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**IMPROVING THE EFFECTIVENESS OF SUPPLY CHAIN COORDINATION AT  
THE LEVEL OF STRATEGIC DECISIONS**

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**Thesis of the doctoral dissertation**

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## Table of Contents

1. Introduction .....	1
1.1 <i>The relevance of the topic</i> .....	1
1.2 <i>Research objectives and questions</i> .....	2
1.3 <i>Summary the literature review</i> .....	3
1.4 <i>Hypotheses</i> .....	4
2. Research methodology .....	7
3. Research results .....	9
3.1 <i>Results of PRISMA and the questionnaire survey</i> .....	9
3.2 <i>Testing hypotheses and formulating theses</i> .....	13
4. Summary .....	17
Literature used in the thesis booklet.....	19
Author's relevant publications .....	22
Other publications of the author .....	25

## List of Figures

Figure 1: Hypotheses.....	6
Figure 2: Structure of the questionnaire survey .....	8
Figure 3: The identified clusters and their names .....	9
Figure 4: Notations used in the matrix .....	10
Figure 5: Contract-choosing matrix .....	12
Figure 6: Results of hypothesis testing .....	14

## 1. Introduction

The doctoral thesis focuses on improving the success of supply chain coordination. Supply chain coordination is one of the most important areas of supply chain management today. The practice and research of supply chain management goes back several decades. In the 20th century, the concept was closely related to logistics, but with subsequent differentiation, it has steadily gained independence and has evolved into a much larger field, involving both internal processes, mainly of a logistical nature, and external processes, focusing on inter-company partnerships, material and information flows.

### *1.1 The relevance of the topic*

According to the GDP data for 2019, supply chain management activities such as transport and warehousing or trade, which is in fact also closely linked to transport functions and thus to the supply chain, play an important role in the economies of different countries. A company analysis shows that the transport activities sector accounts for 5% of global GDP and employs a large number of workers (EU Science Hub, 2020). The share of GDP accounted for by trade has also been growing relatively steadily since the early 1970s. Thus, in 2018, trade accounted for 59% of GDP (The World Bank, 2020). Global trade has started to grow after the global decline caused by the pandemic. Exceeding forecasts, global trade grew by 13% in 2021 compared to the pre-pandemic period in 2019 (UNCTAD, 2022). Although growth slowed in the first quarter of 2022, analysis suggests that a strong increase is also expected in the following period (Trademagazin & Evans, 2021; UNCTAD, 2022). The European Union has also been able to overcome the negative effects of the pandemic, with a positive trade balance in 2021 and a share in global trade of exactly 0.4% (UNCTAD, 2022). Even in Hungary, there were relatively few sectors whose volume indices were clearly increasing, but transport and storage was one of them, according to the HCSO (2020). Of course, the pandemic also had an impact in this area and a sharp decline was recorded in 2020, but the data for 2021 gave cause for optimism (KSH, 2022). Growth and its rate are also influenced by the companies involved in supply chains and the environment surrounding them. The EU's objectives include protecting global supply chains, enhancing food security so that access to basic foodstuffs is not a problem in any EU country (European Commission, 2015 and 2022; Enterprise Europe Network, 2022). In addition, Hungary is home to subsidiaries of many foreign-owned companies - companies active in the automotive sector (e.g. Bosch), chemicals (e.g. BorsodChem) or other important sectors. Hungarian subsidiaries are also the part of global supply chains, so it is a cardinal issue that Hungarian companies are able to manage their supply chains. However, the operation and management of supply chains was greatly hampered first by the COVID-19 pandemic and later by the supply problems caused by the Russian-Ukrainian war. These crises could lead to an increase in the demand for flexible supply chains (which will trigger an even stronger presence of digitalisation and thus its development) and, contrary to the trend so far, to shorter supply chains (Hausmann, 2020; Goreczky 2022).

The literature on supply chain management has also shown a growing trend in recent years, which also means that both business and academia have become interested in the field of supply chain management (Xue et al, Within this, there has also been an increase in the number of publications dealing with coordination, specifically the coordination mechanisms with contract types have been and continue to be the focus of research (Li & Liu, 2006; Shin & Benton, 2007; Coltman et al., 2009; Zhang, 2011; Cai et al., 2020; Li et al., 2021; Vipin & Amit, 2021).

