Uluslararası Sosyal Bilimlerde Yenilikçi Yaklaşımlar Dergisi
International Journal of Innovative Approaches in Social Sciences 2023, Vol. 7 (4), 157-172
https://doi.org/10.29329/ijiasos.2023.628.1

Original article

Perception of Logistics 4.0: A Study of Supply Chain Department Employees[1]

Canan Gula [a] & Sena Erden Ayhün [b, *]

[a] Master's Degree in Business Management Program, Çanakkale Onsekiz Mart University, Çanakkale, Türkiye
[b] Department of Management and Organization, Çanakkale Vocational School of Social Sciences, Çanakkale, Türkiye

Abstract

The concept of Industry 4.0, which developed in parallel with the fourth industrial revolution, brought forward the digitalization of processes and automation of production models. The concept of Industry 4.0 led to an impact on sectors along with the latest information technologies while enabling the implementation of logistics 4.0 activities in the logistics sector. Logistics 4.0 stands out as a new paradigm of the logistics system that aims to respond effectively to customer needs and improve customer relationship management.

The objective of this study is to determine the Logistics 4.0 perceptions of white-collar employees working in supply chain management department in one of the leading organizations under the building products sector. For this purpose, a semi-structured interview was conducted with the participants on the basis of the questions determined in the literature and the data were collected accordingly. A total of 21 white-collar employees from supply chain departments participated in the study. The outputs of the study were created with the content analysis design, one of the qualitative analysis methods. As a result of the study, it is determined that Logistics 4.0 will provide great advantages to supply chain processes but also bring along some disadvantages. The study findings revealed that the sector will face a number of opportunities and threats as well as some strengths and weaknesses while transitioning to this process.

Keywords: Logistics 4.0, Industry 4.0, Supply Chain Management, Management.

Received: 26 October 2023 * **Accepted:** 18 December 2023 * **DOI:** https://doi.org/10.29329/ijiasos.2023.628.1

[1] This study was derived from the Executive MBA graduation project titled " A Research on the Awareness of Supply Chain Managers of Logistics 4.0", conducted by the Author 1 under the supervision of the Author 2

* **Corresponding author:**

Erden Ayhün Sena is Ph. D. Associate Professor in the Department of Management and Organization at Çanakkale Onsekiz Mart University in Çanakkale, Turkey. Her research interests strategic management,corporate governance and corporate social responsibility. She has lived, worked, and studied in Çanakkale, Türkiye.
Email: senaerden@comu.edu.tr

INTRODUCTION

The emergence of the Fourth Industrial Revolution, the rapid increase in the volume of world trade and growing competition led to the redefinition of the logistics sector, as in most sectors. The logistics sector draws attention as an area that has evolved throughout history by means of following social, industrial and technological changes. In parallel with the industrial revolutions, the revolutions in the logistics sector have improved from Logistics 1.0 to today's Logistics 4.0, along with social,demographic and market conditions.

The logistics sector, where products are transported, stored, loaded/unloaded and information services are delivered to the customer, is one of the most important sectors in which the industry 4.0 approach can be applied. A projection of the impact of Industry 4.0 on the industry stands out as Logistics 4.0 on supply chains. Logistics 4.0 enables the integration of both incoming and outgoing material flows into the business world with the help of digital supply chain, allowing to coordinate all processes in the best way possible.

The theoretical chapter of this study, which was formulated with the aim of determining the perceptions of white-collar employees employed in the supply chain department about logistics 4.0, provided information on the development of the Industry 4.0 and Logistics 4.0 concepts as well as explaining the studies conducted in the field of logistics 4.0 literature. For this purpose, a semi-structured interview was conducted with the participants on the basis of the questions determined in the literature and the data were collected accordingly. The outputs of the study were created with the content analysis design, one of the qualitative analysis methods. Within the scope of the study, the strengths, weaknesses, opportunities and threats brought about by logistics 4.0 activities were identified, and in addition, the advantages and disadvantages of logistics 4.0 were determined.

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

Concept of Industry 4.0

The fourth industrial revolution brought about a series of disruptive changes in both business models and the production chains that supported them. The fourth industrial revolution is characterized by its speed, magnitude and depth (FAL Bulletin, 2019: 1). The concept of Industry 4.0, which developed in coordination with the fourth industrial revolution, represented the most up-to-date period of industrial transformation with introduction of digitalizing processes and the automation of production models. This novel period of the production industry combined the most current information technologies with various manufacturing processes and more specificallywith logistics processes (El Hamdi and Abouabdellah, 2022: 1). Given that the first study on the principles and context of the Industry 4.0 concept was published by Kagerman in 2011 (Alçın, 2016: 21), the spread of this concept in the global arena accelerated when the German National Academy of Science and Engineering

(ACADECH, 2013: 5) published the subject as a "manifesto" and designated this approach as the official industrial policy.

Industry 4.0 enabled the fostering and development of new technologies such as Nano, 3D printing, molecular biological technology, genetic technology, and artificial intelligence. Industry 4.0 eliminated all boundaries between physics, biology and digital technique through the combination of virtual system and objects, led to an impact in all areas from the production system, management, corporate governance to the entire country's economy and labor market, and allowed businesses to increase the efficiency of their activities (Khiem, 2018: 228-229). Industry 4.0 focuses on merging internet-based communication technologies, digitalization and future-oriented smart production technologies with the aim of creating intelligent machines and systems, implementing intelligent processes and offering intelligent products and services (Sun et al., 2021: 5). In short, Industry 4.0 is defined as the application of cyber-physical systems to production systems (Drath and Horch, 2014: 56). Eliminating failures, optimizing decision-making, ensuring productivity and efficiency, and reducing energy costs in the demand chain stand out as the prominent benefits of Industry 4.0 (Mrugalska and Wyrwicka, 2017: 470).

