

The Impact of the Necessarily Increasing Resilience of Supply Chains on Supplier Relationships

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Abstract: - Today's supply chains are facing serious challenges. The ever-changing environment, economic situation, and differentiating customer needs make it difficult for chains to operate. To produce a product or service that meets customer needs, it is necessary to work with the right partners. But this is not enough. A dynamic and changing environment also requires flexibility and adaptability, not just for one company but for the whole chain. This is resilience. This study aims to examine which factors determine the choice of supplier in a supplier-customer partnership and how flexible these factors are. The research was carried out using an online questionnaire among Hungarian enterprises.

Key-Words: - Supply Chain Management, Resilience, Resilient Supply Chain, Supplier Selection System, Supplier Relationship, Supplier-Customer Relationship.

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1 Introduction

The world is undergoing significant changes in the 21st century. Consider the impacts of Industry 4.0 and Industry 5.0, which have become indispensable elements in the lives of companies today. These technologies, which enable the digitalization of companies, have emerged as one of the most important sources of competitive advantage, [1], [2], [3], [4]. Alongside this, the flow of information is becoming increasingly efficient, with real-time information exchange now available to all companies through various cloud-based internet tools and integrated enterprise resource planning systems, [5], [6], [7]. Due to dynamically changing consumer demands and increasingly rapid market shifts, companies must possess an adequate level of flexibility to meet consumer needs. After all, this is the essence of a competitive, profit-oriented market. In logistics, the 'customer is king' principle has emerged as a goal, stating that companies must pay attention to and follow consumer demands. By meeting these demands, consumers will be satisfied and, in turn, reward the company by purchasing the product or service offered, which will lead to profit for the company, [8]. However, selling a product to the consumer is just a very small part of the complex and multifaceted process known as the supply chain.

The supply chain is a network of organizations that spans from the procurement or extraction of raw

materials to the final sale to the consumer, [9]. It is evident that the quality of the product or service provided to the consumer depends on every participant in the chain. Therefore, if a problem arises with any of the participants, such as a delivery delay, quality issue, price fluctuation, or external economic influence, it will affect the entire service process. In today's context, this presents a significant risk in customer service, as consumers, who were once located at the end of a linear supply chain, are now part of a much larger, networked structure with many participants. The literature frequently refers to these traditional supply chains, now characterized by their networked nature, as "supply networks," emphasizing the pathways that follow the delivery of goods or services to consumers, [10], [11], [12]. Due to the networked nature of these systems, there is an increasing emphasis on cooperation between partners. These partnerships could potentially offer effective solutions for mitigating supply disruptions and other risks. However, the large number of participants in the supply network inherently increases the risk of supply disruptions. While the rapid development of information technology has provided numerous tools to ensure the effective flow of information among members, there are still challenges that these tools do not fully address.

The search for solutions to the problems caused by the COVID-19 pandemic and the Russian-

Ukrainian war became one of the most important topics in supply chain management during the 2010s and 2020s. Flexible resilience—the ability to respond quickly and effectively to changes—has become one of the most essential tools for the survival of supply chains.

The goal of this study is to examine which factors have come to the forefront when establishing supplier relationships due to the economic and geopolitical changes of our time. In other words, it seeks to identify which influencing factors have risen to the top of the priority list in supplier selection scenarios. The central theme of the study is the examination of supply chain resilience, as the disruptions caused by economic changes in the 2020s have led many supply chain members to rethink their supplier relationships.

2 Literature Review

The central focus of the literature review is the concept of resilient supply chains, or resilience. From a research perspective, it is also essential to understand the potential forms of collaboration between the members of supply chains, with a specific emphasis on supplier relationships.

