current operations, and only 11% of companies noted positive effects of the pandemic on their development strategy (e.g. through increased consumer demand – 71% and bringing new products to the market – 57%). Taking into account the rapid changes in the demand for products, the rules of the market game changed significantly. Changes in the market situation of companies necessitated the reconfiguration of their business ecosystems [Moore, 1993, 2006; Thukral, 2021]. To date, research on the effects of the COVID-19 crisis has focused on individual relations, instead of identifying the system of general interdependences. The most frequently indicated change was the need for changes in supply chains [Ahmed et al., 2022; Mollenkopf et al., 2021], building new distribution channels [Sharma et al., 2020; Ticau, 2022], and developing cooperation, especially competitive, i.e. cooptation [J.M. Crick, D. Crick, 2020], with public administration [Akbar, Kisilowski, 2020; Floetgen et al., 2021], financial institutions [Chen et al., 2022; Song et al., 2021] or universities and research institutes [Puślecki et al., 2021].

The aim of the article is to verify the extent to which the market demand situation of enterprises caused by the COVID-19 pandemic affected the relations in their business ecosystems. Taking into account the criteria of changes in the number of partners and changes in the quality of relations between the parties, we analyzed direct relations within the business ecosystem, i.e. with customers, suppliers, competitors, financial institutions, public administration

institutions, universities and research institutes. Such broad analyses enabled us to map the changes in inter-organizational relations within the corporate business ecosystem. In this connection, we conducted a survey (CAWI) on a sample of 170 companies. Then, using the method of multidimensional analysis of correspondence, we were able to examine the directions of changes in the structure of the business ecosystems of the surveyed companies and changes in the quality of relations between network members as a result of the sudden crisis caused by the COVID-19 pandemic.

## Literature review

### The business ecosystem

The phenomenon of the business ecosystem has been described in the scientific literature for three decades now [Moore, 1993]. A business ecosystem is a system of inter-organizational connections in which phenomena and processes may have a different nature: social [Battistella et al., 2013], economic [Hannon, 1997, pp. 39], or political [Senyo et al., 2019].

A business ecosystem is interdisciplinary [Aarikka-Stenroos, Ritala, 2017; Briscoe et al., 2011] and extends beyond individual sectors [Pulkka et al., 2016]. Research on business ecosystems has been based on the experience and achievements of natural sciences, especially ecology [Lewin, 1999, pp. 198–199; Moore, 1993; Oh et al., 2016; Saltevo, 2021], business discipline (Strategy and Organization, Innovation and Technology Management, Information Technology Management) [Kuenzel et al., 2019; Waßenhoven et al., 2021] and social sciences [Kilduff, Tsai, 2003; Snihur, Bocken, 2022; Wieninger et al., 2020].

An ecosystem can be formed by individuals and organizations which compete, collaborate, or coexist to create a network of values, mainly through entrepreneurship or innovation, e.g. open innovation [Ferreira, Teixeira, 2019; Thierry, Lescop, 2009; Xiaoren, 2014], and create a global competitive advantage [Adner, 2017; Clarysse et al., 2014]. A business ecosystem is also treated as a business community [Teese, 2007]. The value of a business ecosystem is created collectively [Moore, 1993, 1996, 2006]. Strong linkages of cooperation within a business ecosystem, the convergence of goals (strong orientation towards their implementation) and interdependence of activities strengthen the sense of belonging and trust between the ecosystem members and build a common value for the business ecosystem [Brass et al., 2004; Camarinha-Matos, Afsarmanesh, 2008; Lewin, 1999, pp. 207–208; Scaringella, Radziwon, 2017].

A business ecosystem is treated as a long-term networked organization [Camarinha-Matos, Afsarmanesh, 2005]. By operating within a business ecosystem, companies benefit from economies of scale and achieve synergies, especially as a result of the acquisition of complementary intangible resources [Iansiti, Levien, 2004; Zahra, Nambisan, 2012] as well as from the reduction in risks and operating costs [Adner, 2006; Moore, 2006; Ritala et al., 2013] and better satisfaction of consumer needs [Iansiti, Levien, 2004a].

An effective business ecosystem increases the profitability and sustainable development of the network members. Benefits are gained in the areas of technology development, diffusion, and commercialization [Adomavicius et al., 2007; Marra et al., 2022; W. Park, H. Y. Park, 2014; Tanev et al., 2011], supply chain development [Graça, Camarinha-Matos, 2017; Ramanathan, Gunasekaran, 2014; Riquelme-Medina et al., 2023; Rong et al., 2010], product development [Kinnunen et al., 2013] and internationalization [Hult et al., 2020; Rong et al., 2018]. Iansiti and Levien [2004] indicate that the stability of a business ecosystem depends on the productivity of the network and its individual members, the solidity of relations between them, the flexibility of operation (using multiple sources to build a competitive advantage) and the opportunity to create new market niches and new enterprises. Thus, the nature of a business ecosystem depends on its members and their interactions [Iansiti, Levien, 2004; Moore, 1997].

A business ecosystem is analyzed through comparisons to networks, and in particular to clusters [Gereffi, Lee, 2014; Rinkinen, Harmaakorpi, 2018] or science parks [Löfsten, Lindelöf, 2001]. The similarity to clusters results from the creation of relationships within the triple helix [Geels, Kemp, 2007], which involves the participation of enterprises, universities, research and development institutions, financial institutions, policy makers, customers, and other stakeholders. A business ecosystem is often compared to a network of stakeholders [Lappi et al., 2015]. Such a business ecosystem is characterized by increased innovation [Katimertzopoulos, Vlados, 2019] and resilience to turbulent environments [Graça, Camarinha-Matos, 2017]. Unlike a cluster, a business ecosystem is multi-sectoral in character, where geographical concentration is not a critical factor [Sako, 2018] unless geographical proximity fosters and stimulates information exchange and knowledge sharing [Majava et al., 2014; Wulf, Butel, 2017].