Concept of Logistics 4.0

The logistics sector, which has recently shown a great advancement in the world, is important for the national economies. Manufacturing companies procure raw materials thanks to their logistics activities, and deliver their products to end users by processing these raw materials through their production operations. Logistics broadly refers to the courses of ensuring the knowledge flow from the raw-material source to the end point, where the act of consumtion takes place, and planning and controlling this entire process both efficiently and cost-effectively through warehousing and stock amenities (Sezer and Abasiz, 2017: 11). Logistics is the planning, implementation and control of efficient flow processes and storage of goods and services from the outsourced point of origin to the enterprise and from the enterprise to the consumption point in order to meet customer needs (Winkelhaus and Grosse, 2020: 18).

When we examine the literature, it is understood that Logistics 4.0 concept first appeared in 2011 as a counterpart and basis of Industry 4.0 in logistics. The application of Industry 4.0 to the logistics sector is referred to as "Logistics 4.0" (Radivojević and Milosavljević, 2019:286). Logistics 4.0 means "the logistics system that enables individualized customer demands are being met sustainably without incremental costs and backs up this industry and trade related advancement by making use of digital technologies". While this explanation, associates Logistics 4.0 with certain market elements such as sustainability and individualized demand, it also entails uncertainty about the "digital technologies" that are necessary for their implementation (Perotti et al., 2022: 195).

The holistic approaches of Industry 4.0 paved the way for the development of products, services, standards and application techniques. This period of digitalization did not only affect manufacturing and service dynamics, but also introduced cutting-edge aspects to the management of logistics and supply chain. Today's competitive environment allows businesses, which have to respond rapidly to consumers' demands, to adapt to Logistics 4.0 and intelligent/digital supply chain technologies and approaches. Technologies such as Internet of Things (IoT), cyber-physical systems, big data and cloud computing help improve the processes for all industries such as those in the logistics sector (Özdağoğlu and Bahar, 2022: 163). The orientation towards Logistics 4.0 as an element of Industry 4.0 offers opportunities for new business models as well. Some features of Logistics 4.0 that pave the way for new business models include instant information exchange, automated solutions and real-time big data analysis (Strandhagen et. al, 2017: 359).

Logistics 4.0 stands out as a new paradigm of the logistics system that aims to respond effectively to customer needs, improve customer relationship management and optimize customer relationships. In order to implement the Logistics 4.0 concept in an optimal, realistic and effective way, it must be based on resource planning, transportation management system, warehouse management system, intelligent traffic system and information security applications (Anbouri and Benabdehaldi, 2022: 112). Logistics 4.0 is an outcome of the increase in the use of the internet and the use of advanced digitalization, which provides real-time communication between machines and humans. An efficient and powerful Logistics 4.0 should be grounded on and make use of resource planning, storage management systems, transportation management systems, smart transportation systems and information security technological applications (Barreto et al., 2017: 1248).

Logistics 4.0 works integrated with the internet and the software systems based on the latest information technologies. On the other hand, logistics management also enables activities for the realization of goods flows and information flows (Oleśków-Szłapka and Stachowiak 2019: 776): Automated identification technologies, real-time positioning, smart detection, networking, data analysis and business services are components of Logistics 4.0 (Wang, 2016: 70). Logistics 4.0 provides automated identification of all objects and participants in logistics processes, collection of real-time data, planning and optimization of quality management. In addition, logistics 4.0 builds up conditions for data processing and analysis, new information, smart management and new business services (Radivojević and Milosavljević, 2019: 287).

Literature Review

Ekincioğlu (2019) recommends that businesses operating in the logistics sector should recruit and train qualified personnel within the framework of the effects of industry 4.0 on profitability, cost, labor and investment. Karagöz and Bumin Doyduk (2020) declared that enterprises with or without logistics 4.0 practices have awareness about the importance of these practices. Szczupak (2022: 95)

reported that the activities of logistics companies that are obliged to adapt to the changing economic reality in parallel with the processes of Industry 4.0 were influenced. In the model proposed by Saniuk (2022: 198), it was informed that solutions that support the implementation of logistics 4.0, enhance implementation efficiency and reduce the risk of liquidity loss are important, and it was indicated that this model allows the implementation of Logistics 4.0 to be easily monitored and controlled with an increased efficiency. In addition, Richnák (2022: 1) stated that businesses face investment costs, which constitute the biggest obstacle when implementing Industry 4.0 in logistics. Moreover, in the literature, Malagón-Suárez and Orjuela-Castro (2023: 1) proclaimed that the integration of businesses facing technical, social, economic and legal obstacles in the implementation of Logistics 4.0 was prevented.

Bianchi et al. (2021) revealed that the use of technologies such as Big Data, Internet of Things (IoT), Artificial Intelligence (AI), and Blockchain in logistics 4.0 practices allows for organizational growth and contributes to increased productivity and efficiency in operations carried out by service-providing businesses. Gönçer Demiral (2021) categorized the technologies influencing the development of logistics as mature, growing, evolving and exponential technologies. Çağlar (2014) offered suggestions on the benefits that businesses will gain in performance indicators thanks to the support of the activities implemented in the logistics sector with information technologies. Büyüközkan and Güler (2019) found out that the effects of big data and internet of things technologies are important for businesses operating in the logistics sector considering their expectations.

Ghadge et al. (2020) proposed a conceptual model for the successful implementation and acceleration of Industry 4.0 in supply chains. The research findings predicted that Industry 4.0 would bring along new challenges and opportunities for future supply chains. Jepherson et al. (2021) determined that transportation management systems positively and significantly affected the supply chain performance of fast-moving consumer goods. Sayın and Irklı (2020) stated that the use of information technologies in logistics activities leads to performance-enhancing effect on all organizational chains in businesses. Bukova et al. (2018) expanded the basic production factors with a new term "knowledge" and introduced a new definition of logistics with Industry 4.0. Karunarathna et al. (2019) aimed to determine the ways of storage process improvements by making use of logistics 4.0 technologies. Oleśków-Szłapka and Stachowiak (2019) created the Logistics 4.0 Maturity Model in order to improve businesses operating in the logistics sector. Göçmen and Erol (2018) investigated the Industry 4.0 approach within the scope of transportation, storage, loading/unloading and information services processes.