Globalisation, outsourcing of various logistics processes and the expansion of supply chains into networks have made it important to manage the coordination between partners as efficiently as possible (Demeter & Szász, 2012). The aim of supply chain coordination is to harmonise the processes of cooperating companies and to achieve a more efficient flow of information and information sharing. For this, partner relationship management is the most commonly used approach, which aims to establish a cooperative relationship between chain members based on the longest possible duration and the highest possible level of trust.

The growing interest in the literature, reflected in the increasing number of relevant publications year after year, and the increasing awareness of supply chain management in companies, have made this topic one of the most important areas of expertise in the 21st century. Partnerships are one of the keys to achieving good coordination, which is why it is necessary to find the most up-to-date and up-to-date information to improve the effectiveness of coordination. The aim of this thesis is to analyse the relevant literature on the subject, which will help us to understand the importance and the main characteristics of supply chain coordination. Then, my aim is to examine the aspects and considerations for improving supply chain coordination at the strategic decision-making level and to support more successful and efficient coordination by means of supply chain contracts.

## *1.2 Research objectives and questions*

For the frame model defined as the aim of this thesis to work, it is necessary to identify the behavioural patterns and attitudes towards cooperation that characterise partnerships and the factors that influence the choice of partners. This will help to identify the preferred form of cooperation of each company. Contracts that can be applied to supply chains can be used to support the establishment and maintenance of the preferred form of cooperation. The long term positive effects of this can be realised not only for the cooperating companies but also for the whole supply chain.

Thus, my aim is to understand the conditions and possibilities of using the most commonly used types of contracts, and then to analyse the real behaviour patterns of companies through a sample, which will help to identify the factors and differences in the choice of partners in companies. Using the two sets of information, I will construct a matrix that will represent a model that can recommend a contract that facilitates and improves coordination for a given preference.

Thus, in line with the research objectives, my first research question concerns the exploration of the characteristics of partnerships:

### *1. What are the characteristics of partnerships between members of the supply chain?*

A high level of cooperation between chain members is essential for the efficient management and effective functioning of supply chains. Coordination between members can be improved by developing different forms of relationships. However, companies prefer different forms of cooperation, depending on their attitudes, in terms of scope, duration and depth. For successful research, factors that may influence the choice of partners by supply chain members need to be identified. The identification of the characteristics of the partner relationships will provide information that can be used to typify and possibly rank the partner selection factors of individual companies and chain members. I assume that the level of prices will be a major

influencing factor in a partner selection situation. However, many other factors may also play an important role, for example, many firms may be interested in flexibility in delivery terms, or perhaps in fixed payment terms. The first research question focuses on the examination of these factors.

## *2. What are the tools that can be used to coordinate supply chains?*

One important area of supply chain management is supply chain coordination. It aims to ensure alignment between partners, support collaboration, and effectively link the value-creating processes of companies to ensure that the flow of information and materials between members is unimpeded. The range of coordination possibilities is very large, but it should be noted that they fall into two broad categories. The hard factors seek to facilitate coordination by solving the financing problems of the relationships. The soft factors are the attitudes and behaviours of individual companies. Both groups are an important part of the issue of improving coordination. Thus, two further sub-questions are included in research question 2.

### *2.1. What role do soft tools play in supply chain coordination?*

### *2.2. What types of contracts can be used to coordinate the supply chains?*

The analysis of soft factors is important, as trust, motivation, dominance, for example, are all factors that are reflected in the attitudes of a company and have a greater or lesser influence on the attitude of the organisation towards a potential partner candidate. This will also contribute to the type and duration of the partnership that the organisation will prefer to establish. Among the hard factors, the analysis of the potential for coordination with contract types is the most prominent in the international literature and is the subject of this thesis. In the literature review, it is necessary to identify the types of contracts that are most frequently encountered as research topics, i.e. those that are most frequently used.

### *3. How can the types of contracts described in the literature be applied in the context of improving partnerships with different time horizons?*

The identification of the characteristics of partnerships reveals the factors that are important for companies when choosing partners and concluding cooperation agreements. In order to coordinate and harmonise these factors, it is necessary to examine the application of the types of contracts in the supply chain. In this way, it is possible to identify how the expectations of partners are reflected in the contracts. The contracts most commonly used in the literature can be used to help the supply chain members to apply a contract with the conditions that meet their expectations and attitudes.

## *1.3 Summary the literature review*

Supply chain management is a popular topic today, and many publications have been published on the subject over the years.