Due to the diverse types of network members, the relations between them, their geographical proximity and sectoral scope as well as specificity, several types of business ecosystems are distinguished in the literature: the knowledge ecosystem [Clarysse et al., 2014; Van der Borgh et al., 2012], the innovation ecosystem [Adner, 2006; Carayannis, Campbell, 2009; Oh et al., 2016], the entrepreneurial ecosystem [Isenberg, 2010], the industrial ecosystem [Korhonen et al., 2001], the digital business ecosystem [Boley, Chang, 2007; Nachira et al., 2007a; Nachira et al., 2007b] and the social ecosystem [Peltoniemi, Vuori, 2004]. The concept of the business ecosystem has been applied to companies operating both in traditional sectors (e.g. architecture, engineering and construction (AEC), transportation, healthcare, life science, and automotive) [Chang et al., 2020; Majava et al., 2014; Merkert, Wong, 2020; Moore, 2006; Mukti, Prambudia, 2018; Pulkka et al., 2016] and modern sectors (e.g. building information modeling (BIM), ICT, space technology and UAV) [Aksenova et al., 2019; Jansen, Cusumano, 2013; Mikkonen et al., 2014; Orlova et al., 2020; Tomaszewski et al., 2020]. Thinking in terms of the business ecosystem is becoming indispensable in the contemporary strategic management of enterprises, governmental and non-governmental organizations, financial institutions, universities, and other actors creating these network connections [Zahra, Nambisan, 2012]. A company may belong to one business ecosystem, but most often it will be a player

in different business ecosystems, often also playing a different role (e.g. keystone, focal firm, niche player, dominator, or hub landlord) [Iansiti, Levien, 2004; Nambisan, Sawhney, 2011].

A business ecosystem is subject to transformations and constant evolution. This is due to the need to respond to a rapidly changing environment, as well as the implementation of the goals of the ecosystem and its members. As a consequence, the internal relations of the network, its structure, size (size, scale and geographical and sectoral range of activity), the nature and rules of the strategic game within the ecosystem and in relations with other networks change [Zahra, Nambisan, 2011, 2012]. The business models (including roles in the ecosystem) of ecosystem members and the entire system are reconfigured. However, a business ecosystem is an extremely complex organization (structurally, procedurally, and strategically) with a significant risk of failure [Pidun et al., 2020; Pidun et al., 2021].

## **The COVID-19 pandemic and the business ecosystem**

The COVID-19 pandemic caused a sudden international crisis, particularly restricting free movement of goods and people between countries [OECD, 2020; Ratten, 2020]. The pandemic and the related lockdown had a significant impact on trade and services, among which tourism, transport, energy, oil, and gas were particularly affected by the decline in demand [European Commission, 2021; Gössling et al., 2021; UNCTAD, 2021]. In contrast, lockdowns and social distancing increased demand for ICT, e-commerce, and telecommunications services [Kumar et al., 2021; UNCTAD, 2022]. The demand for goods also rose. Global demand for pharmaceuticals, medical devices, personal protective products, construction materials, and consumer durables (e.g. kitchen appliances, motor vehicles, sports equipment, and furniture) increased dramatically [Tauber, Van Zandweghe, 2021]. The crisis related to the COVID-19 pandemic rapidly polarized the market situation of enterprises, dividing them into three groups: winners (the demand for whose goods increased), losers (demand for goods decreased), and neutral ones (demand did not change).

Studies of changes in business ecosystems during the COVID-19 crisis focused mainly on the impact of the pandemic on the relations between enterprises and their external stakeholders in a narrow (bilateral) scope, limited to individual spheres of relations with suppliers, customers, competitors, academic centres and research institutes, representatives of public administration, financial institutions, or other entities.

By examining the impact of the crisis on the operations of enterprises in the era of the COVID-19 pandemic, transformations in their value chains were analyzed. Inefficiencies in supplier relations and disruptions in logistics systems as a result of the sudden increase in demand for end products were noted [Mollenkopf et al., 2021]. Also, excessively long and multi-stage supply chains and supply disruptions made it necessary to look for more convenient suppliers, most often geographically closer (nearshoring), and to create more diverse, resilient and smart chains [Fonseca, Azavedo, 2020], moving away from lean management and just-in-time towards just-in-case, opting to increase inventory to improve flexibility and

resilience in view of supply disruptions at the expense of profitability. Studies conducted by Ernst & Young [2021] and Ahmed et al. [2022] showed that the main direction of corrective actions in the supply chain as a result is to create more cooperative and networked relationships not only with suppliers, but also with customers, and account for modern technologies (e.g. AI and robotic process automation). Cai and Lo [2020], on the other hand, are in favour of the development of an omni-channel distribution and retailing strategy as a response to changes in consumer shopping habits (e.g. online shopping, cooking at home). Therefore, companies often choose to build e-commerce platforms or digital showrooms to encourage buyers and sellers to interact with each other [Sharma et al., 2020].

Studies on corporate relations in the era of the COVID-19 pandemic indicate a greater willingness of companies to cooperate. Increasingly, competitors choose to cooperate, creating co-competition [J.M. Crick, D. Crick, 2020], especially in marketing, R&D or cybersecurity activities. The increased interest in cooperation with competitors results, for example, from the liberalization of European law on competition and cooperation in the COVID-19 emergency [European Commission, 2020] and sudden common opportunities and threats. At the same time, the crisis exposed the limited adaptability of enterprises to the rapidly changing environment, which resulted in the need for competitors to cooperate in order to limit the sudden threat.

In the face of the common and unprecedented threat of COVID-19, researchers also noted increased interest in cooperation between enterprises and public administration units [Akbar, Kisilowski, 2020; Floetgen et al., 2021]. This cooperation was aimed at achieving social goals (e.g. providing hygiene products for hospitals and schools) or lobbying for the introduction of more favourable conditions for doing business in the conditions of the COVID-19 crisis (for themselves individually or for selected industries).

The COVID-19 pandemic forced companies to change their management processes, products, and business models in a very short time. They needed new skills, competences, and resources to innovate quickly [Crick et al., 2023]. At the same time, the COVID-19 emergency created a market opportunity to launch new pandemic-related products (e.g. vaccines), resulting in a global race for companies to be the first to launch globally and readily available products. High expenditure on R&D, time pressure, and the complexity of management processes resulted in an increase in the interest in cooperation with research institutes and universities [Puślecki et al., 2021]. While nearshoring was used in relations with suppliers, no restrictions of this sort were observed in the case of cooperation with R&D centres. Studies conducted by Kim and Cho [2021] showed that research and publication collaborations during the COVID-19 pandemic increased, especially among researchers from the US and Europe. Research cooperation with scientists from Asia was much less active.

