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AN APPLICATION FOR DETERMINING SUPPLY CHAIN INTEGRATION PROBLEMS VIA A MCDA METHODOLOGY: A CASE STUDY OF MANUFACTURING FIRMS IN ORDU PROVINCE

Ahmet AYTEKİN[1*], Selçuk KORUCUK[2],

[1]*Department of Business Administration, Faculty of Hopa Economics and Administrative Sciences, Artvin Çoruh University, Hopa, Artvin, Türkiye, ahmetaytekin@artvin.edu.tr*

[2]*Department of Logistics Management, Bulancak Kadir Karabas¸ Vocational School, Giresun University, Giresun, Türkiye, selcuk.korucuk@giresun.edu.tr*

Abstract: *Businesses are changing their organizational structures in order to compete and increase consumer value. They try to enhance their flexibility in order to respond to changing market needs and meet incoming demand. For this purpose, supply chain integration is becoming increasingly important in businesses and plays a crucial role in improving corporate sustainability. Integration's purpose is to enable the effective and efficient flow of products/services, information, money, and decisions, as well as to give the most value to the customer at the lowest feasible cost. However, business supply chain integration encounters many obstacles. The integration of the supply chain is considered an important key element for the sustainability of production, for the planning and efficiency of processes as well as for the quality and efficiency of services. It is clear that the development of supply chain integration, especially according to business requirements and needs, will also bring sustainable success in the long term. Based on the issues identified as barriers to supply chain integration, it can offer various suggestions at the desired level sufficient to resolve the issue(s) on the ground. In this context, the study investigated and determined the obstacles to supply chain integration in manufacturing businesses, with the goal of weighting the determined criteria. For this purpose, the Interval Valued Fermatean Fuzzy SWARA method was employed to weight the identified criteria. As a result of the analyses, it was concluded that Lack of Information Technology and Sharing " is the most important criterion among the obstacles to supply chain integration, and " Incompatibility of Operational and Strategic Goals " is the least important criterion.*

Keywords: *Supply Chain Management, Supply Chain Integration Obstacles, MCDA, Interval Valued Fermatean Fuzzy Sets, SWARA.*

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* Corresponding author

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1. Introduction

With the phenomenon of globalization, various events and changes occurred in almost all technological, economic and social processes in the last century. With these changes and developments come elements of supply chain management effectiveness such as costs, quality, flexibility, efficiency, etc. As a result, these topics have become important for every industry, and it has become necessary to ensure the sustainability of these concepts in order to create a competitive advantage. Supply chain integration is believed to be one of the important indicators for gaining competitive advantage, especially for manufacturing companies, depending on the success of efficiency factors (Korucuk, 2018).

Especially today, competitive companies are also looking for ways to ensure the integration of all their delivery networks. Value-added service providers can take on different roles to establish their own collaborative systems to find common ground and collaborate (Connor et al., 2014). In companies operating in a global supply chain environment, the main priority of supply chain stakeholders is standardized integration and collaboration in business processes. It can be said that the most important advantage of this integration is the development of common solutions and their implementation in practice. Mainly global companies; The focus is on collaboration in areas such as procurement, logistics, intermediary institutions and supply-side financing (Korpela et al., 2017).

A supply chain's companies communicate with each other on a regular basis. This inter-organizational communication occurs in a variety of ways, ranging from mailing invoices and purchase orders by paper mail to sophisticated information technology that connects two firms' databases. Relationships between supply chain members are required for the growth of supply chain management, including the coordination of production and logistics activities. This form of cooperation necessitates supply chain integration, which entails two organizations making shared decisions about production, stock, and delivery activities (Özdemir & Doğan, 2010).

In the area of global supply chain integration, there are basically four basic requirements, as research into the creation of a digital ecosystem shows. The first of these; secondly, the development of a business model; information model infrastructure, third; Have a business process standard for supply chain echelon connectivity and fourth; This is expressed in the number of operators that ensure the exchange of information between the actors of the system (Korpela et al., 2016).

According to Hu and Monahan (2015), information modules are not only a key driver of the business cycle, but also have a positive impact on factors such as the holistic integration of business processes into the supply chain, reduction of management costs and cost sharing. Weight of business processes on other actors and people in the system. The stronger the integration of suppliers and customers, the higher the potential profitability. Supply chain integration can improve performance by eliminating inefficiencies and instability, properly managing processes, giving customers what they want, avoiding excess inventory, and actively regulating demand (Agan, 2011).

However, there are many factors that hinder integration in terms of supply chain performance and efficiency.