One of the most important milestones in supply chain management was the separation from logistics. In the 1980s, logistics was almost the only field of logistics, and later the concept of supply chains emerged, which then brought supply chain management with it (Pounder, 2013). Supply chains can be understood as the linking of value-creating processes in a company, in which case we speak of value-creating processes when they create value realized by customers

(Chikán, 2020). These value-creating processes form Porter's value chain, which is the set of processes that contribute directly and indirectly to value creation (Porter, 1985). Porter's concept can be seen as a precursor to the concept of supply chains. At that time, however, the concept of supply chain was not at all widespread and was in fact used as a synonym for logistics (Lamber et al, 1998). However, the CSCMP has formally defined supply chain management and logistics to clarify the responsibilities of the two areas: supply chain management encompasses all planning and management processes, including purchasing, processing and all logistics processes, and includes coordination and collaboration mechanisms between all partner companies within the chain, which may be suppliers, intermediaries, distributors or buyers (CSCMP Bylaws, 2013).

The rise of supply chain management has been fuelled by the increasing effects of globalisation, outsourcing, the rapid development of the IT sector and the rapidly changing market environment, which has been greatly influenced by the dynamic changes in customer needs (Demeter et al, Supply chains have become more and more extensive, with more and more links, often across continents, within a chain. Hence the emergence of network perceptions in supply chains, and by the 2010s supply chains were more network-like than chains in the traditional sense (Gao et al., 2018; Xue et al., 2022). Thus, the large number of chain members made the coordination of value-creating processes in companies very challenging for supply chain management. For this reason, supply chain coordination became one of the most important tasks of supply chain management in the 2000s (Um & Kim, 2019).

Supply chain coordination offers a wide range of solutions for aligning members' processes. Some of the coordination tools can be grouped into soft and hard factors. Soft factors are solutions that are approached from a behavioural science perspective, such as dominance issues, the level of trust in partner relationships, or the willingness to share information (Hertz & Alfredsson, 2003; Singh & Benyoucef, 2013). These are the characteristics that will be determined by the different corporate characteristics and attitudes. The other large group, the group of hard factors, will investigate and support the financing side of the partnership. This group includes coordination opportunities through different types of contracts, which constrain cooperation within predefined frameworks and rules accepted by both parties and clearly define the sharing of risks and costs (Coltman, 2009; Stamatiou et al., 2019).

Contracts are seen by researchers as a potentially good solution for supply chain coordination. By understanding the conditions of application, advantages and disadvantages of the most commonly used contracts, it is possible to identify situations where individual contracts have a positive impact on coordination between members.

#### *1.4 Hypotheses*

According to the research questions, the first two hypotheses are related to the first research question, the third, fourth and fifth hypotheses are related to the second research question. No hypothesis has been assigned to the second research question on its own, as the sub-questions formulate this research question in more detail and precision. Thus, within the second research question, the third and fourth are related to the first sub-question and the fifth to the second sub-question. The sixth and seventh hypotheses relate to the Hamradik research question. Thus, the first four hypotheses focus on the exploration of partnership characteristics, including soft factors, while the last three hypotheses focus on contract types

and on the examination of contracts that can be used to improve partnerships. The hypotheses of the thesis are summarised in Figure 1.



<u>Research question</u>	<u>Number of Hypothesis</u>	<u>Hypotheses</u>
1.	<i>H1</i>	Price dominates the choice of partners (contractors).
	<i>H2</i>	Distinct patterns of firm behaviour can be identified based on the strength of influence of partner selection factors.
2.1.	<i>H3</i>	The manufacturing firms in the sample show a lower propensity to cooperate than suppliers.
	<i>H4</i>	The small and medium-sized enterprises in the sample show a greater propensity to cooperate in the longer term than in the shorter term.
2.2.	<i>H5</i>	Contract types that explicitly support cooperation are more frequently used than contracts with decentralized components.
3.	<i>H6</i>	Improving coordination requires the use and harmonisation of contracts as hard factors and the various soft factors (willingness to share information, willingness to take risks, trust).
	<i>H7</i>	Different contracts can be assigned to the groups formed by the behaviour patterns of firms.

Figure 1: Hypotheses (own editing – based on literature)

## **2. Research methodology**

The types of contracts used in this thesis were identified by the using PRISMA procedure. PRISMA is an acronym for Preferred Reporting Items for Systematic reviews and Meta-Analyses. The procedure can be applied to literature searches, systematically narrowing down the relevant literature based on a predefined topic (Moher et al., 2009; Wittorski, 2012).