During the COVID-19 crisis, it became crucial to provide financial support to enterprises at a difficult time for them. Companies could count on a wide range of financial instruments to support them. Some of these financial instruments resulted from the policies of national governments and international organizations. However, this support came with a delay

and the rules for providing support were not always transparent. Loans and other support instruments offered by banks became an important element. Chen et al. [2022] pointed to the diverse approach to lending on the part of banks, some of which were willing to grant loans during the pandemic, while others made it much more difficult to obtain financial support. This shows the inconsistency of relations between banks and enterprises in the era of the COVID-19 pandemic.

Song et al. [2021] presented very interesting research results, in which they showed that during the COVID-19 pandemic, banks (e.g., in China) were more willing to support enterprises (especially SMEs) that suffered most during the crisis. Depending on the degree of damage caused by the pandemic, banks were willing to support enterprises with larger loans on more convenient terms, due to the desire to save these companies from bankruptcy. The crisis and restrictions resulting from social distancing (e.g. in Germany) meant that companies were more likely to maintain contact with banks using the online banking system, thanks to which contracts could be executed remotely, without major disruptions [Flögel, Gärtner, 2020].

## Hypotheses

The research presented above shows that cooperation (especially networking) with various actors in the company environment became a necessity for survival during the COVID-19 pandemic [Dias et al., 2022]. Studies on the relations of enterprises with various actors in the business ecosystem during the COVID-19 crisis focused on the analysis and interpretation of the phenomenon without taking into account the demand situation in which these companies found themselves. Only research devoted to the relations between enterprises and financial institutions took into account the demand factor, indicating the difference in relations depending on the degree of damage in the era of the COVID-19 pandemic. Thus, the question arises as to whether the reconfiguration of corporate business ecosystems was similar regardless of the degree of harm (and consequently the demand situation) brought about as a result of the COVID-19 crisis.

Therefore, the main hypothesis was adopted as follows:

*H<sub>0</sub>: As a result of the COVID-19 pandemic, the direction of changes in the demand situation in a company determined the change in the relations and structure of its business ecosystem.*

Accounting for the fact that changes in the business ecosystems of enterprises will be considered in three demand situations (growth, decline, and no change), three specific hypotheses were constructed:

*H<sub>1</sub>: Companies which noted an increase in demand for their goods or services during the COVID-19 pandemic increased the number of entities in their business ecosystems, also improving the quality of relations with these entities.*

*H<sub>2</sub>: Companies which experienced a decrease in demand for their goods or services during the COVID-19 pandemic reduced the number of entities in their business ecosystems, damaging the quality of relations with entities in the network.*

*H<sub>3</sub>: Companies where the demand for goods or services did not change during the pandemic did not change the number of entities in their business ecosystems, and the quality of relations remained unchanged.*

The verification of the main hypothesis will be determined by the result of the verification of the three partial hypotheses. The hypotheses adopted above will be verified on the basis of empirical research, in which changes in the relations of enterprises with all key groups of external stakeholders forming their business ecosystems were analyzed comprehensively.

## Methodology

A business ecosystem is created by various entities. The generic ecosystem model is limited to focal companies, suppliers, complementors, and consumers [Ander, Kapoor, 2010]. However, a business ecosystem often has a well-developed structure which includes, in addition to the members of the generic ecosystem, competitors, financial institutions, government agencies (regulators), trade unions, economic associations, R&D centres and universities, as well as intermediate suppliers [Moore, 1993; Zahra, Nambisan, 2012]. Within the created network, focal firms develop relations with members of the business ecosystem, both direct (e.g. suppliers, customers, financial institutions, R&D centres and universities) and indirect (e.g. suppliers' suppliers). The COVID-19 crisis caused sudden market changes, which resulted in changes in demand for goods, dividing companies into three groups: winners (demand increased), losers (demand decreased) and neutral (no changes in demand were recorded). Sudden changes in demand caused transformations in relations within the corporate ecosystem. Due to the fact that in the extensive business ecosystems of enterprises direct relations are most sensitive to changes, the research was deliberately limited to the relations of the surveyed enterprises with direct suppliers and customers, competitors, financial institutions (banks), R&D centres and universities, and public administration units. The change in the market situation of companies has an impact on relations with organizations with which they have direct relations.

The assessment of changes in relations within the business ecosystem due to the impact of the COVID-19 pandemic accounts for several variables. These include, above all, changes in the quality of cooperation between members of the business ecosystem and changes in the



number of entities within a specific group of entities (e.g. suppliers, recipients). In the case of suppliers and customers, changes in the time horizon of cooperation were taken into account; accounting for this criterion enabled the indication of whether the resulting demand situation is treated as stable.

The literature on the relations between enterprises and financial institutions in the era of the COVID-19 pandemic indicates different views on the quality of cooperation. Therefore, it seems important to verify the changes in the quality of cooperation between the enterprises and financial institutions (mainly banks), depending on the existing demand situation of the surveyed enterprises. Changes in the frequency of interactions between the businesses and financial institutions during the COVID-19 pandemic are considered.

## Research sample

In order to verify the research hypotheses, a survey was conducted among 170 companies operating in Poland in 2021–2022. Half of the research sample was comprised of large enterprises, employing 250 or more people. Medium-sized enterprises, employing between 50 and 249 employees, accounted for 24% of the surveyed companies. The remainder (26%) were micro- and small firms. The companies were quite diverse in terms of the legal form of their business. Nearly half of them (49%) were limited companies, and 28% were joint-stock companies. In addition, the sample included natural persons conducting business activity (9%), state-owned enterprises (8%), and universities or research institutes (4%). Other legal forms, constituting a small share in the sample structure, were civil partnerships, general partnerships, and cooperatives. In the surveyed sample, 77% of the companies owned only Polish capital. Among companies with foreign capital, 60% were those in which the share of foreign capital was greater than 90%. The share of foreign capital below 25% applied to 23% of the surveyed companies with foreign capital. In the sample, most companies (67%) had been operating on the market for more than 20 years. 19% of the surveyed companies had been operating for 10 to 20 years. Only 5% of the surveyed companies were less than three years old. The remainder, less than 10%, were companies between three and 10 years old.

As a result of the pandemic, the self-assessment of the financial condition of the surveyed companies changed. There was an increase in negative ratings and a decrease in positive ratings issued during the pandemic. In 2019 a very good or good financial situation was indicated by 83% of companies, and in 2022 by 74%. Only 4% of the surveyed companies had a very bad or bad financial situation before the pandemic, and 8% during the pandemic.