The absence of supply chain planning activities, lack of resource sharing, organizational incompatibility, lack of information sharing, lack of responsibility division, and lack of organizational compatibility are the obstacles to supply chain integration in this context (Awasthi and Grzybowska, 2014). Globalization, process integration, transaction costs, strategy and planning, order management, operations management, and corporate standards are among the examples of factors that can hinder supply chain integration (AlSagheer & Ahli, 2011).

In summary; conflicting goals and interests of internal functions and business partners; an element of trust in relationships with suppliers; The lack of information sharing within and between companies, as well as the lack of information technologies that enable information sharing, are considered barriers to supply chain integration. In addition, difficulties in harmonizing business processes and the way of conducting business with the business partner appear to be another obstacle in terms of business culture (Dehmen Gülaslan, 2022).

Although the negative effects of supply chain disruptions have increased in recent years, research and business planning in this context are still not at a sufficient level. As observed, very few of their studies focus on threats and obstacles in the supply chain (Hendricks & Singhal, 2005).

So much so that disruptions that occur in order quantities and deliveries at every link in the supply chain, moving away from the customer and becoming more pronounced as they move between suppliers, have a huge impact. The impact of information erosion on supply chain performance is as follows: increased production, transportation, loading, fulfillment, storage and replenishment times. Profitability decreases with product availability (Chopra & Meindl 2004; Korucuk & Memiş, 2018).

From this point on, barriers to supply chain integration impact important issues such as costs, efficiency, competition, effectiveness and efficiency for companies and beneficiaries, and the identification of relevant issues and risks is considered an essential element. Since a small disruption in supply chain management affects not only production processes but the entire process up to the end consumer, factors that hinder supply chain integration appear to be key elements that need to be carefully considered. Based on all these issues, the study aims to identify barriers to supply chain integration in corporate identity manufacturers in Ordu province and classify them using Multi-Criteria Decision-Making Methods.

In the following sections of the study, the literature review on the concepts of supply chain integration inhibitors was emphasized, and the explanations about the Interval Valued Fermatean Fuzzy (IVFF) Stepwise Weight Assessment Ratio Analysis (SWARA), which constitutes the method of the study, and the application of the method for Ordu province were examined. In the last part of the study, results and information about future studies are presented.

2. Literature review

Some studies in the national and international literature on supply chain integration inhibitors are given below.

Awad and Nassar (2010) examined supply chain barriers in three groups: micro environmental barriers, macro environmental barriers and technical barriers.

Özdemir and Doğan (2010), examined the relationship between supply chain integration and information technologies. They found that the use of information technologies facilitates the integration of the supply chain.

Prajogo's (2011) study of long-term suppliers found a significant relationship between IT capabilities, information sharing and logistics integration. Additionally, long-term relationships with suppliers have direct and indirect impacts on performance.

Sodhi et al. (2012) in their comprehensive literature review examined the factors of supply chain risk management together with supply chain managers and members of international supply chain groups and proposed various solution strategies.

Kim (2013) examined the relationship between supply chain integration and performance. It has expanded current understanding of the benefits and considerations associated with implementing internal supplier and customer integration.

Sabir and Irfan (2014) examined variables that prevent supply chain integration, including a lack of information technology, a lack of information exchange, a lack of trust, a traditional management philosophy, and system incompatibility.

Ho et al. (2015) conducted a comprehensive review of 224 articles related to the area of supply chain inhibitors and risk management from 2003 to 2013. At the end of his studies, he also revealed potential research gaps regarding supply chain risk management.

Yuen and Thai (2016) as supply chain disruptors; They stated that there is a lack of trust and commitment, resistance to change, incompatibility of operational and strategic goals, lack of resources and measurement failure.

Prakas et al. (2017) proposed a supply chain network design framework and a supply and logistics risk model in their study.

Lu et al. (2018) explained the impact of internal and external integration on supply chain management performance.

Kamble et al., (2019) examined modeling barriers to Internet of Things adoption in retail food supply chains.

Venkatesh et al. (2020) using the DEMATEL analysis technique examined barriers to port-centric supply chain integration in a developing economy and from a multi-stakeholder perspective.

Wang et al. (2020) proposed a new paradigm for supply chain integration and collaboration with blockchain and supply chain management in New Zealand.

Branco et al. (2021) assessed barriers to the development of supply chain integration in port management in a developing country.

Tiwari (2021) conducted a comprehensive literature review to understand different levels of integration in supply chain processes and identify missing links using a framework. examined the connection between Industry 4.0 and supply chain integration and suggested further research directions.

Kumar et al., (2022) examined the adoption barriers within the context of integrated blockchain and internet of things in the food supply chain.

Freije et al. (2022) examined the relationship between innovative ability and the degree of internal and external integration with customers and suppliers, taking into account the service level in different companies.

Benevento et al. (2023) examined barriers to healthcare organizations' supply chain integration beyond digital technologies.