In the practice of this thesis, this means that I used the detailed search engine of the ScienceDirect peer-reviewed article database to find articles with keywords that included the English term for various supply chain contracts. To do this, the first step was to find the types of contracts associated with the supply chain. The contracts defined by the literature on supply chain coordination were collected, and the next step was to search for each type. This became the first step in the PRISMA process. I narrowed down the search, and for the results I had already examined the relevance of the articles to supply chain coordination. Based on these, I narrowed down the number of hits to see how relevant the article was to the study of the coordination power of the contract type.

The procedure was carried out in 3 steps, i.e. in 3 steps I narrowed down the number of hits in terms of their relation to supply chain coordination.

To gain a better understanding of the conditions of application of contracts, I have used contract modelling to show which contracts can be used effectively in which situations. In this way, the advantages and disadvantages of each contract could be identified and quantified, which will greatly help in the selection of contracts that are precisely suited to each situation.

In order to identify the factors influencing the choice of partner and to map their influence, I used a questionnaire survey. After preparing the questionnaire, I compiled a database in the first four months of 2021. This database contained the contact details of companies that were relevant to the research topic, as the target group consisted of companies that are mostly involved in logistics activities - suppliers in different industrial fields, various production companies, distributors, retailers, wholesalers, forwarding and various logistics service providers. The aim of the questionnaire survey was to assess the most important factors that have a strong influence on the establishment of a partnership. My aim was to define the aspects that shape the content of each cooperation agreement. To overcome the pandemic and physical constraints, the research was conducted online using the EvaSys survey management system.

Regarding the structure of the questionnaire, it can be grouped into three large parts (Figure 2).

	<u>CONTENTS</u>	<u>GOAL</u>	<u>TYPE OF QUESTION</u>	<u>METHOD OF ANALYSIS</u>
1	<i>General questions concerning the company</i>	Getting to know the questionnaire respondents	- Closed question - Open question	- Descriptive statistical methods
2	<i>Supply chain issues</i>	Understanding the business environment, supply chain and the impact of factors defined as the consequences of inadequate information flows	- Five degree scale question - Closed question	- Descriptive statistical methods
3	<i>Questions about partnerships</i>	To know the factors influencing the choice of partner as defined by the respondent and their influencing power	- Five degree scale question - Open question	- Descriptive statistical methods - Cross-tab analysis - Cluster analysis

Figure 2: Structure of the questionnaire survey (own editing)

The questionnaire was launched in May 2021 and ran until October. The database was partly my own collection (compiled using the opten and crefoport online company database) and partly using previous address lists. I strictly followed the principles of GDPR when conducting the survey. 98 evaluable completions were obtained.

The research sample consists mainly of micro, small and medium-sized enterprises, mainly domestically owned, but also involved in international trade, and mostly active in the manufacturing sector. Half of the respondents defined their own company as a manufacturing company, with a large number of suppliers and freight forwarders (or logistics service providers) also included in the sample. The study only specifically defined suppliers as companies supplying raw materials and semi-finished products.

Data extracted from the questionnaire survey were analysed using the SPSS program. Based on a lengthy examination of the responses of the 98 companies included in the analysis, cluster analysis led to an acceptable result.

**3. Research results**

*3.1. Results of PRISMA and the questionnaire survey*

At the end of the PRISMA process, I identified 6 contracts that appear in the literature with varying frequency. They are, in descending order, the following:

*Wholesale pricing > Revenue-sharing contract > Quantity discount / Flexible quantity discount > Take-or-pay > Buy-back contract > Trade credit*

For further research, I have narrowed down the results obtained in terms of which contracts can really be used to improve coordination. Thus, I excluded trade credit from the list of contracts obtained, and I did not include flexible volume pricing and volume discount type contracts separately.

In analysing the questionnaire survey data, I used cluster analysis to group the companies according to their preferred form of cooperation. Thus, different clusters could be formed within the sample based on the strength and relevance of the factors influencing partner choice in different behavioural patterns (Figure 3).

