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Exploring The Urgency For Shifting From Industry 4.0 To Industry 5.0: A Swot Analysis Of Turkey's Supply Chain Management Strategy

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Abstract

This research focuses on highlighting the critical value that Artificial intelligence and robotic innovations contribute to the Logistics industry across various operational levels. In response to the pressures of an increasingly interconnected and competitive global market, the study seeks to uncover how these advancements can generate efficiency and cost reduction in logistics processes by offering forward-looking insights. Additionally, it addresses the evolving nature of Supply Chain Management (SCM) strategies, especially in light of the disruptions caused by the COVID-19 pandemic, which has reshaped global logistics demands. A Multi-Criteria Decision Making Method forms the basis of the analytical framework. The evaluation begins with a historical perspective on industrial progress—from the origins of mechanized production to the emergence of Industry 4.0—emphasizing the pressing need to move toward Industry 5.0. Ultimately, a detailed SWOT analysis is conducted to assess Turkey's SCM strategy, identifying the internal capabilities and external conditions shaping its performance.

Keywords: Logistics industry, Artificial intelligence, A.I. technology, Logistics, SWOT analysis

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Introduction

The rapid progression of Digital Transformation across the globe has significantly expanded the application of A.I. technology and robotic systems—two defining elements of the Fourth Industrial Revolution (4IR)—into a wide array of industries. In particular, their integration into the Logistics industry has gained considerable momentum, where robots now perform essential functions such as transportation, warehousing, and product packaging. These machines, designed with human-like capabilities, are increasingly being incorporated into logistics operations, often with the capacity for autonomous decision-making and functional accountability. As a result, new challenges and research interests have emerged around the coordination and governance of robots within logistics services. The ongoing COVID-19 pandemic has further amplified favorable attitudes toward the deployment of such technologies in the sector.

Concurrently, the evolution of information technologies has initiated a profound shift in how logistics enterprises operate. The disruptive effects of the pandemic have accelerated the urgency for digital integration and technological innovation within these organizations. In response, this study draws attention to the relevance and strategic value of Logistics 4.0, a concept deeply influenced by 4IR trends. It aims to contextualize its significance within the broader timeline of industrial development while offering forward-looking perspectives.

Conceptually grounded and theory-based, this research presents an informative discussion enriched with examples from various industries that have adopted A.I. technology in their logistics frameworks. The objective is to interpret insights from existing literature that signal the transformative role of Artificial intelligence in shaping the future of logistics and to aid in forecasting emerging directions with greater accuracy.

Literature reviews

This research utilized a multi-criteria decision-making approach to evaluate advancements in the logistics sector, with a particular emphasis on the impact of the industrial revolutions. Statistical evaluations were conducted to assess the integration of artificial intelligence and robotic systems within logistics operations. Recommendations were formulated based on the outcomes of these analyses, and a comprehensive review of related literature was incorporated to support the discussion.

Modern developments in robotic technologies signify a new phase of industrial transformation. Enterprises across various industries are increasingly adapting to advancements in artificial intelligence and robotic systems to enhance efficiency, lower operational expenses, and strengthen their competitive stance [1]. The introduction of A.I. into commercial applications is reshaping operational models, especially in logistics. Key innovations include autonomous transport systems, warehouse automation with robotic mechanisms, and the use of data-driven logistics enhancements. Historical industrial shifts in logistics are marked by distinct revolutions [2]:

- The first industrial revolution marked the shift from manual and animal-based transportation to mechanical systems, introducing rail, sea, and road transport powered by machinery in the late 19th century.
- The second revolution emerged in the 1960s, where partial automation through logistics equipment improved storage and inventory processes.
- The third phase began in the 1980s, characterized by the formalization of logistics management through widespread use of information technology.
- The fourth revolution, which began around 2000, continues today, characterized by the digital transformation of logistics workflows.
- The fifth revolution, currently unfolding, envisions robots that replicate human capabilities, utilize cloud storage for data, and engage in inter-robot communication.