METHODOLOGY

Objective and Importance of the Study

Logistics 4.0 practices allow for the coordination of all processes by integrating both incoming and outgoing material flows into the business world with the help of digital supply chain. Digital supply chains make it possible that the correct product is delivered to the customer at the right place, at the right time and at the right price at the lowest possible cost throughout the entire supply chain. In other words, digital supply chains contribute to increasing customer satisfaction by enabling the integration of basic business processes. In this context, the perceptions of white-collar employees working in the supply chain departments about these technologies will contribute to the determination of the strengths, weaknesses, opportunities and threats of the sector. Based on this determination, senior managers working in businesses, on the other hand, will be able to develop strategies to further improve the strengths of their businesses, prevent their weaknesses, seize opportunities and prevent the dimensions that threaten them by taking into account the said conditions of the sector.

The objective of this study is to determine the Logistics 4.0 perceptions of white-collar employees working in supply chain management department in one of the leading organizations under the building products sector.

For this purpose, the research questions were formulated as follows:

1. What are the advantages of Logistics 4.0 practices?
2. What are the disadvantages of Logistics 4.0 practices?
3. What are the strengths of Logistics 4.0 practices from the perspective of the sector?
4. What are the weaknesses of logistics 4.0 practices from the perspective of the sector?
5. What are the opportunities that Logistics 4.0 practices will bring about from the perspective of the sector?
6. What are the threats of logistics 4.0 practices for the sector?

Sample of the Research

This research was conducted on white-collar employees working in supply chain management department in one of the leading organizations under the building products sector. For this purpose, a semi-structured interview was conducted with the participants on the basis of the questions determined in the literature and the data were collected accordingly. A total of 21 white-collar employees from supply chain departments participated in the study.

Data Collection Tool and Data Collection

In the study, semi-structured interview form was used as data collection tool. When formulating the interview form, a wide literature review was conducted and the most emphasized topics in the

literature were identified, then, questions parallel to these topics were developed. Before the interview questions, all participants were informed about the objective and method of the study and it was declared that all personal data would be kept confidential after the interview. Data were kept by note-taking method during the interviews.

Data Analysis

For the analysis of the data obtained from the study, codes were created and then, content analysis method was implemented. Content analysis, on the other hand, is one of the most commonly implemented methods among qualitative data analysis types. Content analysis is a method used mainly in the analysis of written and visual data. (Özdemir, 2010: 335).

All coding and analysis processes of the study are performed with the MAXQDA Analytics Pro 2020 software, which is a computer-aided qualitative and mixed data analysis program. Ongoing developments all over the world and in our country, especially within the perspective of qualitative research, now make it necessary to implement such professional software. MAXQDA has been used by researchers since 1989 and is an important and up-to-date software that is still being worked on with the aim of optimizing for the nature of qualitative research.

FINDINGS

This part of the study includes the findings obtained as a result of the research. Information on the participants is shown in Table 1.

Table 1. Information on the Participants

Features	Information	Number	Percentage (%)
Gender	Female	5	24
	Male	16	76
Age Range	25-29	2	10
	30-34	3	14
	35-39	5	24
	40+	11	52
Education	College	1	5
	Bachelor's Degree	15	71
	Postgraduate Degree	5	24
Working period	Less than 5 years	4	19
	6-10 years	6	29
	11-15 years	4	19
	16 + years	7	33
Manager's total term of office	1-10	5	34
	11-20	6	40
	21-30	2	13
	31-40	2	13

Findings on the Advantages of Logistics 4.0 Practices

Following opinions are expressed within the scope of the advantages of logistics 4.0 practices: *"Digitalization in archival storage, integration between sector organizations, inter-system integration, labor force efficiency, effective process management, market share increase, full automation, total benefit for all stakeholders, information security, error minimization, transparency, effective communication systems, data analysis, effective resource utilization, increased profitability, speed, increased customer satisfaction, operational traceability"*. Figure 1 shows Advances of Logistics 4.0 Practices.