Kamble et al. (2023) examined the relationship between information and communication-supported supply chain integration and sustainable supply chain performance. As a result, supply chain integration has been shown to have a strong influence and overall mediating effect on the relationship between blockchain technologies and supply chain performance.

Xi, et al., (2023) in the study using social capital theory, found that the three dimensions of green intellectual capital (i.e. green human capital, green structural capital and green relational capital) are green supply chain integration (i.e. green supplier, internal and customer integration) and They examined the mediating effect of supply chain transformational leadership.

In the detailed literature review, very few studies on supply chain integration inhibitors and problems were identified. At this point, it is thought that the study will contribute to the literature.

3. Methodology

Some decision problems could involve uncertain, contradictory, or confusing data. These problems are better modeled by Fermatean Fuzzy Sets (FFSs) than by traditional fuzzy sets. IVFFSs is a generalization of FFSs that includes range values. And IVFFSs provide more domain than FFSs. Some shortcomings and limitations of FFSs are eliminated while the IVFFs. Decision problems with ambiguous, inconsistent, and incomplete data can be modeled using IVFFS. In the current study, we employed IVFF-SWARA and IVFFS to solve the research problem. The IVFF set *(IVFFS) D* is defined via Eq. (1), where *X* is a finite nonempty set (Jeevaraj, 2021; Görçün et al., 2023):

$$D = \{< [a_{DL}(x), a_{DU}(x)], [b_{DL}(x), b_{DU}(x)] > | x \in X\}, \tag{1}$$

In Eq. (1), $a_{DL}(x)$ is the lower bound of membership degree, $a_{DU}(x)$ is the upper bound of membership degree, $b_{DL}(x)$ is the lower bound of non-membership degree, $b_{DU}(x)$ is the upper bound of non-membership degree. Also, $a_{DL}(x), a_{DU}(x), b_{DL}(x), b_{DU}(x) \in [0,1]$, and $0 \leq (a_{DU}(x))^3 + (b_{DU}(x))^3 \leq 1$. The indeterminacy degree of x to D is written $\pi_D(x) = [\pi_{DL}(x), \pi_{DU}(x)]$, where $\pi_{DL}(x) = \sqrt[3]{1 - (a_{DU}(x))^3 - (b_{DU}(x))^3}$, $\pi_{DU}(x) = \sqrt[3]{1 - (a_{DL}(x))^3 - (b_{DL}(x))^3}$ (Görçün et al., 2023).

For simplicity, the pair of $[a_{DL}(x), a_{DU}(x)], [b_{DL}(x), b_{DU}(x)]$ is called IVFF number (IVFFN). Assume $\digamma = ([a_L, a_U], [b_L, b_U])$, $\digamma_1 = ([a_{1L}, a_{1U}], [b_{1L}, b_{1U}])$, and $\digamma_2 = ([a_{2L}, a_{2U}], [b_{2L}, b_{2U}])$ are three IVFFNs. The IVFF operators, the score function ($s(\digamma)$), accuracy function ($h(\digamma)$), and the IVFFS-Euclidean distance measure are defined as follows, where $\lambda > 0$ (Jeevaraj, 2021; Görçün et al., 2023).

$$\digamma_1 \oplus \digamma_2 = \left(\left[\sqrt[3]{a_{1L}^3 + a_{2L}^3 - a_{1L}^3 a_{2L}^3}, \sqrt[3]{a_{1U}^3 + a_{2U}^3 - a_{1U}^3 a_{2U}^3}\right], [b_{1L} b_{2L}, b_{1U} b_{2U}]\right), \tag{2}$$

$$\digamma_1 \otimes \digamma_2 = \left([a_{1L} a_{2L}, a_{1U} a_{2U}], \left[\sqrt[3]{b_{1L}^3 + b_{2L}^3 - b_{1L}^3 b_{2L}^3}, \sqrt[3]{b_{1U}^3 + b_{2U}^3 - b_{1U}^3 b_{2U}^3}\right]\right) \tag{3}$$

$$\lambda \digamma = \left(\left[\sqrt[3]{1 - (1 - a_L^3)^\lambda}, \sqrt[3]{1 - (1 - a_U^3)^\lambda}\right], \left[{b_L}^\lambda, {b_U}^\lambda\right] \right), \tag{4}$$

$$\digamma^\lambda = \left(\left[a_L^\lambda, a_U^\lambda\right], \left[\sqrt[3]{1 - (1 - b_L^3)^\lambda}, \sqrt[3]{1 - (1 - b_U^3)^\lambda}\right]\right), \tag{5}$$

$$\digamma^c = ([b_L, b_U], [a_L, a_U]). \tag{6}$$

$$s(\digamma) = \frac{{a_L}^3 + {a_U}^3 - {b_L}^3 - {b_U}^3}{2} \tag{7}$$

$$h(\digamma) = \frac{{a_L}^3 + {a_U}^3 + {b_L}^3 + {b_U}^3}{2} \tag{8}$$

$$d(\digamma_1, \digamma_2) = \sqrt{\frac{(a_{1L}^3 - a_{2L}^3)^2 + (a_{1U}^3 - a_{2U}^3)^2 + (b_{1L}^3 - b_{2L}^3)^2 + (b_{1U}^3 - b_{2U}^3)^2 + \left((1 - a_{1L}^3 - b_{1L}^3) - (1 - a_{2L}^3 - \right.}{6}} \tag{9}$$