The logistics field encompasses several critical operations, including ordering, storage, packaging, shipping, inventory tracking, routing, and delivery. The term “robotic logistics” describes the application of robotics to one or more of these logistical activities. Among these, robotic technologies have found prominent roles in areas such as storage, order fulfillment, packaging, shipment preparation, and recycling. According to IFR (2018), some of the most prevalent robotic uses include[3]:

- Robotic palletizing: Robots are employed to load and unload products onto and from pallets.
- Robotic packaging: Robots manage both the initial packaging of goods and the repackaging of these goods into larger containers.
- Robotic collection: Robots retrieve and organize items from storage shelves.

The introduction of pallets revolutionized global logistics in the 1920s, significantly streamlining warehouse operations. Forklifts, which became prevalent by the 1950s, made the transport and storage of bulky items more manageable. The integration of industrial robots into palletizing tasks began in 1963, enabling suppliers to process customized mixed-product orders rather than bulk-only shipments. The growing prevalence of robotic packaging and distribution is driven by the expansion of e-commerce and global supply chain decentralization. Collaborative robots used for pallet-related tasks contribute to a competitive edge. Owen-Hill (2018) outlines seven top robotic applications in food packaging[4]:

- Positioning randomly oriented food items,
- Handling a variety of packaging types,
- Removing baked products from molds with precision,
- Discarding empty packaging and placing products into new ones,
- Inserting packaged items into shipping boxes,
- Preparing boxes for shipping via palletizing,
- Automating storage of products in centralized locations.

As robotic collection solutions evolve, their application is expected to substantially benefit supply chains. Collaborative robotic arms and mobile robots now support tasks from production to storage. The general consensus holds that robotic integration in logistics improves operational output, reduces human error, and increases workplace safety by minimizing exposure to labor-intensive and hazardous tasks. IFR (2019) identifies two primary drivers behind the rising demand for autonomous logistics systems[5]:

- The exponential growth of e-commerce has transformed product distribution, requiring more individualized packaging and fulfillment solutions, particularly for heavier goods.

- A persistent shortage of skilled labor has accelerated the adoption of robotics, particularly highlighted during the COVID-19 pandemic, where automation proved vital to logistics continuity.

Mobile robots are defined as systems capable of navigating autonomously to complete specific tasks [6]. They serve diverse roles, including automated guided vehicles (AGVs) in factories, autonomous exploration in military settings, pharmaceutical delivery in hospitals, and use in emergency response operations. First introduced in 1953, AGVs facilitate material movement within manufacturing or storage facilities. Common AGV types include tow vehicles for moving carts, unit loaders with integrated platforms for part transfers, and robotic forklifts. As these systems are adopted in sectors like healthcare and office environments, their application continues to broaden [7].

Contemporary load-handling robots utilize vision systems to interpret warehouse environments. They follow marked pathways and navigate using overhead barcodes, lasers, or reflectors. These technologies support product picking, packaging, palletization, and precise vehicle loading with minimal error margins. They are also used in tasks like structural inspection and targeted loading [7].

An innovative robotic concept involves a quadrupedal, parallel-configuration machine with locking joints and clamping mechanisms on each leg. This robot is designed for mobility across uneven surfaces and is capable of both locomotion and object manipulation. The CAD-based model enables it to lock passive joints as needed for stability and adaptability [8, 9].