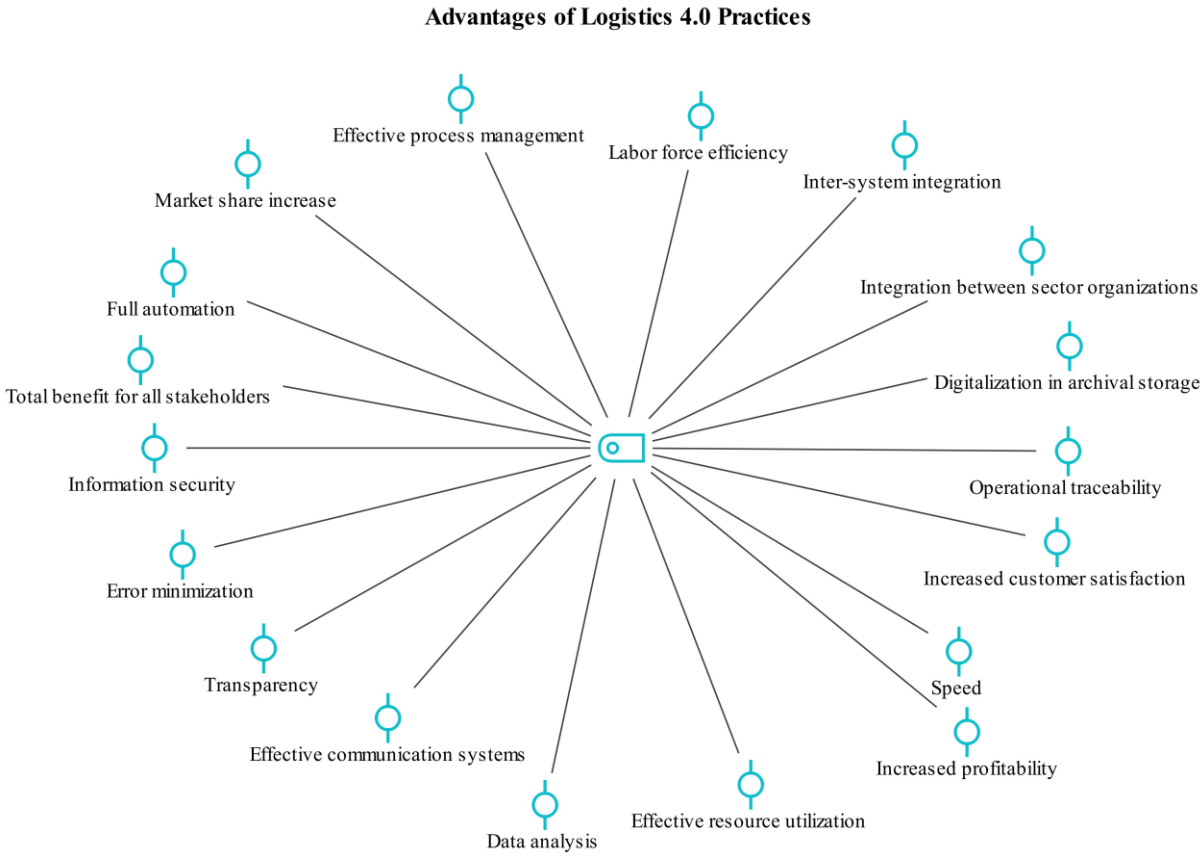

Figure 1. Advances of Logistics 4.0 Practices Sources: developed by authors

Findings on the Disadvantages of Logistics 4.0 Practices

For the disadvantages of Logistics 4.0 practices following opinions are listed; *"Integration problems, technological inadequacies, high investment costs, infrastructure requirements, prejudices, differences in awareness levels in the sector, training requirements, accurate data generation and transfer to the operation and customers, difficulty in integrating all stakeholders into the system, increases in logistics costs in the short term, security problems (magnetic effects, power outages, data loss, cyber-attacks)"*. Figure 2 shows Disadvances of Logistics 4.0 Practices.

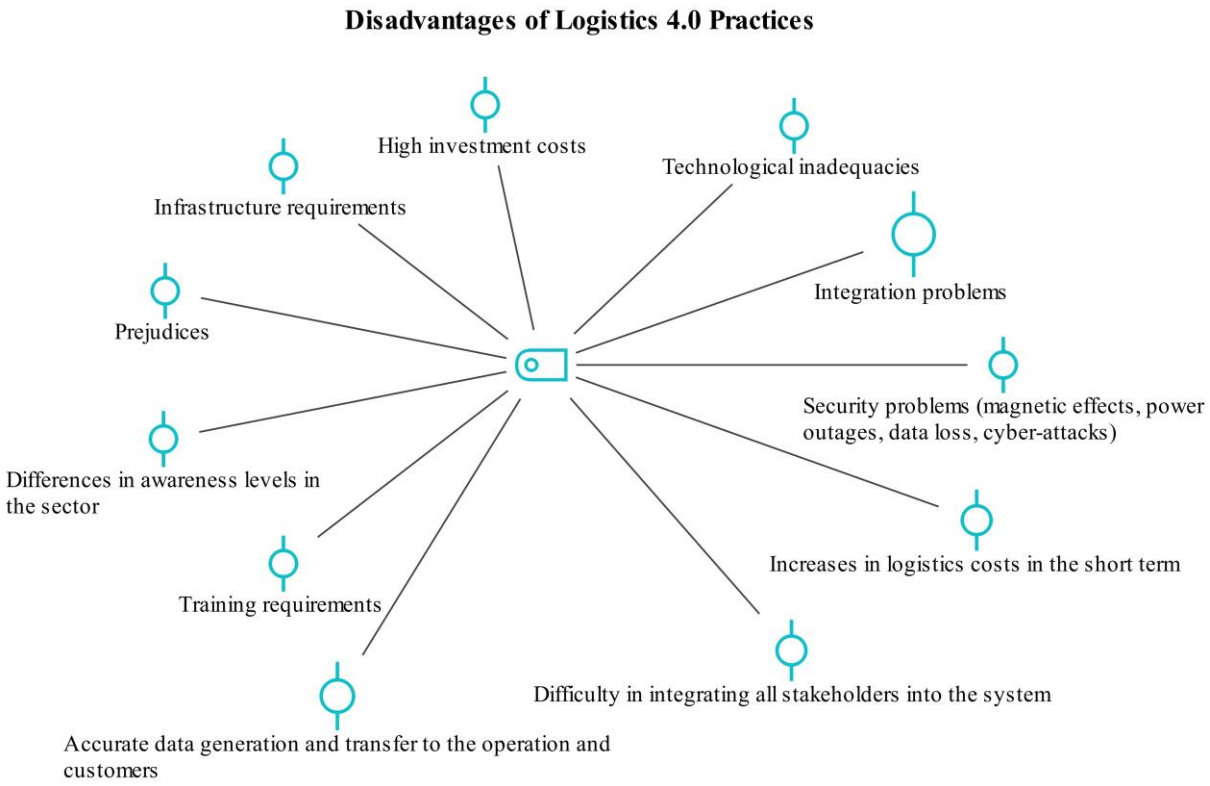

Figure 2. Disadvances of Logistics 4.0 Practices Sources: developed by authors

Findings on the Sectoral Strengths of Logistics 4.0 Practices

"The existence of blockchain initiatives, the presence of start-up companies in digitalization in Turkey, the presence of many companies in the sector having a say in the world market, the existence of well-established companies, specialized production, competent human resources in Turkey, the start of digitalization in transportation, good condition of the sector in terms of storage" are stated within the scope of the strengths of logistics 4.0 practices for the sector. Figure 3 shows sectoral strengths of logistics 4.0 practices.