The IVFF Weighted Arithmetic Average (IVFFWA) and the IVFF Weighted Geometric Average (IVFFWG) operators are defined as follows, where $\digamma_i = \digamma_1, \digamma_2, \ldots, \digamma_m$ (Görçün et al., 2023):

$$\text{IVFFWA}_w(\digamma_1, \digamma_2, \ldots, \digamma_m) = \left(\left[\sqrt[3]{1 - \prod_{i=1}^{m} (1 - a_{iL}^3)^{\lambda_i}}, \sqrt[3]{1 - \prod_{i=1}^{m} (1 - a_{iU}^3)^{\lambda_i}}\right], \left[\prod_{i=1}^{m} b_{iL}^{\lambda_i}, \prod_{i=1}^{m} b_{iU}^{\lambda_i}\right]\right). \tag{10}$$

$$\text{IVFFWG}_w(\digamma_1, \digamma_2, \ldots, \digamma_m) = \left(\left[\prod_{i=1}^{m} a_{iL}^{\lambda_i}, \prod_{i=1}^{m} a_{iU}^{\lambda_i}\right], \left[\sqrt[3]{1 - \prod_{i=1}^{m} (1 - b_{iL}^3)^{\lambda_i}}, \sqrt[3]{1 - \prod_{i=1}^{m} (1 - b_{iU}^3)^{\lambda_i}}\right]\right). \tag{11}$$

The IVFF- SWARA

Subjective weighing techniques based on pairwise comparison are frequently employed in problems with a small number of criteria. The requirement for [n(n-1)/2] comparisons, on the other hand, has motivated researchers to conduct alternative searches as the number of criteria increases. In this context, Keršuliene et al. (2010) developed the SWARA technique, which provides weighting with (n-1) pairwise comparisons (Aytekin, 2022). IVFFSs, on the other hand, is a useful tool for modeling problems with uncertainty. The extension of SWARA defined under IVFF proposed by Görçün et al. (2023) will be employed in this study. The implementation steps of the IVFF-SWARA are given below (Görçün et al., 2023):

Step 1. An importance evaluation vector of criteria is constructed by considering the judgments of experts. In this context, experts use linguistic terms given in Table 1 (Hezam et, al.,).

Therefore, $\vartheta_{jk} = ([a_{jkL}, a_{jkU}], [b_{jkL}, b_{jkU}])$ denotes the evaluation of criterion j by expert k, where $j = 1, \dots, n; k = 1, \dots, r$.

Table 1. Linguistic Terms For Evaluation Of Criteria And Corresponding IVFFNs.

Linguistic Terms	Notations	IVFFNs			
		μ_L	μ_L	ν_L	ν_L
Extremely low	EL	0.05	0.10	0.90	0.95
Very low	VL	0.10	0.20	0.85	0.90
Low	L	0.20	0.30	0.80	0.85
Medium-low	ML	0.30	0.40	0.70	0.80
Medium	M	0.40	0.50	0.60	0.70
Medium-high	MH	0.50	0.65	0.50	0.60
High	H	0.65	0.80	0.40	0.50
Very high	VH	0.80	0.90	0.20	0.35
Extremely high	EH	0.90	0.95	0.05	0.10

Step 2. Experts' evaluations are integrated via the IVFFWAA operator. The aggregated IVFF importance vector is formed using Eq. (12), λ_k denotes the weight of k-th expert.

$$\vartheta_w(\vartheta_1, \vartheta_2, \dots, \vartheta_n) = \left(\left[\sqrt[3]{1 - \prod_{k=1}^{r}\left(1 - a_{jkL}^3\right)^{\lambda_k}}, \sqrt[3]{1 - \prod_{k=1}^{r}\left(1 - a_{jkU}^3\right)^{\lambda_k}}\right], \left[\prod_{k=1}^{r} b_{jkL}^{\lambda_k}, \prod_{k=1}^{r} b_{jkU}^{\lambda_k}\right]\right). \tag{12}$$

Thus, $\vartheta_j = ([a_{jL}, a_{jU}], [b_{jL}, b_{jU}])$ for each criterion is obtained.