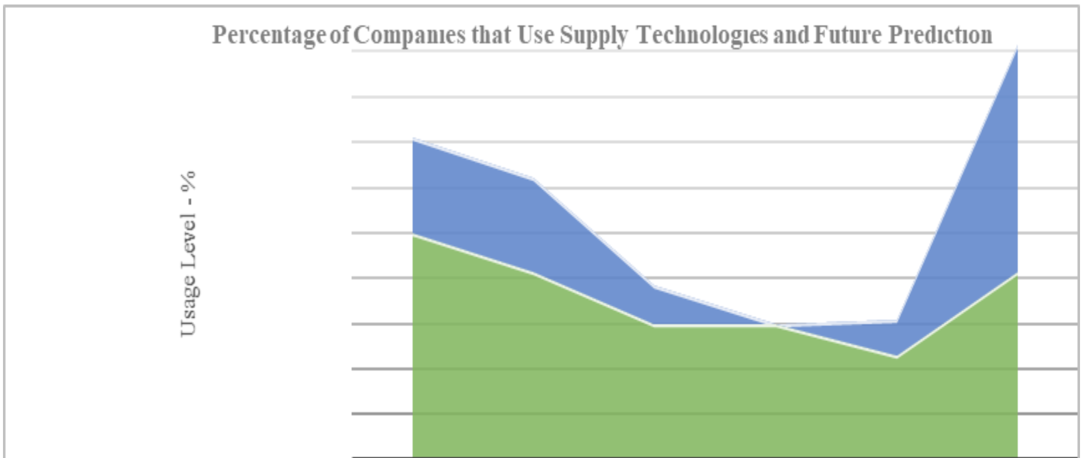
The DHL [10] identifies 29 influential trends anticipated to shape the logistics sector in coming years. These insights, drawn from a wide-ranging network of research institutions, technology firms, start-ups, and clients, highlight key macro and micro developments. Significant future influencers include artificial intelligence, robotics, quantum computing, sustainability, and global transport dynamics [11].

Data from DHL's research suggests that the COVID-19 crisis has catalyzed digital transformation and automation in logistics. Wilding (2020) outlines projections that include[12]:

- A shift in supply chain priorities from cost-efficiency to resilience,
- Changes in customer expectations prompting reconfiguration of transportation and warehouse strategies,
- The rise of new working models accelerating the push toward automation and digital platforms.

A retrospective study by Muro & Andes (2015) analyzing the contribution of robotics to labor productivity found that steam engines increased annual productivity by 0.34% between 1850 and 1910. Comparatively, industrial robots boosted productivity by 0.36% in 14 sectors across 17 countries between 1993 and 2007. Though modest, this represents a 10% share of the total productivity increase[13]. The same study revealed that computer technology (C.T.) contributed 0.60% to productivity growth in Europe, the U.S., and Japan from 1995 to 2005—nearly double the impact of robotics.

Autonomous vehicle-based logistics are expected to expand in capacity while minimizing delays. The percentage of firms currently using or planning to adopt supply chain technologies over the next five years is shown in **Figure 1**. The pandemic has made robotics and A.I. integration in logistics nearly indispensable, and future projections suggest a continuing rise in the application of Internet of Things (IoT) and blockchain technologies. Conversely, reliance solely on data analytics is anticipated to diminish within the same timeframe.



	Internet of things	Blockchain	Autonomous vehicles	Drones	3D Printers	Data Analysis
Businesses currently using	42	41	17	0	16	100
Businesses that will use it within 5 years %	100	83	60	60	46	83

Figure 1. Percentage of companies that will use them in the next 5 years [14]

Table 1 presents a summary of the findings gathered from the literature concerning robotic applications within the logistics sector. It outlines various scientific studies that focus on how artificial intelligence is integrated into logistics, detailing both the research themes and the specific objectives explored in these publications.