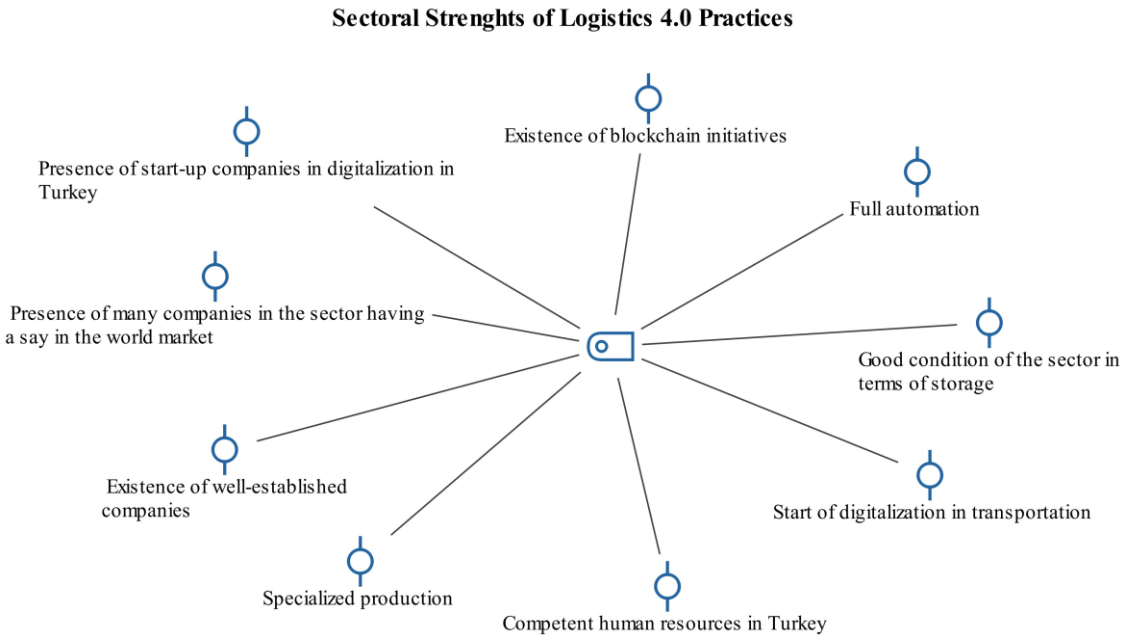

Figure 3. Sectoral Strenghts of Logistics 4.0 Practices Sources: developed by authors

Findings on the Sectoral Weaknesses of Logistics 4.0 Practices

The issues of "*infrastructure deficiencies, stock diversity, low product added value, traditionalist approach, logistics being a sector that is desired to be low-cost, logistics being a labor-intensive sector*" are listed among the weaknesses of logistics 4.0 practices for the sector. Figure 4 shows sectoral weaknesses of logistics 4.0 practices

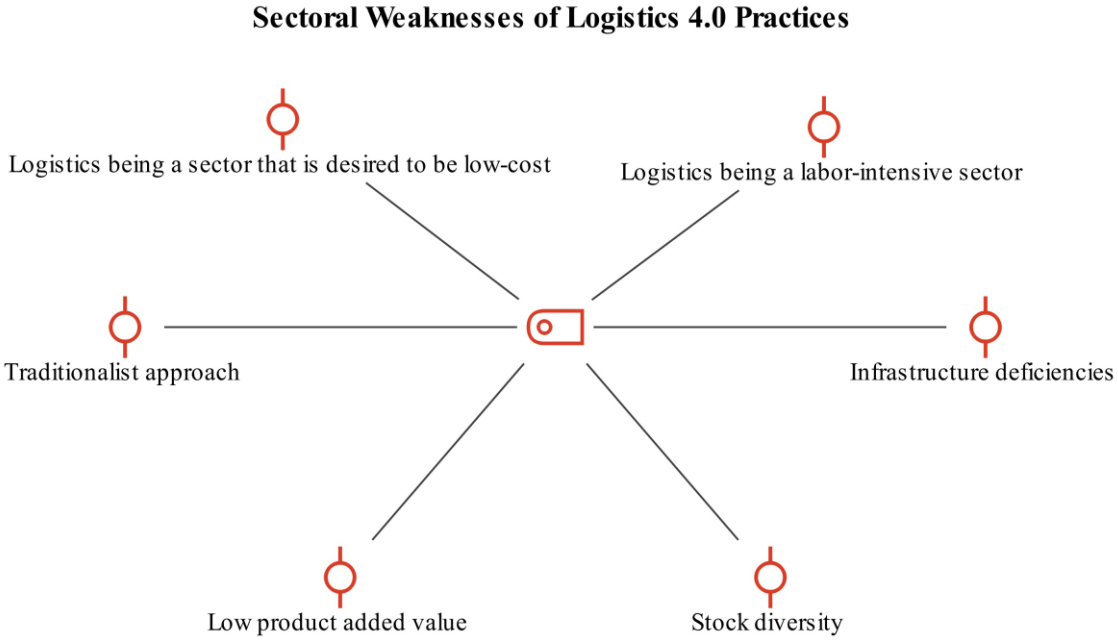

Figure 4. Sectoral Weaknesses of Logistics 4.0 Practices Sources: developed by authors

Findings on the Sectoral Opportunities of Logistics 4.0 Practices

The opinions such as "*employee efficiency, reduction of human-driven errors, integration between all stakeholders, increasing service quality, reducing costs in the long term, increase in sector market share, customer orientation towards digitalization, simultaneous communication, end-to-end supply chain management"* are specified within the scope of the sectoral opportunities of logistics 4.0 practices. Figure 5 shows sectoral opportunities of logistics 4.0 practices