Step 3. Score value of ϑ_j is computed using Eq. (13).

$$s(\vartheta_j) = \frac{{a_{jL}}^3 + {a_{jU}}^3 - {b_{jL}}^3 - {b_{jU}}^3}{2}. \tag{13}$$

Step 4. Criteria are ranked in descending order based on the $s(\vartheta_j)$ values. s_1 denotes the first-placed criterion based on this ranking while s_n is the last placed criterion. Comparative significance (ι_j) of $s(\vartheta_j)$ related to each criterion is obtained via this ranking order. Thus, $s(\vartheta_{s_1})$

shows the score value of first placed criterion, while $s(\vartheta_{s_n})$ is the score value of the last placed criterion.

Step 5. The comparative significance of first placed criterion is determined as $\iota_1 = 1$, while the comparative significance of the second-place criterion is obtained from $s(\vartheta_{s_1}) - s(\vartheta_{s_2})$. The same process is followed for the remaining criteria.

Step 6. Comparative coefficient (co_j) for each criterion is calculated by applying Eq. (14):

$$co_j = \begin{cases} 1, & \text{if } j = 1, \\ \iota_j + 1, & \text{if } j > 1. \end{cases} \tag{14}$$

Step 7. Recalculated importance values (q_j) are computed via Eq. (15):

$$q_j = \begin{cases} 1, & \text{if } i = 1, \\ \dfrac{co_{(j-1)}}{co_j}, & \text{if } i > 1. \end{cases} \tag{15}$$

Step 8. Weight coefficient (w_j) of each criterion is calculated using Eq. (16):

$$w_j = \frac{q_j}{\sum_{j=1}^{n} q_j}, \tag{16}$$

where $0 \leq w_j \leq 1$ and $\sum_{j=1}^{n} w_j = 1$.

4. Results

Table 2 lists the criteria considered in the study concerning the supply chain integration obstacles in manufacturing firms.

Table 2. The List of Criteria

Codes	Criteria	Source(s)
C1	Lack of Resource Sharing	Awasthi & Grzybowska (2014).
C2	Lack of Organizational Alignment	Awasthi & Grzybowska (2014).
C3	Lack of Information Technology and Sharing	Sabir & Irfan (2014), Korucuk & Erdal, (2018), Munir, et al., (2020).
C4	Lack of Sharing Responsibility	Awasthi & Grzybowska (2014).
C5	Failure to Plan Supply Chain Activities	Awad & Nassar (2010), Demirdöğen & Korucuk (2017).
C6	Lack of Trust and Commitment	Yuen & Thai, (2016), Korucuk & Erdal, (2018).
C7	Incompatibility of Operational and Strategic Goals	AlSagheer& Ahli (2011), Awasthi & Grzybowska (2014).

C8	Measurement Failure and Resistance to Change	AlSagheer & Ahli (2011), Awasthi & Grzybowska (2014).
C9	Transaction Cost	Awasthi & Grzybowska (2014), Korucuk & Memiş, (2018).

For the problem under investigation, three experts were interviewed. One of the experts manages the production, and the other is a customs consultant. The third expert is currently employed as an academician and has experience in operational logistics. We give equal weight for all experts in this study. Table 3 displays the linguistic evaluations of criteria by experts.

Table 3. The Linguistic Evaluations Of Criteria

	C1	C2	C3	C4	C5	C6	C7	C8	C9
Expert 1	H	VH	EH	MH	M	M	MH	H	VH
Expert 2	H	H	VH	H	H	MH	M	VH	VH
Expert 3	H	VH	Y	VH	EH	M	ML	H	VH

The integrated IVFF importance vector for each criterion is constructed via Eq. (12). Thus, ϑ_j, $s(\vartheta_j)$, s_j are presented in Table 4.

Table 4. The integrated IVFF Importance Values, Score Function Values and Ranking Criteria Based On Score Function Values.

	ϑ_j					
	a_{jL}	a_{jU}	b_{jL}	b_{jU}	$s(\vartheta_j)$	s_j
C1	0.6500	0.8000	0.4000	0.5000	0.2988	7
C2	0.7624	0.8752	0.2520	0.3942	0.5181	3
C3	0.8154	0.9020	0.1587	0.2596	0.6273	1
C4	0.6864	0.8154	0.3420	0.4718	0.3603	6
C5	0.7555	0.8465	0.2289	0.3271	0.4954	4
C6	0.4393	0.5625	0.5646	0.6649	-0.1056	8
C7	0.4177	0.5421	0.5944	0.6952	-0.1569	9
C8	0.7143	0.8429	0.3175	0.4440	0.4219	5
C9	0.8000	0.9000	0.2000	0.3500	0.5951	2

The weight coefficients of criteria are computed using Eq.s (14)- (16), and are given in Table 5.