2.1 Resilient Supply Chains

The question of the resilience of supply chains has become particularly important since the late 2010s. The global crisis caused by the COVID-19 pandemic and the subsequent supply disruptions due to the Russian-Ukrainian war posed significant challenges to supply chain management, [13]. These were events that companies could not have prepared for in advance, catching them completely off guard. Adapting to this new situation was the point at which companies faced the challenge of maintaining and strengthening their competitive advantage, as well as ensuring their survival. The economic impacts, such as significant inflation, influenced companies' financial operations. The increased demand for certain food and healthcare products created logistical challenges for companies, [14], [15]. Additionally, from a logistics and supply chain management perspective, it was crucial to address the declining security of transport routes and the disruptions caused by the destruction or temporary shutdown of certain hubs (such as several Ukrainian ports), which significantly affected not only supplier companies but also the operations of manufacturing companies, [16], [17], [18], [19].

Naturally, the resilience of supply chains was a subject of research even earlier, in the 2000s and

2010s, as the issue of adapting quickly to a changing environment had already been identified as a risk at that time, [20], [21]. The increasing extent of globalization, shorter product life cycles, dynamically changing and growing consumer demands, the desire to reduce inventories, and the shortening of the overall supply chain cycle time all became central research topics aimed at aligning supply chains with these objectives. However, it was the COVID-19 pandemic and the Russian-Ukrainian war that forced companies to be more flexible than ever in adapting to changed circumstances and to sustain that adaptability effectively and efficiently or restore the previous state as quickly as possible. The literature refers to this ability as resilience, [22], [23].

Thus, resilient supply chains must flexibly manage the changes occurring in their environment, with the goal of doing so as quickly and efficiently as possible. Several studies have been conducted within the professional community regarding how the COVID-19 pandemic and the Russian-Ukrainian war have altered corporate attitudes, how the emphasis on flexible adaptation has shifted, and the tools that can be used to achieve this, [23], [24], [25]. A common conclusion in these studies is that companies need to conduct more in-depth risk analyses in order to develop more accurate risk management strategies and to prepare for unexpected turns of events with multiple scenarios, [26], [27], [28], [29].

2.2 General Characteristics of Partnerships in Terms of Supply Chain Management

There are several forms of partnerships within the supply chain. The need for cooperation arose as a key issue following a paradigm shift, which is closely related to the broadening of supply chains. Previously, companies and supply chains were based on forecasts to determine their operations, a model known in the literature as the forecast-based operational model. This has now been replaced by an operational model based on concrete data and information, with the fundamental aim of ensuring efficient and effective information flow, thereby eliminating the errors of inaccurate forecasts – this is the response-based operational model, [30].

Cooperation within the chain generally begins with short-term, ad-hoc relationships, which will grow in time, increasing in both the degree of cooperation and the time commitment required. Thus, various types of relationships are distinguished in order of their depth, such as cooperative relationships, strategic alliances, joint ventures, or mergers and acquisitions, [31], [32].

It is also crucial to consider the attitudes of the members regarding the establishment of partnerships between companies. An essential element of a flexible and efficient supply chain or network is that the members approach each other with trust and a focus on cooperation. This is the basis of the supplier relationship model, which distinguishes between the competitive and cooperative models. This is one of the most well-known and fundamental categorizations of supplier relationships. The essence of the competitive model is that the supplier is treated as an adversary, with the company engaging with many suppliers and competing on price, ordering from them sporadically. In contrast, the cooperative model involves fewer suppliers who are seen as medium- or long-term partners, with whom the company forms mutually beneficial relationships through flexible contracts and integrated activities, [33], [34].

To achieve efficient information flow and a high level of customer service, companies need to treat suppliers as partners. Since an essential characteristic of supply chains is that each member functions both as a buyer and a seller, it is important that they meet the needs that arise within the supply chain at an appropriate level, as this will ultimately impact final consumer satisfaction. By doing so, the level of service provided to the final consumer can also be improved, as any dissatisfaction from the consumer indicates that a problem has occurred within the chain. This issue could be related to the supplier providing the wrong product, improper storage, or delivery, all of which may manifest in the supply chain performance, such as in customer service level measurements. Of course, there is no universal solution for establishing cooperative relationships between companies, and it is highly context-specific what kind of relationship, in terms of nature, scope, and duration, is needed with a given supplier. However, to successfully adapt to a changing environment, cooperation is necessary. In today's economic world, the need for flexibility as a corporate characteristic within cooperation is increasingly crucial.