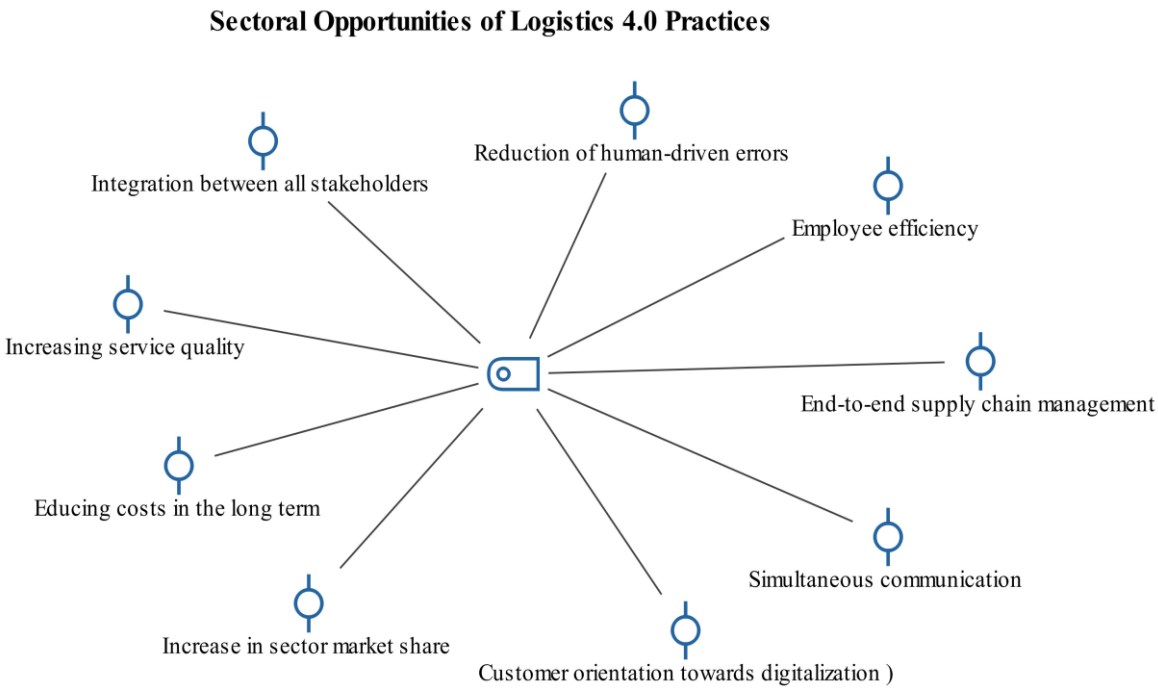

Figure 5. Sectoral Opportunities of Logistics 4.0 Practices Sources: developed by authors

Findings on the Sectoral Threats of Logistics 4.0 Practices

"*Security threats, integration problems among all stakeholders, employment concerns among employees, increased level of complexity, changing purchase behavior of customers, increase in logistics costs, higher transition investment costs*" are expressed within the scope of the sectoral threats of Logistics 4.0 practices. Figure 6 shows sectoral threats of logistics 4.0 practices.

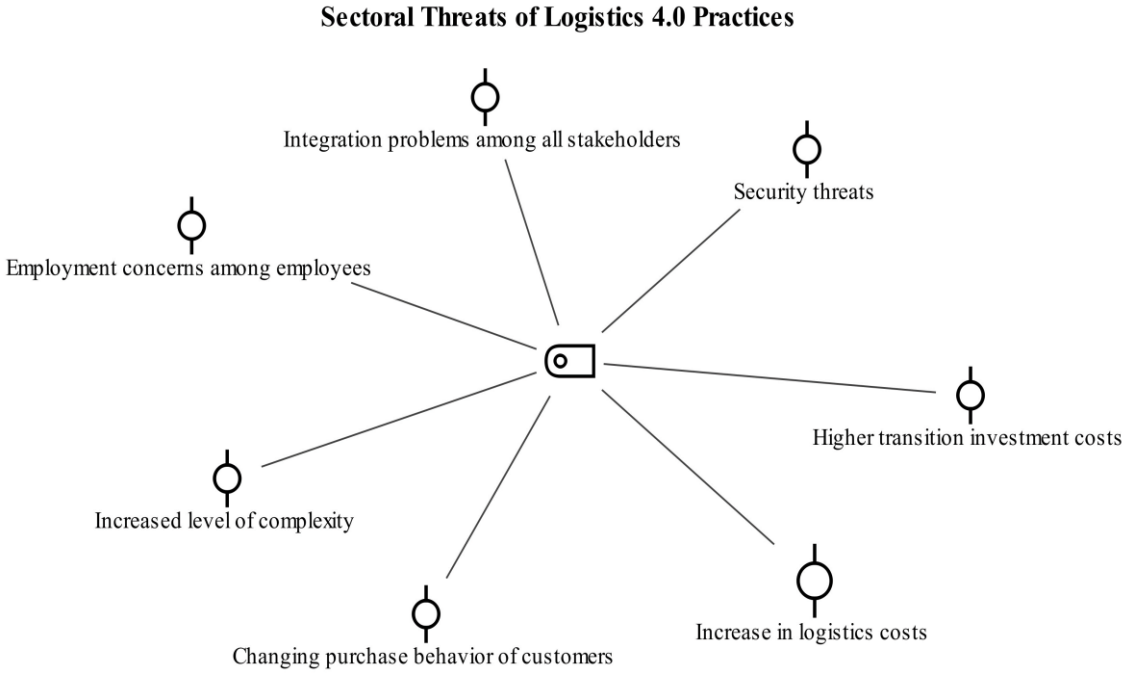

Figure 6. Sectoral Threats of Logistics 4.0 Practices Sources: developed by authors

CONCLUSION AND RECOMMENDATIONS

Technology is constantly evolving in every field with the effect of changing customer demands and purchasing behaviors, increasing customer awareness, and growing number of businesses in the sector with globalization. There is no doubt that this will harm the businesses failing to keep up with these changes and open up to foreign markets from their local markets. The supply chain is of great importance in all processes between businesses' procurement of raw materials for manufacturing products and delivery of the sold product to the customer. On the other hand, logistics, which is one of the most significant building blocks of the supply chain, has become even more important in the conditions of increasing competition both pre-and post-production.