Table 1. Literature on the use of A.I. and Robotics in the logistics industry

Authors	Article Subject	Purpose of the Article
DHL Logistics (2020)[10]	Logistics Trend Radar	The article outlines the advantages of augmented reality systems, highlighting the use of vehicle windshields as display panels. This enables vehicle operators to engage with augmented reality, enhancing safety through driver support features that display navigation data and alert users to potential hazards.
Özbek & Eren (2012)[15]	Multiple Criteria Decision Making Methods for Selecting Third Party Logistics Firms: A Literature Review	This research explores existing literature on how third-party logistics (3PL) firms are selected and evaluated. It emphasizes the variety of evaluation techniques, including basic analytical tools and more advanced multi-criteria approaches. Many identified methods rely on hybrid techniques combining qualitative and quantitative inputs, though few are based on real-world applications. Evaluations are organized by method type.
Sayın & Erol (2020)[16]	Modeling the Supply Potential for Setting of Paper Waste Collection Centers Under Reverse Logistics	The research introduces a unique approach by integrating the quality classification of collected waste into the location-allocation model. The model's design is enhanced through a dynamic decision support system, adding a new layer to reverse logistics operations.
Ekol Logistics (2021)[17]	Warehousing Examples	The article discusses Ekol's provision of multi-user logistics facilities tailored for the pharmaceutical and medical sectors across Turkey, Hungary, and Ukraine. Emphasis is placed on adherence to GMP/GDP standards and each country's Ministry of Health regulations. These facilities accommodate various product categories, including prescription and OTC drugs, clinical items, cold-chain medications, and animal health products.
Jahanzeb *et al*. (2021)[18]	Covid-19	The study sheds light on the growing interest in servant leadership during the pandemic. This leadership style is seen as positively influencing employee outcomes, making it a focal point for organizational behavior scholars amid COVID-19-related challenges.
Navarro Cid *et al*. (2022)[19]	Covid-19	To address the motivational dynamics of work during COVID-19, this article argues for improved temporal study designs that go beyond informal assessment rules. It emphasizes the need to rigorously analyze within-participant variance for more robust motivational research.
Patrono *et al*. (2021)[20]	Covid-19	This paper explores both the physical and psychological health symptoms experienced by university students in Northern Italy during the first COVID-19 wave, attributing these changes to lifestyle disruptions brought about by lockdown conditions in one of Europe's hardest-hit regions.
Carvalho *et al*. (2022)[21]	Covid-19	The study discusses the critical competencies of clinical nurse leaders during the pandemic, showing how their advanced practice roles contribute significantly to the efficiency and resilience of healthcare institutions.
Neogi *et al*. (2022)[22]	Covid-19	This research concludes that preventive strategies and health financing indicators are more reliable predictors of COVID-19 infection and mortality rates per million population than other global health security and system benchmarks.
Brubacher *et al*. (2022)[23]	Covid-19	This article outlines a protocol for analyzing how institutions, politics, organizational structures, and governance affected the COVID-19 response in British Columbia, Canada, through a case study approach that focuses on jurisdictional dynamics.
Frost & Sullivan (2020)[24]	Industry 5.0 - Starts the process of using trained manpower in the field of production with humanoid robots	The article discusses Industry 5.0, emphasizing the fusion of roles such as machinery maintenance and quality control into unified operations. It forecasts a future industrial landscape defined by smart supply chains and hyper-personalization, where skilled human workers will collaborate with humanoid robots that handle labor-intensive tasks in production environments.

*Created by the author

Baykasoğlu and Subulan (2016) present an example of integrating A.I. into logistics through Ekol's warehousing management solutions, which offer temperature- and humidity-regulated storage tailored for clients in the health sector[11]. Their services encompass specialized storage environments with varied temperature ranges designed for sensitive products, alongside comprehensive order management, shipment handling, and electronic sales XML file reporting to the national Ministry of Health. Additional capabilities include sample product oversight, cold-chain storage and order preparation, return logistics, clinical trial product warehousing, as well as dedicated warehouse management and order preparation systems for the health industry. These processes are further supported by automated storage zones, real-time KPI monitoring, and order status tracking. Ekol leverages extensive multi-user facilities to serve pharmaceutical and medical industries across Turkey, Hungary, and Ukraine, with strict compliance to GMP/GDP standards and the specific Ministry of Health regulations in each country of operation. Their warehouses cater to a broad spectrum of product categories such as prescription and OTC medications, cosmetics, Ministry of Health-approved nutritional products, diabetes treatments, controlled substances, cold-chain medicines, and veterinary pharmaceuticals [25, 26].

For Turkey's pharmaceutical and medical industries, Ekol has established a bonded warehouse specifically designed for health-related storage, featuring precise temperature and humidity controls. This facility includes two distinct climate zones: a standard storage area maintained between 15°C and 25°C and a cold zone held at 2°C to 8°C. It is also equipped to store pharmaceutical raw materials and contains a specialized section for regulated items. In its secondary packaging departments, one of the largest Ministry of Health-approved areas in Turkey, Ekol fulfills all customer packaging needs, offering services such as [27]:

- Printing and labeling with data matrix codes
- Secondary aggregation of data matrix codes
- Ink-jet printing on product boxes
- Box replacement
- Insertion of prospectuses
- Application of decal labels
- Conversion of products into samples
- Export product preparation