3 Research Design

Resilience, as an attitude, is essential in corporate operations, particularly in today's rapidly and dynamically changing environment. This study examines the operation of resilient supply chains from a logistics perspective, specifically focusing on the issue of flexible adaptation by supply chain members. The aim is to define, with the help of a

research sample, the preferred supplier selection factors and to explore the opinions of domestic companies regarding the importance and feasibility of making flexible adjustments to delivery-related factors. The logistics aspect is evident in the parameters related to corporate procurement, which serves as the focal point of this study.

The first step of the empirical research was to create a database, where the researcher selected the companies relevant for the research from an online company database. The sampling was convenience sampling, that is, the most accessible companies were invited by the researcher to participate in the research. The online questionnaire was sent to the selected companies. 98 questionnaires were returned and completed to an assessable level. The questionnaire thus helped to identify and develop the partner selection criteria or parameters used by the sampled companies.

3.1 Characteristics of the Research Sample

The companies participating in the survey were sourced from official online corporate databases. These databases were Crefoport and Opten. Both databases provide online interfaces that require registration, allowing registered members access to company data, including size, net revenue, and contact information. The sample database was filtered to include companies primarily involved in trade, production, and logistics services, thus forming the research sample. The survey was conducted using the EvaSys survey management system, and it was distributed to the companies' email addresses through this system. The email distribution followed GDPR principles strictly, and participants were informed that the study would be conducted anonymously and that the results would solely be used for writing this study.

The questionnaire consisted of three major sections. The first section included general questions aimed at categorizing respondents based on their size and industry. The second section required respondents to define the partner selection factors and rate their importance using a five-point scale. This section revealed how important the identified parameters were in the supplier selection process in the current changing environment. The third section included questions about flexibility. The purpose of this section was to identify the flexibility attitude of the companies in the sample regarding changes in partner selection factors.

The research sample consisted of 98 responses. Based on ownership structure, 29.6% of the responding companies were foreign-owned, while the majority (70.4%) were domestically owned.

These companies were primarily small and medium-sized enterprises (SMEs), which made up 58.1% of the sample. Additionally, microenterprises and a smaller portion of large companies participated in the study. The companies in the sample operate across various industries, with the majority (50.5%) involved in manufacturing. Transport and warehousing service providers (16.1%), commercial companies (8.6%), and agricultural businesses (6.5%) were also well-represented. It was also surveyed how much the companies engage in international trade. Among the respondents, 62.2% reported having an international service presence, meaning they are actively involved in international trade.

The main characteristics of the research sample are summarized in Figure 1.

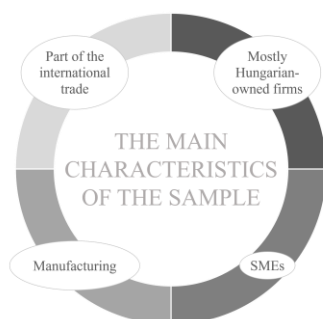


Fig. 1: Main characteristics of the research sample
(Source: own construction)

3.2 Research Methodology

The purpose of this study is to understand the attitudes of decision-makers in the corporate sector regarding the importance of flexibility in modifying delivery-related parameters within a partnership.

To achieve this, it is first necessary to identify the logistics criteria related to supply deliveries that may influence partner selection. These are parameters that are directly affected by supply disruptions. The defined parameters in the research are summarized in the Figure 2.

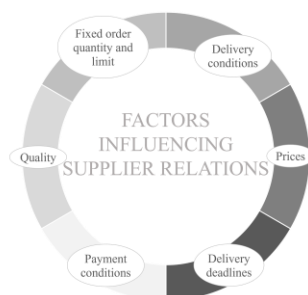


Fig. 2: Defined parameters related to supplier selection in the research
(Source: own construction)

Price has always been a significant influencing factor in partner relationships. It is an unavoidable factor that can greatly affect the establishment or efficient functioning of a partnership. Recent events serve as a precedent, demonstrating how certain occurrences can impact logistics service fees (such as the drastic increase in freight charges). Thus, the price level, as a supplier selection parameter, refers to the entire supply service.