As a result of the COVID-19 pandemic, most entrepreneurs noted changes in the demand for their goods or services. Half of the surveyed companies indicated an increase in demand, 20% a decrease, while for 30% of the respondents demand remained at the same level as before the pandemic. Differences in changes in demand for goods or services were observed in relation to the size of the company. More than half of the large companies (54%) declared an increase

in demand, as did fewer than half (46%) of SMEs. Furthermore, a decline in demand during the pandemic was indicated by nearly one in four of the small or medium-sized companies and only 16% of the large enterprises. No change in demand was observed for a similar share of the large firms and SMEs (about 30%).

Considering the diverse demand situations of enterprises resulting from the COVID-19 pandemic crisis and the variety of connections between companies and other entities within their business ecosystems, the dependence of the direction of changes in the reconfiguration of the business ecosystems of the companies on their market situation was analyzed.

Thus, the analysis referred to the changes in relations with suppliers, competitors, customers, academic centres and research institutes, public administration, and financial institutions.

The survey was conducted with a questionnaire using the CAWI technique, and the respondents in the study were representatives of company management. The questions in the questionnaire concerned the changes in business ecosystems that occurred as a result of the COVID-19 pandemic. The representatives of the enterprises assessed changes in their business ecosystems by referring to individual entities of the ecosystem, taking into account the core business (suppliers, customers, and competitors) and entities from the company's business environment (financial institutions, public administration, universities and research institutes). The assessment of changes in business ecosystems was made by the companies in the following aspects: changes in the number of entities, changes in the quality of relations, and changes in the horizon of cooperation (especially in the case of relations with suppliers and customers).

The surveyed enterprises indicated changes in the demand for their goods or services during the pandemic; on this basis, we selected three groups of the enterprises depending on the direction of demand changes: enterprises with increased demand, with reduced demand, and with unchanged demand compared to the situation before the pandemic.

To study the relationship between the demand situation of the enterprises and the reconfiguration of the business ecosystem, we used a multidimensional analysis of correspondence. Correspondence analysis is an exploratory data analysis technique that aims to discover structures and patterns in data collected in the course of research [Khangar, Kamalja, 2017].

One of the significant advantages of correspondence analysis is that it is used to analyze qualitative data and does not impose special requirements on the distributions which the analyzed variables should be subjected to [Alhuzali et al., 2022]. In the survey, we received qualitative data from the companies and the analysis of correspondence allowed us to deepen the results obtained and understand the structure of a multidimensional data set.

Correspondence analysis allows for a graphical presentation of the results obtained in the form of so-called research correspondence maps [Greenacre, 2010]. In our study, we presented several correspondence maps that show the relationship between the demand situation of enterprises during the pandemic and the reconfiguration of business ecosystems in relation to relationships with suppliers, customers, competitors, academic centres, public administration, and financial institutions.

## Results and discussion

### Supplier relations

The research showed that before the COVID-19 pandemic, the key suppliers were mainly domestic companies. Exclusive cooperation with domestic suppliers was declared by 26% of the surveyed companies, and majority cooperation by 40% of the companies. In the case of 19% of the companies, the suppliers were mostly or exclusively foreign companies.

The surveyed companies differentiated their behaviour towards suppliers depending on their importance. They emphasized the need to maintain good cooperation with the so-called key suppliers at the expense of relations with other suppliers. A vast majority (90%) of the companies indicated that key suppliers did not change as a result of the pandemic. One in ten companies which changed suppliers emphasized that the reason for the decision was the loss of the market position and/or financial liquidity by suppliers as a result of the COVID-19 crisis. Another reason given was the initiative of suppliers to change the terms of the existing cooperation in the financial dimension (shortening payment terms or raising prices). Furthermore, another reason for the changes was the loss of ability to deliver goods or services in due time. Entrepreneurs also pointed out that during the pandemic, new domestic suppliers appeared offering similar goods and services, but better terms of cooperation. Another reason for the changes was that domestic suppliers closed down their operations as a result of COVID-19. The reasons for changing domestic and foreign suppliers were very similar. In addition, the closure of borders as a result of the COVID-19 pandemic was indicated as the reason for changing foreign suppliers.

The pandemic changed the number of suppliers in the case of 38% of the surveyed companies, most of which were not classified as key suppliers. The same number of companies (19%, respectively) indicated an increase or decrease in the number of suppliers. For most companies, the number of suppliers did not change.

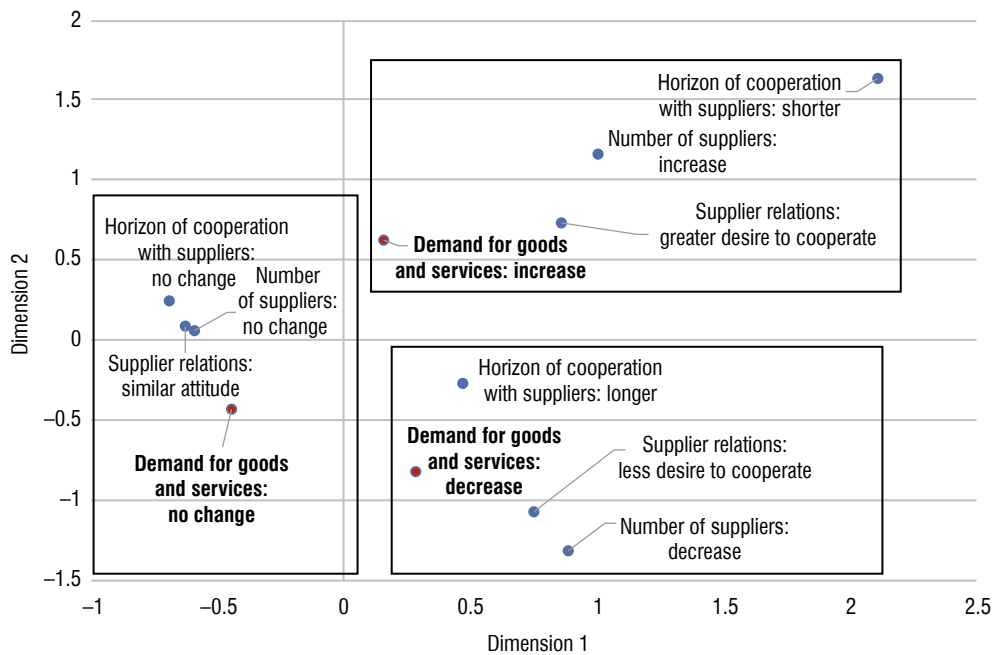
In the case of 57% of the companies, the time horizon of supplier relations changed as a result of the COVID-19 pandemic. This change consisted mainly in its significant (25%) or slight (26%) lengthening. Only 6% of the companies indicated a shortening of the time horizon of cooperation.