<b><u>CLUSTER 1.</u></b>	<b><u>CLUSTER 2.</u></b>	<b><u>CLUSTER 3.</u></b>	<b><u>CLUSTER 4.</u></b>
<i>Those seeking a strategic alliance</i>	<i>Those seeking a cooperative relationship</i>	<i>Those seeking a minimum cooperative relationship with direct partners</i>	<i>Those seeking a casual market relationship</i>

Figure 3: The identified clusters and their names (own editing)

The clustering factor was the degree of influence of partner choice factors. In addition, dominance also shaped the results to a lesser extent. An interesting result is that where there is no dominance in the chain, only direct chain members tend to have minimal cooperative relationships. Another surprising result is that clusters 1 and 4 are equally dominated by producer and supplier firms, yet two contrasting groups emerge. In cluster 1, there were signs of a strategic alliance, where companies operate or would like to operate in a form of cooperation based on mutual benefits and longer-term cooperation, where they share resources and are integrated, even virtually, through an integrated management system. Cluster 4, on the contrary, does not support any longer-term cooperation, on the contrary - only occasional market linkages are preferred according to the responses. The similarity between these two clusters lies in the fact that both groups have a higher proportion of small producers and service providers. Clusters 2 and 3 favour a cooperative relationship, the difference between them being that Cluster 3 would establish this form of inter-firm relationship with direct partners only at a minimum level. So it would use a weaker type of cooperative relationship, while cluster 2 would use a much more stable cooperation. This may be due to the fact that cluster 3 is composed of micro-enterprises operating as service providers, a type of cooperation with its immediate environment being preferred. Another differentiation is that cluster 2 has a higher producer

dominance, which has a positive effect in this respect, as it would imply that a producer-dominated supply chain would also seek to establish a cooperative relationship.

The analyses show that it is indeed true that production and manufacturing companies dominate supply chains. However, in some cases this dominance can have a positive impact on the chain by supporting cooperation, but in other cases it is the other way round, with the dominant players using their dominance to shape cooperation on their own terms and mainly by establishing only occasional market links.

On the basis of this information, a dominant but cooperative producing company cannot be offered the same contract as a dominant but casual producing company. Contracts aim at reducing the frictions between firms, which optimally fits the individual attitudes of the firms. If a producer is dominant but does not even seek a minimum cooperative relationship, it cannot be expected to use a contract that requires a high degree of information sharing or joint decision making.

By means of the questionnaire research and the processing of the literature on contract types, I have created the basis for a model that is also suitable for counselling. One of the popular hard factors of supply chain coordination, contract types can be used to improve cooperation and coordination between individual chain members and partner firms, provided that members choose the right contract according to their own attitudes and preferred relationship type. This would be helped by the matrix, which, using the results of quantitative research, would classify the different types of contracts into groups according to the characteristics identified therein, which would improve coordination between members due to the conditions of use and the benefits based on their use.

To interpret the matrix, it is necessary to know the notations used in the matrix - this is summarised in Figure 4.

<u>NOTATION</u>	<u>SUBSCRIPTION</u>	<u>MEANING</u>
<b>X</b>	LESS RECOMMENDED	only a limited ability to deal with coordination problems
<b>XX</b>	RECOMMENDED	handles coordination problems well
<b>XXX</b>	HIGHLY RECOMMENDED	minimise or even eliminate coordination problems

Figure 4: Notations used in the matrix (own editing)

An "X" will indicate the minimum positive effect. It is worth addressing this, as even if only minimally, if coordination between members is improved, the operational indicators and cost factors may improve. "XX" indicates the preferred application, which already has a substantial positive impact on the members' operations, and thus represents a recommendation to apply the contract in question. 'XXX' will indicate the maximum level of adaptation to the situation, the group and its attitudes, so this will indicate the explicitly recommended use of the contracts.

After analysing and combining the data, the matrix could be constructed (Figure 5).

		<i>Level of integration required</i>			
		<i>low</i>			<i>high</i>
<i>CONTRACTS</i>	<i>GROUPS</i>	Casual market relationship	Minimum cooperative relationship with direct partners	Cooperative relationship	Strategic alliance
		<i>No cooperative attitude</i>	<i>Low level of cooperative attitude</i>	<i>High level of cooperative attitude</i>	<i>Exceptionally high level of cooperation</i>
<i>low</i>	Take-or-pay	<b>XX</b>			
	Wholesale pricing (decentralized)	<b>X</b>	<b>X</b>		
	Quantity discount	<b>XX</b>	<b>XX</b>	<b>XX</b>	
	Flexible quantity discount		<b>X</b>	<b>XXX</b>	<b>XX</b>
	Buy-back contract				<b>XX</b>
	Wholesale pricing (centralized)		<b>XX</b>	<b>XXX</b>	<b>X</b>
<i>high</i>	Revenue-sharing contract			<b>XX</b>	<b>XXX</b>