The pharmaceutical sector places significant importance on the storage and distribution of promotional materials, a service Ekol provides to leading companies in the industry. Their tailored logistics systems simplify the management of promotional items, using a web-based platform for real-time order status and warehouse inventory updates. When promotional products arrive from suppliers, a photo is taken and managerial approval is secured before generating orders for the sales teams or companies. These promotional goods can be tracked throughout the delivery chain with up-to-date information accessible online within Ekol's distribution network. Robotic technologies, through Automated Storage and Retrieval Systems (ASRS), handle the storage and retrieval of items—whether pallets, bins, or cartons—from their designated locations on demand. According to Ozguner and Ozguner (2019), ASRS provides several advantages to Ekol's clients, including[28]:

- Increased storage efficiency by requiring less aisle space and utilizing higher racks, which allows roughly 2.5 times more items to be stored per unit area compared to traditional storage methods
- Lower labor expenses by automating storage and retrieval processes, thus removing the need for manual stacking operators and reducing workplace accident risks
- Shortened cycle times for storage and retrieval operations by nearly 80% compared to conventional warehouse equipment
- Decreased error rates, virtually eliminating mistakes caused by human factors, resulting in nearly 100% accuracy in inventory and order fulfillment
- Enhanced delivery optimization enabled by system algorithms that prioritize faster retrieval and transport of items to nearby destinations

Materials and Methods

In recent years, there has been a substantial surge in the adoption of robots within the logistics industry, evidenced by the rise in sales from 19,000 units in 2015 to 189,700 units between 2018 and 2020, signaling a strong growth demand in the sector. Previously, robotic systems were predominantly utilized in enclosed storage areas; however, these have now been supplanted by advanced technologies that offer enhanced speed, sophistication, and safety, contributing significantly to these positive trends. While A.I. applications have become widespread across various global industries, a notable development has been the integration of collaborative robots, which work alongside human operators and have only recently gained traction.

Globally, sales of service robots have surged by 32%, logistics robots have doubled with a 110% increase, and medical robots have grown by 28%. When examining the global market value for logistics robots, it reached approximately $1.9 billion, reflecting a 110% growth in total units sold and leased between 2018 and 2019 **(Figure 2)**. This upward trajectory in market valuation is projected to continue in the coming years, driven primarily by the escalating demand for quicker production cycles and more efficient product delivery at competitive pricing—factors heavily supported by advancements in A.I. and robotic technologies. The growth rates of service robots, logistics robots, and medical robots stand at 32%, 110%, and 28%, respectively [29].

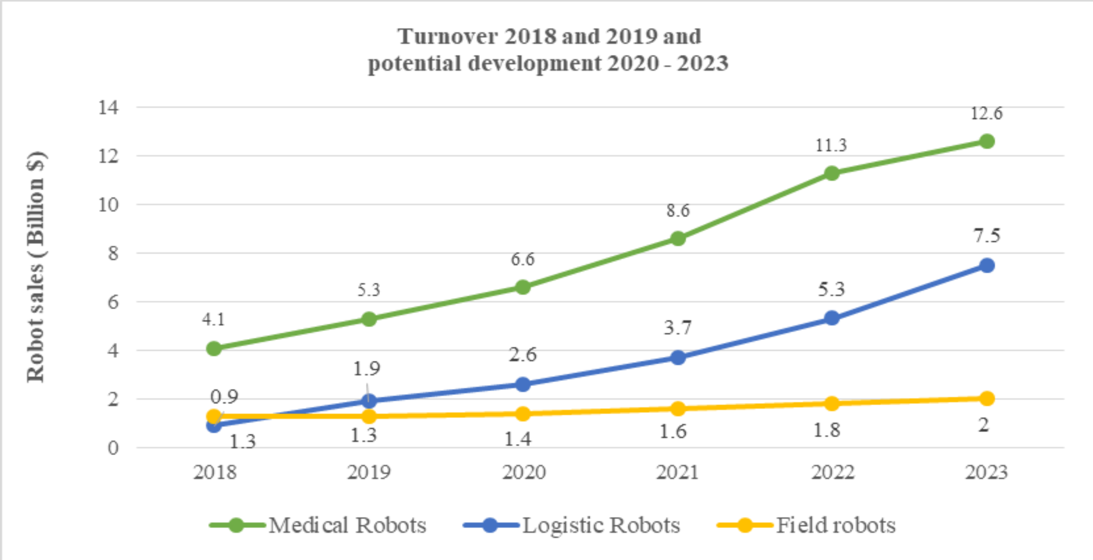
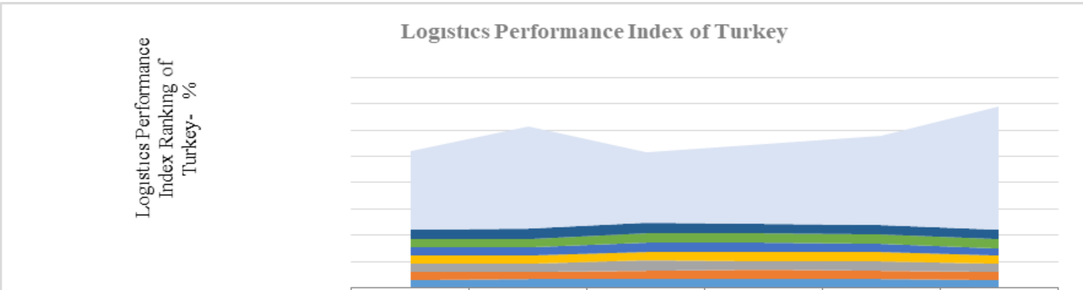