Delivery conditions and deadlines depend on the production schedule and timeline. According to modern logistics thinking, companies should work with the lowest possible inventory levels to reduce inventory-related costs. However, it has been confirmed that completely eliminating inventory from system operations is nearly impossible, especially in the current changing economic environment. Therefore, it is important to consider the potential partner's ability to work under flexible deadlines and delivery conditions.

The quality of delivery is a fundamental factor in customer service standards. This refers to the overall service quality, including whether the goods arrive in good condition, in the correct quantity, and within the agreed timeframe as specified by the customer. If any of the aforementioned parameters are not met according to the customer's — and ultimately the final consumer's — requirements, the subsequent stage in the chain or network will incur additional costs. Correcting errors incurs extra costs for the company, thus affecting the entire network. From a resilience perspective, this parameter can be interpreted as the supplier's ability to provide quality service even in the face of changing customer demands.

Handling potential liquidity problems caused by external effects is an important consideration. If a partner immediately terminates the cooperation due to such a situation, it could lead to the company's bankruptcy. Payment terms, however, do not only refer to such extreme cases. For example, can payment deadlines be adjusted flexibly due to difficulties caused by inflation? Is there an opportunity to apply framework agreements that set expected monthly, semi-annual, or annual order amounts? These questions are part of the payment terms considerations.

Another important issue is how much the company is influenced by suppliers who impose fixed order quantities or order limits. How flexible is the supplier in handling this? Are there lower or upper order limits set, either in terms of value or quantity? In the fluctuating economic environment, it is crucial that these limits are set based on well-founded forecasts and are dynamically adjusted to

changes in the environment and demand. Thus, the existence of order limits can be an important parameter in supplier selection.

3.3 Results

Using a five-point scale, respondents were able to assess the importance of each parameter. The higher the rating given to a particular parameter, the greater its significance in the supplier selection process for the respondent's company. Based on the results of this research, it is possible to confirm that, in the Hungarian business sector of the 2020s, the flexibility factor is of significant importance in the supplier selection process.

The results indicate that for most of the companies in the sample, the majority of the defined parameters are considered important when selecting a supplier partner (Figure 3).

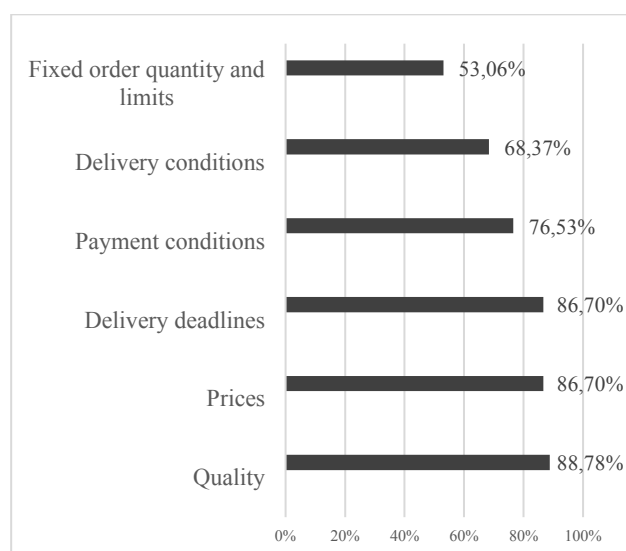


Fig. 3: Evaluation of supplier selection parameters
(Source: own construction)

During the research, the identified supplier selection factors were ranked by the participants using a five-point scale. This means that the respondents rated the most important parameter with a value of 5, and the least important parameter with a value of 1. The values of 5 and 4 for each parameter are presented as percentages relative to all responses in Figure 3.