Figure 5: Contract-choosing matrix (own editing)

Using the matrix in Figure 5, I assigned the contract types that best fit the attitudes defined for the clusters. *The strategic alliance cluster* opts for a form of long-term cooperation based on mutual benefits, in which case companies also share resources to achieve a common goal (Balaton & Hortoványi, 2018). Here, members need contracts that allow for stronger integration between members. In the case of *the cooperative relationship group*, a looser committed relationship between partners is assumed. Here, the time horizon of the relationship is shorter, but not specific to a particular case (Besanko et al, 2004). Thus, for this group, contracts should be chosen that are able to strengthen coordination between the two companies, but do not necessarily require a higher degree of vertical integration. The group of those seeking a *minimum cooperative relationship with their direct partners* would prefer a cooperation that is not too strong already than the occasional market relationship. Contracts where integration with the direct partner is not an option should be considered here. The willingness to share information is low and the willingness to take risks is low, so that the range of contracts that can be offered is well defined. The group of those seeking a *casual market relationship* has the lowest propensity to cooperate and share information. They are not in favour of integration, they do not prefer any joint activities, and they do not even favour cooperation with direct partners. This is a typical characteristic of casual market relationships (Besanko et al, 2004). Thus, this group should be offered types of contracts that do not necessarily seek vertical integration - i.e. centralization - of the entire chain. For this group, it is necessary to offer contracts that can manage a chain in a decentralized arrangement, thus reducing conflicts of interest and coordinating the relationship between the partners according to expectations.

### 3.2. Testing hypotheses and formulating theses

Drawing on the literature and empirical research, I tested the hypotheses formulated, the results of which are summarised in Figure 6.



<u>Number of Hypothesis</u>	<u>Hypotheses</u>	
H1	Price dominates the choice of partners (contractors).	<b>ACCEPTED</b>
H2	Distinct patterns of firm behaviour can be identified based on the strength of influence of partner selection factors.	<b>ACCEPTED</b>
H3	The manufacturing firms in the sample show a lower propensity to cooperate than suppliers.	<b>REJECTED</b>
H4	The small and medium-sized enterprises in the sample show a greater propensity to cooperate in the longer term than in the shorter term.	<b>REJECTED</b>
H5	Contract types that explicitly support cooperation are more frequently used than contracts with decentralized components.	<b>ACCEPTED</b>
H6	Improving coordination requires the use and harmonisation of contracts as hard factors and the various soft factors (willingness to share information, willingness to take risks, trust).	<b>ACCEPTED</b>
H7	Different contracts can be assigned to the groups formed by the behaviour patterns of firms.	<b>PARTIALLY ACCEPTED</b>

Figure 6: Results of hypothesis testing (own editing)

Based on the hypothesis test, I formulated the theses of the thesis.

<i>T1</i> Clearly, settlement prices between partners are a strong determinant of the choice of partners.
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Thesis 1 identifies the strongest partner selection factor; this became the settlement price between partners. It is based on the hypothesis that the primary criterion for partner selection will be price, which, depending on the position in the supply chain, can be unit price, market price - in short, clearing price. Hypothesis H1 was confirmed on the basis of my sample, with most of the companies surveyed (88% of respondents) indicating price as the strongest factor of influence.

*T2 Patterns of cooperation can be grouped according to the different strengths of influence of the associated partner selection factors: those seeking strategic alliances, those seeking cooperative relationships, those seeking minimal cooperative relationships with direct partners, and those seeking casual market relationships.*

Soft coordination factors as determinants of partner choice have different strengths of influence in different groups of patterns, which allows for a good distinction between patterns of firm behaviour. The cluster analysis led to results based on these clustering characteristics. That is, the level of prices, the share of risk sharing in addition to delivery and payment terms, the importance of common integrated processes such as common decision making mechanisms, common planning procedures, the use of integrated corporate governance, common inventory management, the willingness to share information, emerged as partner selection factors with different influencing power in each cluster. These factors were assessed differently by each group and four different behavioural patterns could be isolated using cluster analysis. For those seeking a strategic alliance, it is important that the partner supports integrated processes linking the companies and has a high willingness to share information. The group that supports cooperative relations has a medium level of expectation for common processes and a medium level of willingness to share information. The cluster of those who wanted to have a minimal cooperative relationship with their direct partners considered only demand management and joint sales planning and management as important common processes; this was also only expected from the direct partners of the company. For the group of those seeking a more casual market relationship, the need for joint processes is completely neglected, and the willingness to share information is low from the company's point of view, and the organisation does not expect this attitude from its partner. Hypothesis H2 is thus confirmed.