Figure 2. Service Robots for Professional Use – Major Applications [29].

In 2019, robots demonstrated their crucial role in addressing labor shortages and handling hazardous duties, leading to the expansion of robotic applications within production, supply chain, and logistics sectors. According to Robotics Business Review [30], companies that successfully automate any stage of their supply chain and logistics operations gain a competitive edge, particularly when robots efficiently move products from warehouses to packaging stations, with other robots taking over subsequent packaging or worker assistance tasks. The adoption of robots in industry has progressed steadily but at a measured pace, with logistics applications such as palletizing being among the earliest uses. Emerging innovations like drone deliveries are beginning to take shape, suggesting continued growth in robotics within logistics. The 5. Intelligence Robotics (5. I.R.) revolution, also known as Industry 5.0, marks a new era in unmanned and ultra-intelligent robotics technologies, where robots possess the capability to self-repair, monitor, and reprogram autonomously [31]. The rapid development of artificial intelligence is transforming the world, and logistics supply chains must also accelerate their operations to satisfy e-commerce demand, particularly under the quarantine conditions imposed by the COVID-19 pandemic in 2020 [32].

Logistics Performance Index (LPI) scores provide insights to countries, helping them assess their logistics strengths and weaknesses, as well as those of their partners, to enhance logistics effectiveness [33, 34]. **Figure 3** illustrates the evolution of Turkey's LPI scores over time. Notably, Turkey experienced a decline in its LPI scores from 2016 to 2018, with the most significant drop observed in the customs dimension. Turkey's overall logistics performance index remained unchanged between 2007 and 2018, holding steady at 3.15. Among the six evaluated dimensions, customs consistently received the lowest scores. Improving the digital collaboration between customs and logistics operations in Turkey could elevate these scores [35].



	2007	2010	2012	2014	2016	2018
Ranking	30	39	27	30	34	47
Timeliness	3.38	3.94	3.87	3.68	3.75	3.63
Tracking and tracing	3.27	3.09	3.54	3.77	3.39	3.23
Logistics,quality and Competence	3.29	3.23	3.52	3.64	3.31	3.05
International Shipments	3.07	3.15	3.38	3.18	3.41	3.06
Intrastructure	2.94	3.08	3.62	3.53	3.49	3.21
Customs	3	2.82	3.16	3.23	3.18	2.71
LPI	3.15	3.22	3.51	3.5	3.42	3.15

Figure 3. Logistics Performance Index of Turkey [36]