Table 5. The Weighting Results for Criteria

Criteria	$s\left(\vartheta_{s_j}\right)$	ι_j	co_j	q_j	w_j	Importance Ranking
C3	0.6273		1.0000	1.0000	0.1413	1
C9	0.5951	0.0322	1.0322	0.9688	0.1369	2
C2	0.5181	0.0770	1.0770	0.8995	0.1271	3
C5	0.4954	0.0227	1.0227	0.8796	0.1243	4
C8	0.4219	0.0735	1.0735	0.8194	0.1158	5
C4	0.3603	0.0616	1.0616	0.7718	0.1091	6
C1	0.2988	0.0615	1.0615	0.7271	0.1028	7
C6	-0.1056	0.4044	1.4044	0.5177	0.0732	8
C7	-0.1569	0.0513	1.0513	0.4925	0.0696	9

The most important criterion is "Lack of Information Technology and Sharing" as seen in Table 5. Besides, the importance ranking order of the criteria is C3> C9> C2> C5> C8> C4> C1> C6> C7.

5. Conclusions

Today, one of the ways to run business processes smoothly and ensure sustainable competitiveness of businesses is to structure supply chain integration effectively and efficiently. Integration is important in every application that falls within the main field of activity of supply chains and provides efficiency and cost savings to businesses that provide performance superiority. However, if the supply chain integration does not achieve the desired level of security and coordination, it leads to various risks and problems. Therefore, this situation has a negative impact on companies and may result in various losses for companies in terms of efficiency, productivity, competitiveness and cost advantages. It even causes disruptions in production processes, and businesses that cannot provide supply chain integration experience customer loss.

In this context, the study investigated supply chain integration barriers in manufacturing enterprises with corporate identity in Ordu province. According to the results of the study, the most important criteria regarding supply chain integration barriers were determined to be "Lack of Information Technology and Sharing", "Transaction Cost", "Lack of Organizational Alignment" and "Failure to Plan Supply Chain Activities", respectively.

In other words, barriers to supply chain integration led to disruption when manufacturing companies lose the benefits of information and technology exchange, and transaction costs increase. Therefore, the lack of proper business planning in the supply chain can be viewed as a significant integration barrier that can lead to disruptions in organizational and business processes.

Integration in supply chain management activities is extremely important so that companies have a more modern and competitive structure to operate in a globalized market.

Supply chain integration helps create appropriate applications by providing companies with cost advantages, improving service quality and increasing customer satisfaction to achieve maximum benefits. For this reason, the factors and barriers affecting supply chain integration are important. The explicit disclosure of this situation based on the results of the present study is considered a further contribution of the study.

In addition to its theoretical contributions, the study has very important implications for policy makers, practitioners and those interested in this issue in the manufacturing sector. This; It provides the opportunity to evaluate factors affecting supply chain integration. In addition, relevant research addresses a critical area such as supply chain integration in manufacturing and proposes a set of new criteria relevant to real-world decision-making problems. Another contribution of the study is that it is a source of inspiration for future authors as well as for various sectors and industries.

At the same time, obstacles to supply chain integration present various uncertainties and complexities for policymakers and practitioners. Therefore, this situation may cause difficulties for manufacturing companies in terms of costs, marketing, waste, energy environment, efficiency and demand management, and process application levels. The results obtained here from the study serve as a roadmap to overcome the difficulties mentioned above. There are also many criteria regarding barriers to supply chain integration. An important issue is therefore the selection of the most appropriate solution by evaluating many conflicting qualitative and quantitative criteria. The results achieved in this phase also represent a further valuable contribution to research.

Since the results achieved also represent important criteria for the integration of the supply chain, which increase the level of production and service, the achievable production level can be raised to a higher level through improvements. Effective use of information and technology can make supply chain planning more accurate and reduce transaction costs. Ultimately, transaction costs are controlled, companies have alternative situations available and supply chain disruptions are reduced.

One of the main limitations of the study is the limited number of expert groups surveyed, which cannot be increased due to time constraints. Another reason for these limitations is the fact that the study was conducted in a specific province and sector. Furthermore, a catalog of criteria on the subject of supply chain integration was not found in the reports of the expert groups or in the literature search.

At this point, the study can be seen as a guide to fill an important gap in addressing the above-mentioned barriers to supply chain integration. Again, research may be evaluated in the future using other multi-criteria decision-making methods or other parametric or non-parametric methods. This can also be improved by adding fuzzy logic and the results can be compared and discussed.

References

Agan, Y. (2011). Impact of Operations, Marketing, and Information Technology Capabilities on Supply Chain Integration, Journal of Economic and Social Research, 13(1), 30-32.