*T3 The willingness of companies to cooperate is not affected by their role in the chain. Thus, it is equally possible for a producer, a supplier, a distributor, a retailer, a wholesaler or any logistics service provider to have a higher and a lower propensity to cooperate.*

According to hypothesis H3, firms in the production role in the chain have a lower propensity to cooperate than firms in the supply role. Hypothesis H3 is not supported by the questionnaire survey and cluster analysis information and cannot be confirmed. This means that there is no relationship between the degree of cooperation and the role in the chain. This claim is formulated in thesis 3.

*T4 There is no relationship between the size of the company and its level of cooperation. The degree of cooperation is not affected by whether the company is large, small or medium-sized or micro.*

Hypothesis H4 was also not supported, so its refutation led to the development of Hypothesis 4. According to hypothesis H4, SMEs are more willing to cooperate in the longer term than in the shorter term. Questionnaire research, cluster analysis and a cross-tabulation analysis of the relationship between cluster membership and firm size did not support the hypothesis.

*T5 According to the PRISMA procedure, contracts with a higher degree of cooperation are more popular than those with a lower degree of cooperation. To support cooperation, these types of contracts are able to achieve a higher level of centralization or vertical integration, and therefore there will be a higher level of cooperation between members using this type of contract. These types of contracts tend to be centralized and thus contain centralized components, whereas the types requiring a lower degree of cooperation contain mostly decentralized components.*

Hypothesis 5 is based on hypothesis H5, which already addressed research question 2, i.e. it focused on contract types and their potential to improve partnership coordination. For the hypothesis testing, I used the results of the PRISMA procedure, which identified the most popular types of contracts, with the types that were most likely to promote cooperation being the first ones to be identified. Hypothesis H5 was thus supported by the information obtained, which allowed the formulation of Hypothesis 5.

*T6 Aligning the hard and soft factors is an essential condition for improving coordination between partners. In the present situation, the hard factors are contracts, while the soft factors are corporate attitudes and characteristics. In order to improve and support coordination between partners, it is necessary to identify the characteristics and expectations of the partners and to apply the different contracts accordingly.*

Thesis 6 focuses on the relationship between hard and soft factors. The basis for the statement of this thesis is that, as stated in hypothesis H6, the use of contracts alone is not sufficient to achieve proper coordination. It has to be done by taking into account the characteristics and attitudes of the contracting parties related to the soft factors. Only in this way will it be possible to assign the contract best suited to them and to their preferred partnership, which will then have a real positive impact on coordination.

*T7 Contracts used by strategic alliance seekers: centralized wholesale pricing, revenue-sharing contract, flexible volume discount, buy-back contract.  
Contracts applicable to cooperative parties: centralized wholesale pricing, revenue-sharing contract, quantity discount, flexible quantity discount.  
Contracts that can be used by those seeking minimum cooperation with direct partners: decentralized and centralized wholesale pricing, quantity discount, flexible quantity discount.  
Contracts used by those seeking a casual market relationship: decentralized wholesale pricing, quantity discount, take-or-pay contract.*

The partially accepted hypothesis H7 is the basis for thesis 7. The cluster analysis applied to the questionnaire survey identified 4 clusters. For each cluster, it was possible to identify the behaviours and patterns that helped to determine the preferred form of cooperation, and thus to know the influencing power of the associated partner selection factors. Contracts could be assigned to these forms of cooperation on the basis of knowledge of their conditions of application, advantages and disadvantages. It is not the case, however, that only one or two contracts can be assigned to a cluster which are no longer applicable to other clusters. There is overlap, so that a single contract may support several forms of partnership. The matrix is based on these findings and they form the basis for thesis 7.

#### 4. Summary

Supply chain management is one of today's dynamically evolving and increasingly important disciplines. As the literature review shows, in the 21st century, business is no longer dominated by traditional supply chains, but these chains have become much more complex and complex networks, with an increasing number of chain members. Rather than being geographically concentrated in one country, supply chains are becoming more interconnected across continents, with the flow of materials and information between companies. This is a key mission and task of supply chain management. Negative impacts in recent years, such as the pandemic COVID-19 or the Russian-Ukrainian war, have posed huge challenges to supply chain management. In my opinion, it is therefore important and relevant to address the issue of supply chain coordination.