Advances taking place in information and communication technologies have affected every sector and led to significant changes and transformations in the logistics sector as well. The concept of Industry 4.0, which developed in parallel with the fourth industrial revolution, has enabled the digitalization of processes, and these new information technologies have had an impact on logistics processes as well as various production processes today. The orientation towards Logistics 4.0 as an element of Industry 4.0 has paved the way for new business models (Strandhagen, 2017), and the foundations of logistics and supply chain have undergone change with technologies such as internet of things (IOT), cyber-physical systems, big data and cloud computing. Logistics 4.0 processes, which involve features such as enabling instant information exchange, generating automated solutions and offering real-time big data analysis, contribute positively to the sector (Özdağoğlu & Bahar, 2022).

However, Richnák (2022: 1) claimed that enterprises face investment costs, which is the biggest obstacle when implementing Industry 4.0 in logistics, and Malagón-Suárez and Orjuela-Castro (2023: 1) mentioned the negativities of logistics 4.0 practices by indicating that the integration of enterprises facing technical, social, economic and legal obstacles in the implementation of logistics 4.0 to their supply chains is prevented.

This study aimed to determine the perceptions of white-collar employees in the supply chain department of Logistics 4.0. The study findings supported the previously conducted studies and revealed that logistics 4.0 practices will lead to both positive and negative perceptions by the employees. In particular, the features such as speed, transparency, error minimization, increased profitability and customer satisfaction brought about by technological developments, digitalization and inter-system integration in archiving, contribution to workforce efficiency, effective process management, market share increase, information security, transparency, data analysis and effective resource use are specified within the scope of the advantages of logistics 4.0. However, the issues of "integration problems, technological inadequacies, high investment costs, infrastructure requirements, prejudices, differences in awareness levels in the sector, training requirements, accurate data generation and transfer to the operation and customers, difficulty in integrating all stakeholders into the system, increases in logistics costs in the short term, security problems (magnetic effects, power outages, data loss, cyber-attacks)" are stated within the scope of the disadvantages of logistics 4.0 practices.

In the study, the strengths and weaknesses, opportunities and threats of logistics 4.0 practices from the perspective of the sector were also determined. Accordingly, the existence of blockchain startups, the presence of both start-ups and well-established enterprises in digitalization in Turkey, the availability of competent human resources and the digitalization of transportation and the good condition of the sector in terms of storage are listed within the scope of the strengths of logistics 4.0 practices for the sector. Both digital business applications and the availability of competent human resources in the field are put forward as important variables that can enhance the success of logistics 4.0 practices. According to the study, following issues are listed as the weakness indicators: there is lack of infrastructure, stock diversity, low product added value and logistics is a labor-intensive sector that is desired to be low-cost.

Customers' current orientation towards digitalization, increases in market shares and employee productivity enabled by logistics 4.0 activities, decrease in human-driven errors, integration between all stakeholders, increase in service quality, decrease in costs in the long term and allowing for simultaneous communication are specified within the scope of the opportunities of logistics 4.0 practices. The high complexity levels of Logistics 4.0 practices, causing employment concerns for employees, changing purchasing behaviors of customers, security threats, integration problems between all stakeholders,

increasing complexity level, increase in logistics costs, higher transition investment costs are stated as the threats of logistics 4.0 practices for the sector.

The studies conducted in the literature demonstrate that the number of studies on logistics 4.0 practices in enterprises has been increasing in parallel with the advancement of Industry 4.0. The study in question has contributed to the literature in terms of conducting a situation analysis of the sector, along with the advantages and disadvantages that logistics 4.0 activities will bring along. The most important constraint in the research is that the study address only the opinions of the employees in the supply chain department of one company on Logistics 4.0. In this context, the future studies are recommended to expand the sample by conducting research on different sample groups.

REFERENCES

ACATECH (2013). Acatech: Recommendations for Implementing the Strategic Initiative Industrie 4.0, Final Report of the Industry 4.0 Working Group.

Alçın, S. (2016). Üretim İçin Yeni Bir İzlek: Sanayi 4.0. Journal of Life Economics, 3(2), 19-30.

Anbouri, O., & Benabdelhadi, A. (2022). Implications of The Industry 4.0 in Logistics Operations. International Journal of Accounting, Finance, Auditing, Management and Economics, 3(6-1), 106-119.

Barreto, L., Amaral A., & Pereira, T. (2017). Industry 4.0 Implacations in Logistics: an Overview, Manufacturing Engineering Society International Conference 2017, MESIC 2017, 28-30 June 2017, Vigo (Pontevedra), Spain Procedia Manufacturing 13, 1245–1252.

Bianchi, R. C., Henrique, A. D., Hollveg, S. D. S., & Zonatto, P. A. F. (2021). Logistics 4.0 in Organizations: a Theoretical Approach. South Florida Journal of Development, 2(2), 1266-1284.

Bukova,B., Brumercikova,E.,Cerna,L. ve Drozdziel,P.(2018). The Position of Industry 4.0 in the Worldwide Logistics Chains. LOGI – Scientific Journal on Transport and Logistics, 9(1) 18-23.

Büyüközkan, G. ve Güler, M. (2019). Lojistik 4.0 Teknolojilerinin Analizi için Metodolojik Yaklaşım. Journal of Entrepreneurship and Innovation Management, 8(1), 21-47.

Çağlar, B. (2014). Lojistik İşletmelerinde Bilişim Teknolojilerinin Kullanımı, Müşteri Memnuniyeti ve İşletme Performansı İlişkisi: Bir Araştırma. Selçuk Üniversitesi Sosyal Bilimler Enstitüsü Dergisi , (32) , 41-55.

Drath R., Horch, A. (2014). Industrie 4.0: Hit or Hype, IEEE Industrial Electronics Magazine, 8(2), 1-16.