Entrepreneurs also assessed the changes in the nature of supplier relations as a result of the pandemic. A total of 44% of the surveyed companies noticed changes in their relationships, half of whom considered them negative and the other half positive. The negative changes consisted in the decreased willingness of suppliers to cooperate, which was reflected in tightening the terms of cooperation or downplaying previous arrangements. Positive changes were manifested by suppliers showing greater willingness to cooperate.

The correspondence analysis clearly shows that in the enterprises where there was a decrease in demand for the goods or services offered, we can more often observe a decrease

in the number of suppliers, an extension of the cooperation horizon, and a lower willingness to cooperate with suppliers (Figure 1). Moreover, the companies which recorded an increase in demand for goods or services during the COVID-19 pandemic indicated an increased number of suppliers and their greater willingness to cooperate. In these companies, the time horizon of cooperation with suppliers was also shortened. In the group of the companies where demand did not change during the COVID-19 pandemic, we can observe no changes in the number of suppliers, a similar attitude of suppliers with regard to their relations and an unchanged time horizon of cooperation.

**Figure 1. Changes in the number of suppliers, relations, and the time horizon of cooperation between the enterprises and suppliers depending on the demand situation: correspondence map**



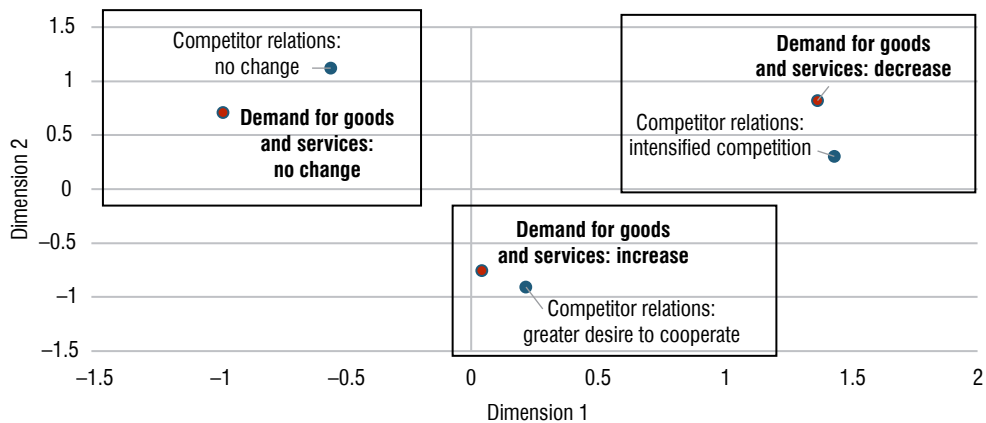
N=170

Source: own elaboration.

### Competitor relations

According to 80% of the surveyed companies, the pandemic did not significantly affect the number of competitors. On the other hand, a significant number of the respondents (38%) indicated changes in relations with competitors. An increase in the willingness to cooperate was indicated by 17% of the respondents, while the intensification of competition with competitors was noted by 21%. On the other hand, a majority (62%) did not notice any significant changes in relations with competitors.

**Figure 2. Changes in relations with competitors and changes in demand for goods or services: correspondence map**



N=170

Source: own elaboration.

The companies which recorded an increase in demand for goods or services during the pandemic were more likely to indicate that competitors were more cooperative than before the pandemic and that the cooperative relations between competitors did not change (Figure 2). On the other hand, in the companies where a decrease in demand for goods or services was observed during the pandemic, competition with their competitors was intensified. In the group of the companies where demand did not change, competition relations were at the same level as before the pandemic.

## Customer relations

The research showed that before the COVID-19 pandemic, in 69% of the analyzed companies, the key customers were exclusively or mostly domestic companies. Mostly or only foreign customers were indicated by 13% of the respondents. On the other hand, 18% of the surveyed companies had the same number of domestic and foreign customers.

As in the case of relations with suppliers, the surveyed companies emphasized the need to protect relations with their so-called key customers. A vast majority (88%) of the companies indicated that key customers did not change as a result of the pandemic. Among the companies in which such changes occurred, they most often consisted in replacing the existing customers with other customers. The protection of key customers took place at the expense of relations with customers of lesser importance to the surveyed enterprises.

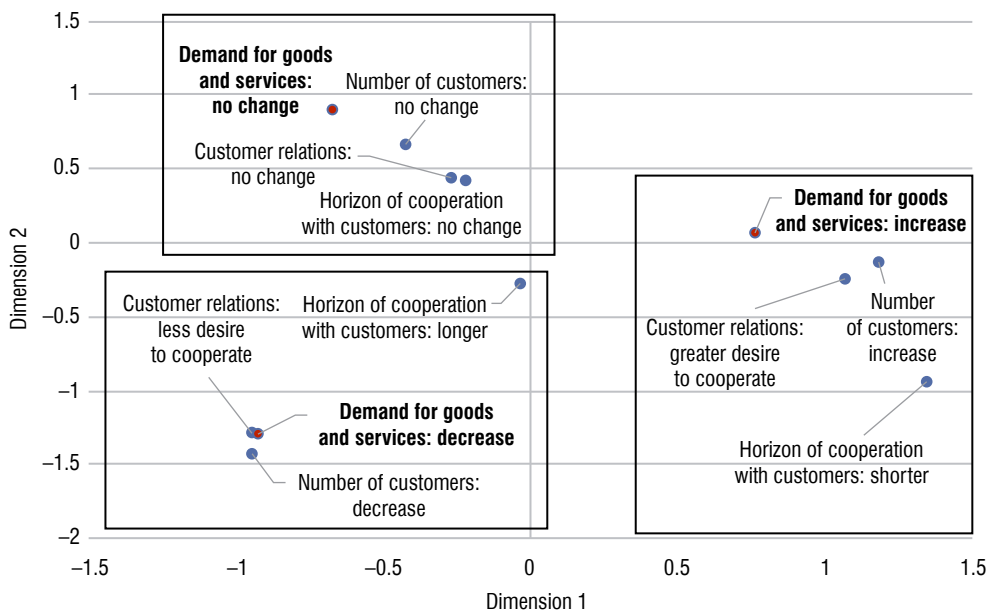
Taking into account the total number of customers (including the key ones), half of the surveyed companies declared changes in these relations. Among them, 18% of the respondents declared a reduction in the number of recipients as a result of the COVID-19 pandemic, and one in three of the surveyed companies showed a reduction in the number of customers.