AlSagheer, A., & Ahli, M. (2011). Impact of supply chain integration on business performance and its challenges. International Business & Economics Research Journal (IBER), 10(12), 79- 92.

Awad, D. & Nassar, O.M. (2010). A broader view of the supply chain integration challenges. International Journal of Innovation, Management and Technology, 1(1), 51-56.

Awasthi, A. & Grzybowska, K. (2014). Barriers of the supply chain integration process. In Logistics Operations, supply chain management and sustainability,15-30. Springer, Cham.

Aytekin, A. (2022). Çok Kriterli Karar Analizi. Nobel Bilimsel.

Benevento, E, Stefanini, A., Aloini, D., Dulmin, R. & Mininno, V., (2023). Beyond Digital Technologies: Investigating the Barriers to Supply Chain Integration of Healthcare Organizations, in IEEE Transactions on Engineering Management, doi: 10.1109/TEM.2023.3280329.

Branco, M., Teixeira, R., Mir, S. & Lacerda, D. P. (2021). Barriers to the Development of Port Operator Supply Chain Integration: An Evaluation in a Developing Country. Transportation Journal, 60(2), 141-170. https://doi.org/10.5325/transportationj.60.2.0141

Chopra, S. & Meindl, P. (2004). Supply Chain Management: Strategy. Planning and Operation, 2. Press, Prentice Hall.

Connor, K., Cook, I. P., Porche, I. R. I. & Gonzales, D. (2014). Cost Considerations in Cloud Computing, RAND Corporation. 1-16.

Dehmen Gülaslan, M. (2022). Tedarik Zinciri Yönetiminde Bilgi İletişim Teknolojileri Kullanımının Tedarik Zinciri Entegrasyonuna ve Performansına Etkisi: İmalat Sanayiinde Bir Araştırma,, Marmara Üniversitesi Sosyal Bilimler Enstitüsü, İstanbul.

Demirdöğen, O. & Korucuk, S. (2017). Depolama ve Satın Alma Kararlarının Üretime Etkisi: TRA1 Bölgesi İmalat İşletmelerinde Bir Uygulama, Dumlupınar Üniversitesi, Sosyal Bilimler Dergisi 54. Sayı, 56-76.

Freije, I., de la Calle, A. & Ugarte, J. V. (2022). Role of supply chain integration in the product innovation capability of servitized manufacturing companies. Technovation, 118, 102216. https://doi.org/10.1016/j.technovation.2020.102216

Görçün, Ö. F., Aytekin, A., Korucuk, S. & Tirkolaee, E. B. (2023). Evaluating and selecting sustainable logistics service providers for medical waste disposal treatment in thehealthcare industry. Journal of Cleaner Production, 408, 137194.

Hezam, I. M., Rani, P., Mishra, A. R. & Alshamrani, A. (2023). Assessment of autonomous smart wheelchairs for disabled persons using hybrid interval-valued Fermatean fuzzy combined compromise solution method. Sustainable Energy Technologies and Assessments, 57, 103169.

Hendricks, K. B. & Singhal, V. R. (2005). An Empirical Analysis of The Effect of Supply Chain Disruptions on Long-Run Stock Price Performance and Equity Risk of The Firm. Production and Operations Management, 14(1), 35-52.

Ho, W., Zheng, T., Yıldız, H. & Talluri, S., (2015). Supply Chain Risk Management: A Literature Review. International Journal of Production Research, 53(16), 5031- 5069.

Hu, M. & Monahan, S.T., (2015). Sharing Supply Chain Data in the Digital Era, MIT Sloan Management Review, 57 (1), 95-96.

Jeevaraj, S. (2021). Ordering of interval-valued Fermatean fuzzy sets and its applications. Expert Systems with Applications, 185, 115613.

Kamble, S. S., Gunasekaran, A., Parekh, H. & Joshi, S. (2019). Modeling the internet of things adoption barriers in food retail supply chains. Journal of Retailing and Consumer Services, 48, 154-168. https://doi.org/10.1016/j.jretconser.2019.02.020

Kamble, S. S., Gunasekaran, A., Subramanian, N., Ghadge, A., Belhadi, A. & Venkatesh, M. (2023). Blockchain technology's impact on supply chain integration and sustainable supply chain performance: Evidence from the automotive industry. Annals of Operations Research, 327(1), 575-600.

Keršuliene, V., Zavadskas, E. K. & Turskis, Z. (2010). Selection of rational dispute resolution method by applying new step-wise weight assessment ratio analysis (SWARA). Journal of Business Economics and Management, 11(2), 243-258.