The results presented in the figure reveal that the most important supplier selection factor is quality, which even surpasses price. Based on these findings, it can be concluded that for the companies in the sample, the quality of the supply is of the utmost priority. This factor defines the entire service and is considered the most crucial in the selection of a supplier.

The second most important parameters in the ranking, according to the respondents, are price and delivery deadlines. Price is a factor that is fundamentally constrained by the company's financial capabilities. Naturally, the more favorable the price, the more attractive it is for the company. However, based on the results, it is evident that the price-to-value ratio is more important than just the price itself. The ideal situation would be for suppliers to offer high-quality services at a low price.

The delivery deadlines are also an important factor. Timeliness is crucial in the supply process because timely delivery of goods supports production logistics with raw materials. This can also support Just-in-Time (JIT) systems, where the company uses only minimal safety stock and orders materials precisely when and in the quantities needed for production. This factor is relevant for minimizing inventory levels.

A somewhat surprising result is that payment and delivery conditions do not carry high priority. This is because these are generally considered standard processes in the companies surveyed, with little room for choice or with flexible handling of these conditions.

At the bottom of the priority list are order limits and fixed order quantities. These parameters, regarding whether the supplier applies order limits or fixed quantities, do not seem to be important in the supplier selection process.

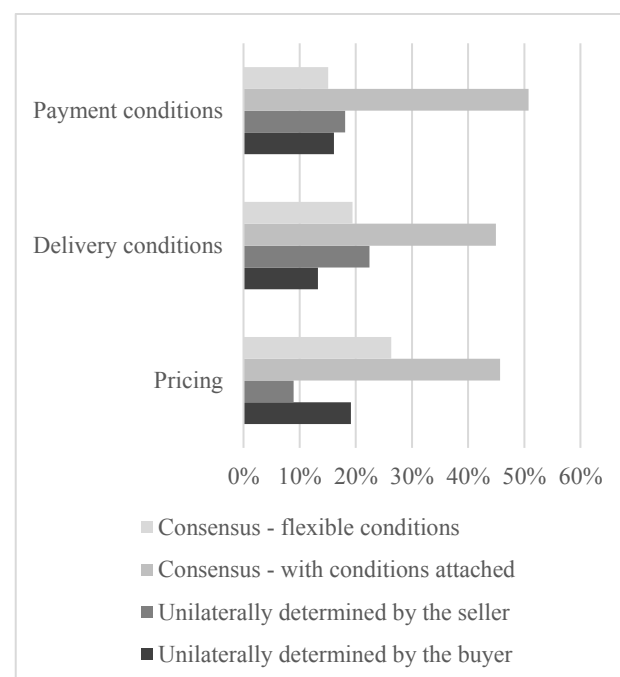


Fig. 4: Decision-making mechanisms for supplier selection parameters
(Source: own construction)

In the next phase, multiple-choice questions helped identify the flexibility attitudes characterizing the responding companies. The respondents could select how and to what extent they involve the supplier or partner in the design of parameters. Respondents had four options: the content and conditions of a given parameter are determined solely by either the seller's or the buyer's role, or the agreement is reached by consensus, with either fixed or flexible conditions. The responses were summarized as percentages in Figure 4.

Figure 4 summarizes the extent of cooperation, the level of joint decision-making, and the degree of flexibility in determining the parameters. The figure does not show all the defined parameters because the research handles them in aggregate form. The delivery conditions include the application of order limits and delivery deadlines, while quality is a parameter where flexibility is difficult to interpret, as quality is inherently subjective and any flexibility in this area might negatively affect satisfaction and service levels. The research interprets flexibility in relation to quality changes through price adjustments, suggesting that any change in quality is likely to also result in a price change.

According to the sample, in the opinion of the respondents, partners are involved in the pricing decisions as they agree on the price jointly by consensus. The conditions are fixed and cannot be changed flexibly. The same applies to delivery conditions: the system is created based on consensus, but with fixed conditions. Among the respondents, most use consensus-based decision-making for payment conditions, but fixed terms are generally applied. A relatively small proportion of the sample uses flexible conditions. A larger proportion shows flexibility in price determination, where the terms are agreed upon flexibly through consensus.