Ekincioğlu, O. (2019). Lojistik Yöneticilerinin Endüstri 4.0'ın İşletme Düzeyindeki Etkilerine İlişkin Görüşleri Üzerine Nitel Bir Araştırma: Bursa Örneği. Yayınlanmamış Yüksek Lisans Tezi. Celal Bayar Üniversitesi Sosyal Bilimler Enstitüsü Uluslararası Ticaret ve Finans Anabilim Dalı, Manisa.

El Hamdi, S., & Abouabdellah, A. (2022). Logistics: Impact of Industry 4.0. Applied Sciences, 12(4209), 1-17.

FAL Bulletin (2019). Industry 4.0 and the Emergence of Logistics 4.0. Number: 7, 1-15. https://repositorio.cepal.org/server/api/core/bitstreams/b5b219d2-c4dc-49ee-b9f2-20446556aab9/content.

Ghadge, A., Er Kara, M., Moradlou, H., & Goswami, M. (2020). The impact of Industry 4.0 Implementation on Supply Chains. Journal of Manufacturing Technology Management, 31(4), 669-686.

Göçmen, E , Erol, R . (2018). The Transıtıon To Industry 4.0 In One Of The Turkısh Logıstıcs Company . International Journal Of 3d Printing Technologies and Digital Industry , 2(1) , 76-85 .

Gönçer Demiral, D. (2021). Endüstri 4.0'ın Lojistik Boyutu: Lojistik 4.0. IBAD Sosyal Bilimler Dergisi, (9), 231-251.

Jepherson, M. E., Ngugi, P. K., & Moronge, M. (2021). Effect of Transportation Management Systems on Supply Chain Performance of FMCG In Kenya. American Journal of Supply Chain Management, 6(1), 1-12.

Karagöz, B. ve Bumin Doyduk, H. (2020). Lojistik 4.0 Uygulamaları ve Lojistik Firmalarının Bakış Açısı. İnsan ve İnsan, 7(23) , 37-51.

Karunarathna, N., Wickramarachchi, R., ve Vidanagamachchi, K. (2019). A Study of the Implications of Logistics 4 . 0 in Future Warehousing : A Sri Lankan Perspective.

Khiem, B.B. (2018). Industry 4.0 Impact on Logistics in Vietnam, International Journal of Economics, Business and Management Research, 2(1), 227-234.

Malagón-Suárez, C. P., & Orjuela-Castro, J. A. (2023). Challenges and Trends in Logistics 4.0. Ingeniería, 28, 1-28.

Mrugalska, B., Wyrwicka, M.K. (2017). Towards Lean Production in Industry 4.0, Procedia Engineering, 182, 466-473.

Oleśków-Szłapka J. ve Stachowiak A. (2019). The Framework of Logistics 4.0 Maturity Model. In: Intelligent Systems in Production Engineering and Maintenance. ISPEM 2018. Advances in Intelligent Systems and Computing, 835. Springer, Cham.

Özdağoğlu, A. and Bahar, S. (2022), "Logistics 4.0 and Smart Supply Chain Management", Yakut, E. (Ed.) Industry 4.0 and Global Businesses, Emerald Publishing Limited, Bingley, 163-183. https://doi.org/10.1108/978-1-80117-326-120211012.

Özdemir, M. (2010). Nitel Veri Analizi: Sosyal Bilimlerde Yöntembilim Sorunsalı Üzerine Bir Çalışma, Eskişehir Osmangazi Üniversitesi Sosyal Bilimler Dergisi, 11(1), 323-343.

Perotti, S., Santacruz, R. F. B., Bremer, P., & Beer, J. E. (2022). Logistics 4.0 in Warehousing: A Conceptual Framework of Influencing Factors, Benefits and Barriers. The International Journal of Logistics Management, 33(5), 193-220.

Radivojević, G. ve Milosavljević (2019). “The Concept Of Logıstıcs 4.0”4th Logistics International Conference, Belgrade, Serbia, 23-25 Mayıs 2019.

Richnák, P. (2022). Current Trend of Industry 4.0 in Logistics and Transformation of Logistics Processes Using Digital Technologies: An Empirical Study in the Slovak Republic. Logistics, 6(79), 1-21.

Saniuk, A. (2022). The Logistics 4.0 Implementation Supported by the Balanced Scorecard Method. European Research Studies Journal, 15(1), 198-207.

Sayın, A. A. ve Irklı K. (2020). Lojistik Faaliyetlerde Bilişim Teknolojileri Kullanılmasının Üretim İşletmesi Organizasyonuna Etkisi, Turkish Studies - Economy, Finance, Politics, 15(1), 519-540.

Sezer, S., & Abasiz, T. (2017). The Impact of Logistics Industry on Economic Growth: An Application in OECD Countries. Eurasian Journal of Social Sciences, 5(1), 11-23.

Strandhagen, J. O., Vallandingham, L. R., Fragapane, G., Strandhagen, J. W., Stangeland, A. B. H., & Sharma, N. (2017). Logistics 4.0 and Emerging Sustainable Business Models. Advances in Manufacturing, 5, 359-369.

Sun, X., Yu, H., Solvang, W. D., Wang, Y., & Wang, K. (2021). The Application of Industry 4.0 Technologies in Sustainable Logistics: A Systematic Literature Review (2012–2020) to Explore Future Research Opportunities. Environmental Science and Pollution Research, 1-32.

Szczupak, L. (2022). The Impact of 'Industrial Revolution 4.0'on Logistics Companies' Operations. European Research Studies Journal, 15(3), 95-106.

Winkelhaus, S., & Grosse, E. H. (2020). Logistics 4.0: A Systematic Review Towards a New Logistics System. International Journal of Production Research, 58(1), 18-43.

Wang, K. (2016). Logistics 4.0 Solution New Challenges and Opportunities, Proceedings of the 6th International Workshop of Advanced Manufacturing and Automation-IWAMA, 68-74, Manchester, UK, 10-11 Kasım 2016.