Nearly half of the surveyed companies indicated that the time horizon of relations with customers did not change, while among those indicating changes, a majority declared an extended time horizon, and only 8% of the surveyed companies indicated a shortening thereof (slight or radical).

The nature of relations with recipients changed under the influence of the COVID-19 pandemic for 41% of the surveyed companies. It should be noted that these changes consisted in a greater willingness of customers to cooperate than before the pandemic (27% of responses). A lesser willingness to cooperate or reluctance to cooperate was shown by the customers of 14% of the surveyed companies.

The correspondence analysis allowed us to show that depending on the demand situation, we can observe different changes in the relations between the surveyed companies and customers (Figure 3). In the companies where the demand for goods or services decreased as a result of the crisis caused by the COVID-19 pandemic, we can see a decrease in the number of customers, a reluctance shown by customers to cooperate and an extension of the time horizon of cooperation. On the other hand, in the companies declaring an increased demand for goods or services, the number of customers increased, the time horizon of cooperation became shorter, while at the same time the willingness of customers to cooperate increased. In the companies whose offers of goods or services did not change, their relations with customers was not reconfigured, either.

**Figure 3. Changes in the number of customers, relations, and the time horizon of cooperation between the enterprises and customers depending on the demand situation: correspondence map**



N=170

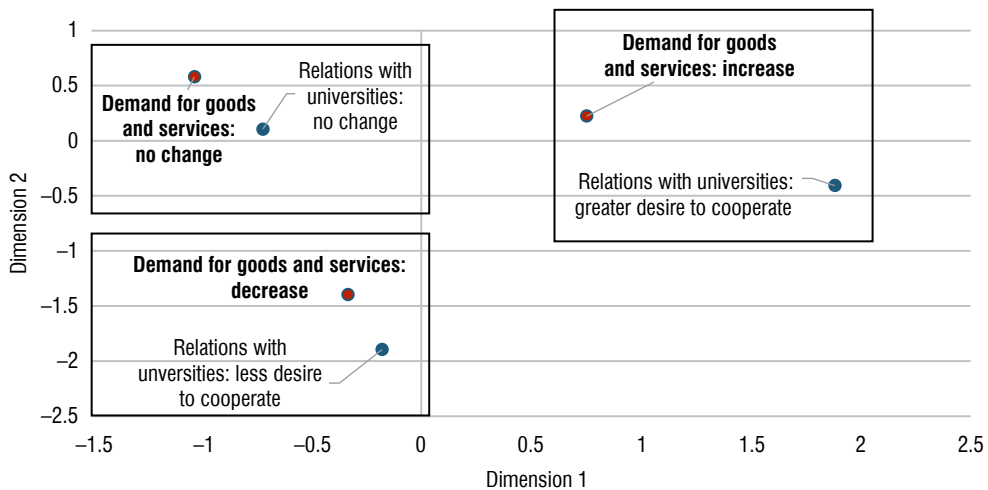
Source: own elaboration.

## Relations with universities and research institutes

Slightly over half (55%) of the surveyed companies cooperated with universities or research institutes before the pandemic. Among these companies, 79% indicated that the number of universities or research institutes they worked with did not change during the COVID-19 pandemic. Other companies pointed to changes: for 12% the number decreased and for 9% it increased.

A majority of the companies (65%) which cooperated with universities or research institutes believe that their cooperative relations did not change as a result of the pandemic. An improvement in relations in cooperation with universities or research institutes was indicated by 17% of the respondents and a deterioration by 18%.

**Figure 4.** Changes in the relations between the enterprises and academic centres and research institutes depending on the demand situation: correspondence map



N=94

Source: own elaboration.

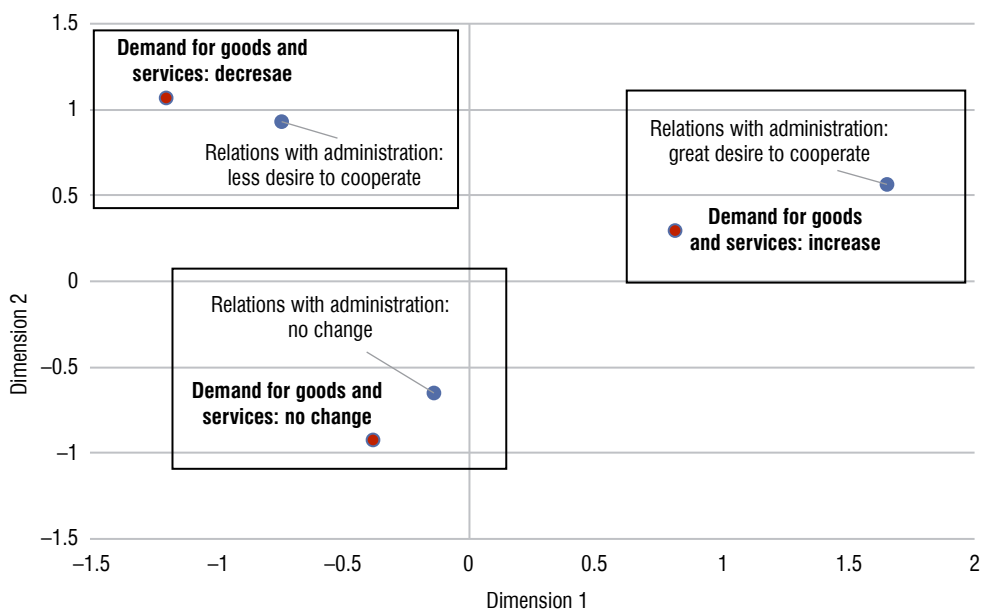
Changes in demand for goods or services resulting from the pandemic affected certain changes in the relations between the companies and academic centres (Figure 4). In the companies which experienced higher demand for goods or services, we come across those that improved relations with academic centres. A lack of changes in demand during the pandemic also most often translated into a lack of change in relations with academic centres and research institutes. On the other hand, in the companies where the demand for goods or services decreased, we are more likely to find those that indicated a deterioration in relations with universities.