In conclusion, the decisions are mostly based on consensus, but the parties adhere to the established conditions, which can only be adjusted to a limited extent, according to the responses of the companies in the sample.

The relationships between the examined data were also explored. The results suggested that it is likely possible to categorize the companies in the sample based on their decision-making mechanisms. As a first step, the relationships between the variables had to be investigated. The results of the correlation analysis are summarized in Figure 5.

	CHI-SQUARE	CORRELATION
PRICES AND QUALITY DECISION-MAKING MECHANISMS	0,224	NO SIGNIFICANT CORRELATION
DELIVERY CONDITIONS (DEADLINES, LIMITATIONS, FIXED ORDERS) DECISION-MAKING MECHANISMS	0,175	NO SIGNIFICANT CORRELATION
PAYMENT CONDITIONS DECISION-MAKING MECHANISMS	0,081	NO SIGNIFICANT CORRELATION

Fig. 5: Result of correlation analysis
(Source: own construction)

It can be observed that there is no significant correlation between the priority ranking of factors in the supplier selection criteria and the type of decision-making mechanism employed by the companies in the study, as all Chi-square values exceed 5%. This supported the hypothesis that the companies in the study could be grouped. A clustering procedure was applied, and the companies were grouped based on their decision-making mechanisms. As shown in Figure 4, the factors influencing partner selection demonstrate a noticeable distinction between those with a higher willingness for cooperation and flexibility, and those exhibiting a less flexible and cooperative attitude. Based on these observations, the companies in the sample can be grouped.

The clustering procedure resulted in three groups, which are briefly summarized in Figure 6.

GROUP 1	GROUP 2	GROUP 3
HIGH COOPERATION LEVEL	HIGH COOPERATION LEVEL	LOW COOPERATION LEVEL
STRIVING FOR CONSENSUS	STRIVING FOR CONSENSUS	SELLER OR BUYER DOMINATION
LESS FLEXIBLE	FLEXIBLE	UNFLEXIBLE

Fig. 6: Identified groups within the research
(Source: own construction)

The first group members prefer fixed terms in a cooperative relationship, but the determination of these terms is done jointly with the partner. Companies in the second group have a decision-making mechanism similar to the first group, but they also allow for flexible handling of terms, making them the most efficient in establishing a resilient supply chain. The third group, however, shows a low willingness for cooperation, with terms being unilaterally determined in the partnership, either due to seller or buyer dominance.

4 Conclusion

The fundamental aim of the research was to establish a supplier selection criterion system and investigate the flexibility in handling these criteria. This means the focus of the study is to determine how important the various parameters are in supplier selection and how willing partners are to adjust the conditions related to these parameters in response to external or internal factors. In a dynamic environment, stable relationships, especially with strategically important suppliers who support processes related to the company's core activities, are particularly important.

The results first indicate that the most important factor is quality, while the least important is the fixed order quantities and order limits. From this, it can be concluded that, in supplier relationships, companies always strive to collaborate with partners who can provide the highest possible quality. Additionally, price and delivery deadlines also hold high priority. Based on the sample, payment and delivery conditions are no longer decisive, and fixed order quantities and limits are considered negligible in the establishment of the supplier selection system. The next question examined the flexibility attitude in the research. The follow-up questionnaire, which focused on willingness to cooperate and the companies' adaptive flexibility, reveals that while the companies in the sample show willingness to cooperate, the ability to adapt flexibly is less evident (Figure 7).