There are many tools available to the sector to ensure and strengthen coordination between its members. At international level, many researchers are concerned about the issue of coordination with contract types. The aim of this thesis was also to help companies to select the contract or contracts that best fit their own attitudes and preferred inter-company relations by creating a model for decision support based on an analysis of contract types. Contract types fall into the category of so-called hard factors, but in my opinion there are certain soft factors that cannot be ignored when coordinating with contract types. One such factor is the question of dominance, because this factor will not only influence the design of the contract terms, but will also narrow down the range of possible contracts. But we must also bear in mind the various motivational factors, such as the link between the willingness to share information and trust, or the willingness to take risks. The literature review identified and described the most commonly used contracts. This was done in order to define the conditions of use of each type and the positive and negative effects of their use on coordination between members. The impact of market demand uncertainties on the possibilities of using each contract, the extent to which dominance influences contract choice and the overall ability of each contract to improve coordination in a given situation were identified. I have used an example to quantify the coordinating power of the contracts to make them more comparable. This served as a pillar for recommending contracts for the model. The other pillar was the data and information extracted from the online questionnaire survey, which examined the partner selection factors of companies and defined their influencing power to identify the preferred forms of cooperation. This made it possible to create a matrix, which assigns to each group a type of contract that facilitates coordination to a greater or lesser extent on the basis of the characteristics identified. This is a kind of recommendation, which also includes a checklist of the most important criteria, in order to make a more precise choice. By creating a decision-support matrix, my aim is to make the operation of members of supply chains, which are disadvantaged in many ways today, more efficient and effective by enabling them to select the contract that meets their expectations, thereby enhancing coordination and cooperation between members.

Research question 1 focused on understanding the characteristics of partnerships. The establishment of partnerships within the supply chain is very important, as the higher the level of cooperation between the chain members, the more integration can be achieved, which will basically improve the functioning of the two companies, but indirectly can also improve the performance of the whole supply chain. Therefore, it is an important factor to know the requirements for partnering. A pilot questionnaire survey sample was used to investigate companies' behavioural patterns reflecting the characteristics and attitudes that characterise different partnerships. The sample showed that partner selection factors are different in weight and that these differences can be used to group corporate behaviours, which can in fact be

identified with preferred forms of cooperation. Furthermore, it was found that prices are clearly a strong determinant, but that delivery and payment terms are also relevant factors. Flexible variation in order quantities or the need for fixed order limits do not have a strong influence and do not influence the choice of partner in almost all cases.

The tools that can be used to coordinate supply chains (research question 2) fall into two broad categories. Expectations of the various soft factors are very important, as they can be used to determine their potential for coordination (research question 2.1). The degree of information sharing willingness of firms is important, as is the degree of risk-taking willingness of prospective partners, as these are all indicators of the depth of the potential trust relationship. Joint activities, such as integrated sales planning or virtual connectivity, are also an essential element. These factors make up the range of characteristics of the partnership, which have different influencing power depending on the attitudes of the company. The second major issue is the range of contracts that can be used for supply chain coordination (research question 2.2). In this question, I sought to find out which types of contracts appear most frequently in the literature, since the frequency with which a type appears suggests that it could potentially be a good solution to overcome or improve various coordination problems. I used the PRISMA procedure to identify the contracts. In a three-step research process, I identified and ranked the most frequently occurring contracts and then examined their applicability in supply chain coordination through a deeper analysis. Thus, not all of the types identified in the process were included in further research.

It was also necessary to investigate how the functioning of partnerships with different time horizons could be made more efficient through the use of different types of contracts in supply chains (research question 3). The purpose of contracts is to facilitate coordination between partners, i.e. to align processes and reduce conflicts of interest by setting a framework for cooperation with pre-defined terms and conditions agreed by both parties. Once the partner selection factors are known and their leverage is identified according to the company's attitudes, knowledge of the conditions of application, advantages and disadvantages of the contracts will help to apply a contract that fits the company's expectations. In this way, the company's attitudes and the opportunities offered by the contracts will be aligned and will complement each other to make the company's operations and the partnership established more effective. The matrix was thus created to answer research question 3. In this model, contracts can be matched to the forms of cooperation identified in the questionnaire research and preferred by companies. The contracts will thus be specifically adapted to the attitudes, characteristics and expectations of the companies, so that they can maximise their coordination-enhancing effect.

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