## Public administration relations

Relations with public administration were maintained by 70% of the surveyed enterprises. Among them, more than half (55%) did not notice any changes in relationships caused by the COVID-19 pandemic. A deterioration in relations was indicated by 28% of the surveyed companies and an improvement by 17%.

The companies which recorded increased demand for goods or services during the COVID-19 pandemic indicated an improvement in relations with public administration, while those companies in which demand decreased more often indicated a deterioration in relations with public administration (Figure 5). The companies which did not record changes in demand for the goods or services they offered were more likely to indicate no changes in their relations with public administration during the pandemic.

**Figure 5. Changes in the relations between the enterprises and public administration depending on the demand situation: correspondence map**



N=119

Source: own elaboration.

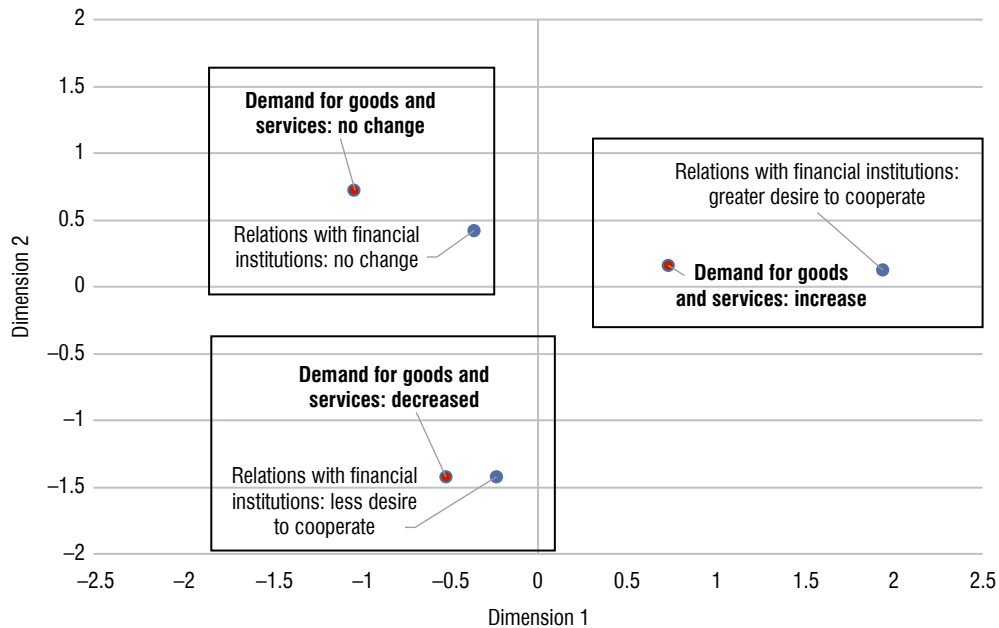
## Relations with financial institutions

During the COVID-19 pandemic, a majority of companies (78%) maintained relations with financial institutions, such as banks or insurers. Most of these companies (66%) said that the pandemic did not change their relationship with these institutions. However, 19% of the respondents complained about the deterioration of relations, while 15% of the companies experienced an improvement in relations.



The pandemic did not affect the frequency of contacts with financial institutions in the case of 64% of the surveyed companies. The intensification of contacts was indicated by 29% of the enterprises and limitation of contacts with financial institutions by only 7% of the companies.

**Figure 6. Changes in the relations between the enterprises and financial institutions depending on the demand situation: correspondence map**



N=133

Source: own elaboration.

A lower demand for goods or services observed in the companies during the COVID-19 pandemic resulted in a deterioration in relations with financial institutions (Figure 6). A lack of change in demand also translated into no change in the relations between the enterprises and financial institutions. On the other hand, a higher demand for goods or services was observed more often in those companies that indicated an improvement in relations with financial institutions.

Analyses of the results of the research on changes in enterprise ecosystems under the influence of the COVID-19 pandemic indicate very interesting regularities. The companies whose products saw increased demand during the COVID-19 pandemic experienced an increase in the interest and cooperation of their suppliers and customers. They expanded their business ecosystems by establishing relationships with new suppliers and customers based on short-term contracts. The search for new suppliers also involved difficulties in maintaining the existing supply chains [Xia et al., 2022; Kozancoglu et al., 2021]. Relations with the existing suppliers and customers were not modified. In the case of relations with competitors, companies showed an increased inclination to competition. In the survey, the

companies emphasized that competitors showed greater willingness to cooperate, especially in the areas where demand increased abruptly. The companies also improved their relations with academic centres, financial institutions, and public administration. However, they did not increase the number of partners in these areas. The results of the study provided the basis for the positive verification of hypothesis  $H_1$ . Indeed, the companies which strengthened their market position as a result of the COVID-19 pandemic improved their relationships with partners within the business ecosystem and increased the number of cooperators – both suppliers and customers.

The companies for whose products demand decreased during the COVID-19 pandemic found themselves in a completely different situation. They reduced the number of suppliers and customers, protecting key partners while ensuring long-term relationships with them. Such behaviour came as a reaction to limited willingness on the part of suppliers and customers to cooperate with the surveyed companies and also protect against a sudden withdrawal from their existing relations. Some companies experienced stricter debt collection procedures on the part of suppliers and extended deadlines for repayment of financial liabilities on the part of customers. The decline in demand also intensified competition between competitors. A deterioration in relations was noted in contact between the enterprises and public administration, academic centres, and financial institutions. The extraordinary situation of the COVID-19 pandemic caused a massive increase in the expectations of the enterprises for exceptional treatment and support from the public administration institutions. A particularly demanding (often even aggressive) attitude was represented by the companies whose demand situation deteriorated significantly. There were more such companies than those that benefited from the COVID-19 pandemic. Despite attempts to support the affected companies, relations with public administration deteriorated. In the case of cooperation with academic centres, the new market situation affected the quality of relations. The success factor in the extraordinary situation of sudden changes in demand for products was the speed of response to new market situations and the flexibility of action. The COVID-19 pandemic exposed the different operational pace of enterprises and research centres, as well as more significant differences in the perception of the seriousness of the market situation. Some companies were forced to make quick and radical strategic changes, and research and academic centres often adopted a wait-and-see attitude. This caused some friction between the parties and lowered the quality of their relationship. Financial institutions, on the other hand, were less willing to support the enterprises which were painfully affected by the turbulence resulting from the COVID-19 pandemic. They were less willing to grant loans and demanded greater collateral for them. They prolonged their procedures for assessing the financial credibility of enterprises. This affected the quality of relations between the enterprises and financial institutions. Despite the complexity of the relations between the enterprises and public administration, academic centres, and financial institutions, the number of partners in these areas was not reduced. The results of the study provided the basis for a positive verification of hypothesis  $H_2$ . The companies that experienced a worse demand situation as a result of the COVID-19 pandemic experienced a deterioration

in relations with partners within their business ecosystem, and in the case of relations with suppliers and customers, they decided to reduce the number of partners.