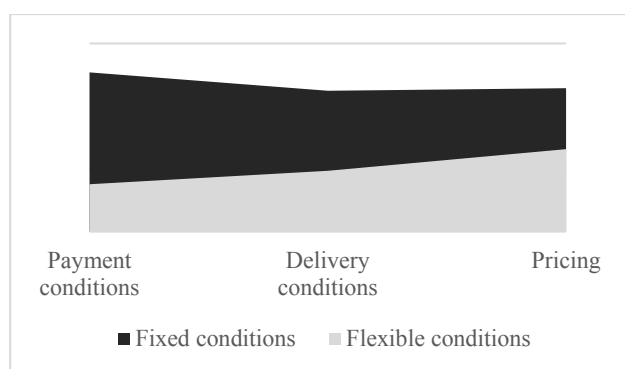


Fig. 7: How flexibility attitudes are reflected in supplier selection parameters

(Source: own construction)

Based on the data, the researcher also performed a cluster analysis, the results of which show that the companies in the sample can be classified into three types. The first group is less flexible but cooperative with their partners. The second group is both cooperative and flexible regarding the terms established with their partner. The third group has a low willingness to cooperate, and thus, the terms of

cooperation are unilaterally determined by one of the partners.

As the economic environment today is highly dynamic, increased demands, along with various external influences, pose significant challenges for companies. Therefore, it is essential for companies to possess resilience and flexibility to effectively and successfully adapt to changes. Since most companies in the sample consider quality, conditions, and deadlines related to delivery as the most important factors, it can be inferred that an essential expectation is also that the partner be appropriately flexible regarding these factors. If a supplier does not demonstrate adequate flexibility concerning the examined parameters, deficiencies may arise in a prioritized parameter, which could deteriorate the quality of the partnership and potentially lead to the termination of cooperation.

The research revealed that payment and delivery conditions, as well as fixed order quantities and limits, are not of decisive importance, and thus the flexibility factor related to these parameters is relatively low. For a well-functioning partnership, which positively impacts the entire supply chain and network, it is necessary for suppliers to be flexible in adapting to changes in prices, delivery deadlines, and maintaining high-quality standards (which, in this study, is interpreted as a change in price). The research shows that these are the parameters that define supplier relationships. As seen in previous years, if these factors cannot be flexibly adapted by the company, and the supplier partner cannot keep pace with these changes, it could negatively affect the level of customer service, potentially leading to the end of cooperation between the parties.

It can thus be concluded that in the modern supplier system, quality, supplier pricing, delivery deadlines, and conditions are significant factors. Companies' flexible attitudes must extend to the adaptation to changes caused by environmental, economic, and customer demand changes, as these are the factors that can fundamentally determine the quality of a supplier-customer relationship. If the partnership cannot ensure flexibility despite the changing environment, the collaboration is likely to end.

Based on the research sample, willingness to cooperate is evident in the companies' operations; however, the flexibility attitude requires further development. A positive outcome is that flexible conditions are applied in pricing, which is a very important factor in the supplier selection system. To ensure that supply chains and networks can present higher levels of resilience to the changing environment, this flexibility factor needs to be

enhanced. A good foundation for building higher resilience is the fact that a larger proportion of the companies in the sample are involved in consensus-based decision-making regarding supplier selection factors.

5 Limitations and Future Research Directions

The research has some limitations. As 98 companies participated in the research, the results can only be interpreted for this sample. So the sample currently only reflects the opinions of companies in Hungary, the conclusions drawn in the paper are essentially valid only for this sample, and results cannot be considered general. The groups formed in the cluster analysis reflect the opinions of the Hungarian companies that participated in the study. Therefore, this can be seen as a typology of supplier selection behavioral patterns, which provides a solid foundation for further research. This could serve as the basis for a larger study aimed at gathering insights from a greater number of Hungarian companies and, by expanding to an international level, validating or adjusting the results of the current research with a much larger sample. Precisely for this reason, one of the main thrusts of the researcher's future research is to conduct a study with a much larger number of respondents, which no longer focuses only on Hungarian companies, but also examines corporate attitudes at an international level, and this could help to increase the validity of the research. Now, the research presented in this paper is the basis for a larger study. At present, it has managed to examine how some Hungarian companies think in a changing environment, what partner selection factors they consider important, and how cooperatively they define these factors. Another limitation is in addition it does not take into account the so-called soft factors and their ability to influence the partner selection situation - i.e., it does not address trust, motivation, and other attitudes. Future research will also aim to explore these factors in more depth.

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