Kim, D, Y., (2013). Relationship between supply chain integration and performance. Operations Managemenet Research, 6, 74–90. https://doi.org/10.1007/s12063-013-0079-0

Korpela, K., Salonen, A., Virta, L.J., Kekkonen, R.A. & de Vos, W.M. (2016). Association of early-life antibiotic use and protective effects of breastfeeding: role of the intestinal microbiota. JAMA Pediatr. 170: 750–757.

Korpela, K., Hallikas J. & Dahlberg, T. (2017). Digital Supply Chain Transformation Toward Blockchain Integration. Proceedings of the 50th Hawaii International Conference on System Sciences, 4182-4191.

Korucuk, S. (2018). ÇKKV Yöntemleri İle İmalat İşletmelerinde TZY Performans Faktörlerinin Önem Derecelerinin Belirlenmesi ve En İdeal Rekabet Stratejisi Seçimi: Ordu İli Örneği . Dokuz Eylül Üniversitesi İktisadi İdari Bilimler Fakültesi Dergisi, 33(2), 569-593. 10.24988/deuiibf.2018332782.

Korucuk, S. & Erdal, H. (2018). AHP-VIKOR Bütünleşik Yaklaşımıyla Lojistik Risk Faktörlerinin ve Risk Yönetimi Araçlarının Sıralanması: Samsun İli Örneği, İşletme Araştırmaları Dergisi Journal of Business Research-Turk 10(3), 282-305.

Korucuk, S. & Memiş, S. (2018). Tedarik Zinciri Yönetimindeki Risk Faktörlerinin AHP ile Ölçülmesi: Erzurum İli Örneği, Bitlis Eren Üniversitesi Sosyal Bilimler Dergisi , 7(2), 1036- 1051.

Kumar, S., Raut, R. D., Agrawal, N., Cheikhrouhou, N., Sharma, M. & Daim, T. (2022). Integrated blockchain and internet of things in the food supply chain: Adoption barriers. Technovation, 118, 102589. https://doi.org/10.1016/j.technovation.2022.102589

Lu, D., Ding, Y., Asian, S. & Paul, S. K. (2018). From Supply Chain Integration to Operational Performance: The Moderating Effect of Market Uncertainty, Global Journal of Flexible Systems Management, 19(1), 3-20.

Munir, M., Jajja, M. S. S., Chatha, K. A. & Farooq, S. (2020). Supply Chain Risk Management and Operational Performance: The Enabling Role of Supply Chain Integration. International Journal of Production Economics, 227, 107667.

Özdemir, A. İ. & Doğan, N. Ö. (2010). Tedarik Zinciri Entegrasyonu ve Bilgi Teknolojileri . Erciyes Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 1(28), 19-41.

Prajogo, D. & Olhager, P. (2012). Supply Chain Integration and Performance: The Effects of Long-Term Relationships, Information Technology and Sharing, And Logistics Integration, Int. J. Production Economic (135), 514-522.

Prakash, S., Soni, G. & Rothore, A.P.S. (2017). Multi-Echelon Closed-Loop Supply Chain Network Design and Configuration Under Supply Risks and Logistics Risks, International Journal of Logistics Systems and Management, 28(1), 1742-7975.

Sabir, R. I. & Irfan, M. (2014). Levels & Barriers to Supply Chain Integration: A Conceptual Model of Supply Chain Performance. International Journal of Management Science and Business Administration, 1(1), 52-59.

Sodhi, M.S, Son, B. & Tang, C. (2012). Researchers' Perspectives on Supply Chain Risk Management, Production and Operations Management, 21(1), 1-13.

Tiwari, S. (2021). Supply Chain Integration And Industry 4.0: A Systematic Literature Review, Benchmarking: An International Journal, 28(3), 990-1030. https://doi.org/10.1108/BIJ-08-2020-0428.

Venkatesh, V. G., Zhang, A., Deakins, E., Mani, V. & Shi, Y. (2020). Supply chain Integration Barriers to Port-Centric Logistics—An Emerging Economy Perspective. Transportation Journal, 59(3), 215-253. https://doi.org/10.5325/transportationj.59.3.0215

Wang, M., Wu, Y., Chen, B. & Evans, M. (2020). Blockchain And Supply Chain Management: A New Paradigm for Supply Chain Integration and Collaboration. Operations and Supply Chain Management: An International Journal, 14(1), 111-122. http://doi.org/10.31387/oscm0440290

Xi, M., Fang, W. & Feng, T. (2023). Green Intellectual Capital And Green Supply Chain Integration: The Mediating Role Of Supply Chain Transformational Leadership, Journal of Intellectual Capital, 24(4), 877-899. https://doi.org/10.1108/JIC-12-2021-0333

Yuen, K. F. & Thai, V. (2017). Barriers to Supply Chain Integration in The Maritime Logistics Industry, Maritime Economics & Logistics, 19(3), 551-572.