On the other hand, the companies which were not affected by changes in demand as a result of the COVID-19 pandemic did not experience changes in the structure of the business ecosystem, either. This applied to both the number of partners in the business ecosystem and the relationship with them. Therefore, hypothesis  $H_3$  should be considered positively verified.

Analyzing the results of the research, which are the basis for the verification of the research hypotheses  $H_1$ ,  $H_2$ , and  $H_3$ , it should be concluded that leading hypothesis  $H_0$  was positively verified. As a result of the COVID-19 pandemic, the directions of changes in the demand situation of the surveyed companies were determined by changes in the relations and structure of the business ecosystem.

## Summary

### Theoretical contribution

The results of the studies verified and reorganized the previous observations of changes in relations in the business ecosystem of enterprises in the era of the COVID-19 pandemic. The improvement in cooperative relations with competitors, as indicated by J.M. Crick and D. Crick [2020], applies only to companies which benefited from the COVID-19 pandemic in terms of demand. In the case of the other two groups of enterprises no increased inclination to cooperation was observed. Similar conclusions apply to relations with public administration and academic centres. The research also explains the diverse observations of the relationship between enterprises and financial institutions [Chen et al., 2022], the quality of which depends on the demand situation and, consequently, the financial situation of the analyzed enterprises.

The analysis of literature and research results leads to more general conclusions. Sudden and significant changes in the environment cause the polarization of the market situation of enterprises. Companies that improve their market situation as a result of the current situation develop relations within the business ecosystem by acquiring new cooperators (suppliers, customers, and academic and research centres) based on short-term contracts. Conversely, companies whose market situation has deteriorated focus on maintaining their relations with key cooperators through additional contractual security. This means that both groups of companies consider sudden market changes short-term, and not an evolutionary market process.

Changes in demand have an impact on the structure of corporate business ecosystems. It means that market changes in enterprises will affect the size (numerical volume) of the ecosystem and the quality of relations created between partners in the network. The analyses show the different pace of the reaction of entities to market situations. Enterprises and their suppliers and customers, as well as financial institutions, will react much faster. With their participation, the relations will undergo significant changes in both positive and negative

dimensions. In the case of relations with research and academic centres, the situation can be improved by looking for new research partners, as their activities are characterized by an extended time horizon of market reactions. However, some companies decide to take such actions in the long term. The research indicates that as a result of sudden market changes, companies focus on short-term changes, which in turn can soon change depending on the development of the situation.

Companies and their business ecosystems strive for far-reaching flexibility both in the area of market activities and the structure and size thereof. They defend their key ecosystem members, who form the backbone of the ecosystem. The development of the business ecosystem is additive in character through relations with the subsequent members of the network.

The presented studies are pioneering. They present the consequences for a company's business ecosystem at the level of relations between network members. So far, analyses have been limited to bilateral relations. Therefore, it is difficult to compare the presented research with other papers, as it was possible to refer only to those areas which were examined in fragments.

The article presents behaviours and relations in the business ecosystems of enterprises under the influence of the COVID-19 pandemic. The complexity and volatility of the environment in the modern economy indicate that such radical market changes will be increasingly observed. Therefore, the observations and conclusions from the presented research will be applicable to the next observed crisis situations.

## **Research limitations and future research directions**

Despite a wide spectrum of analyses, certain assumptions and research limitations were adopted. First of all, an analysis of the direct and closest relations of companies within their business ecosystems was made. Considering the concept of the business ecosystem [Iansiti, Levin, 2004, 2004a; Moore, 1993, 1996, 2006], the complex structure of the network, in which there are direct and indirect connections, is pointed out. Therefore, it is necessary to consider expanding the research to include indirect relations and to investigate the extent to which the market situation of companies affects further relations within the business ecosystem.

During the survey on the relations in the business ecosystem of enterprises in the era of the COVID-19 pandemic, companies were asked about making structural changes in the network by increasing the number of partners. The aspects related to the location of new members of the business ecosystem were omitted. Was the need to acquire new partners related to the breakdown of global relationships and the need to search for new partners as part of nearshoring [Akbari, 2024; Braun et al., 2023]? Does the geographical proximity of the new partners affect their choices due to the experience gained during the COVID-19 pandemic, which affects the costs of control and coordination within network links? There is a need to take into account the international factor in research and its effect on the creation and development of business ecosystems of enterprises in a highly turbulent and diverse environment.

In the research, the concentration of the researchers focused on identifying changes in relations in the business ecosystems of enterprises depending on the demand situation of enterprises as a result of the COVID-19 pandemic. It was assumed that within the business ecosystem of a company, the stimulus for change in its business ecosystem is its demand situation. However, within one business ecosystem, there may be more such stimulators. The simplest situation of a single company and its immediate business ecosystem was analyzed. It would be extremely interesting to conduct research that would take into account the diverse demand situations of at least several members of the business ecosystem, considering strategic behaviour towards one another.

The research on the phenomenon of the creation and development of business ecosystems draws mainly from scientific achievements focused on networks. Taking into account the state of knowledge of different types of networks, the concept of a business ecosystem is probably the least known. Thus, it certainly seems justified to undertake further research on the specificity and methods of development of the business ecosystem and the importance for the competitiveness of its members in today's turbulent business environment.

### **Authors' contribution:**

The authors confirm the following contributions to the paper: study conception, design and data collection: JC; analysis and interpretation of results: KD; draft manuscript preparation: JC and KD. Both authors reviewed the results and approved the final version of the manuscript.

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