Based on the Logistics Performance Index (LPI) Ranking, Turkey improved its position from 30th place in 2007 to 27th in 2012; however, it experienced a decline afterward, falling to 47th place by 2018. This downward trend was primarily driven by challenges in customs, where delays and cost issues played a significant role. Additionally, recent years have seen a reduction in the quality of shipment criteria and logistics services overall [37]. Collaborative robots—machines designed to work alongside humans—are enhancing workforce capabilities by accelerating skill efficiency and transforming various logistics processes [24]. Looking ahead, the integration of 5IR and blockchain technologies in logistics is expected to bring substantial added value, especially in foreign trade and customs clearance. These technologies offer advanced tools crucial for the development of 5IR systems [24]. As a result, robotics adoption in logistics is demonstrably improving labor productivity.

Turkey's logistics performance was further evaluated through a SWOT analysis considering several criteria:

- Exports by mode of transport,
- Imports by mode of transport,
- Logistics Performance Index of Turkey,
- SWOT Analysis of Turkey.

Table 2 illustrates the breakdown of exports and imports according to transportation modes, revealing that seaway and roadway are the predominant methods for freight movement in Turkey, while railways account for the smallest share of transportation.

Table 2. Exports and imports by mode of transport

			Exports by Mode of Transport			
	Seaway	**Railway**	**Roadway**	**Airway**	**Other**	**Total**
2014	88.900.953	964.170	61.133.176	14.388.661	1.117.902	166.504.862
2015	79.762.173	861.740	51.946.113	17.400.190	1.011.898	150.982.114
2016	80.139.270	673.816	49.537.436	17.908.782	987.696	149.246.999
2017	93.378.625	699.915	50.988.408	17.217.240	2.210.432	164.494.619
2018	108.802.681	753.544	52.222.468	14.127.905	1.262.157	177.168.756
2019	109.114.264	971.021	54.461.860	14.849.231	1.436.347	180.832.722
2020	100.907.927	1.287.765	53.127.588	12.732.561	1.581.914	169.637.755
2021	120.387.912	1.487.369	62.304.873	16.810.158	2.103.226	203.093.538
			Imports by Mode of Transport			
	Seaway	**Railway**	**Roadway**	**Airway**	**Other**	**Total**
2014	147.778.523	1.253.892	40.577.283	24.889.608	36.643.124	251.142.429
2015	126.868.187	1.434.902	37.840.932	20.159.751	27.315.439	213.619.211
2016	121.013.276	1.768.602	36.716.500	23.107.208	19.583.655	202.189.242
2017	138.596.809	1.294.504	40.374.083	34.439.948	24.009.784	238.715.128
2018	136.737.402	1.299.419	39.129.380	28.756.745	25.229.537	231.152.483
2019	112.967.845	1.447.897	37.177.012	29.238.406	29.514.041	210.345.203
2020	114.838.355	2.144.863	41.883.477	39.260.478	21.389.634	219.516.807
2021	141.174.732	2.626.105	44.167.395	23.833.328	30.641.730	242.443.290

Resource: General Trade System, Transport Modes, (Thousand $)[38]

Turkey's total exports reached their peak in 2021, following a decline in 2020 due to the impact of the COVID-19 pandemic. However, the total imports in 2021 remained lower compared to those in 2014 [39]. The Logistics Performance Index (LPI) evaluates countries based on six key dimensions, with each nation receiving individual scores for these categories. According to Uca *et al*. [40], these dimensions include:

- The ease and cost competitiveness of shipments,
- Shipment traceability,
- Timeliness in delivering shipments to recipients as scheduled,
- Customs clearance efficiency, encompassing speed and simplicity at control points,
- Quality of transportation infrastructure, including ports, information technology, and tracking systems,
- The quality and sufficiency of logistics services at customs.

SWOT analysis of Turkey

A SWOT analysis, which examines strengths, weaknesses, opportunities, and threats, serves as a strategic tool to analyze the competitive stance of an organization or country. This method evaluates both internal and external factors alongside current and future prospects. The SWOT analysis presented here offers an objective, data-driven examination of Turkey's logistics sector, highlighting its strengths, weaknesses, opportunities, and potential threats **(Figure 4)**. The assessment of Turkey's logistics sector through the SWOT framework is detailed below [41]:

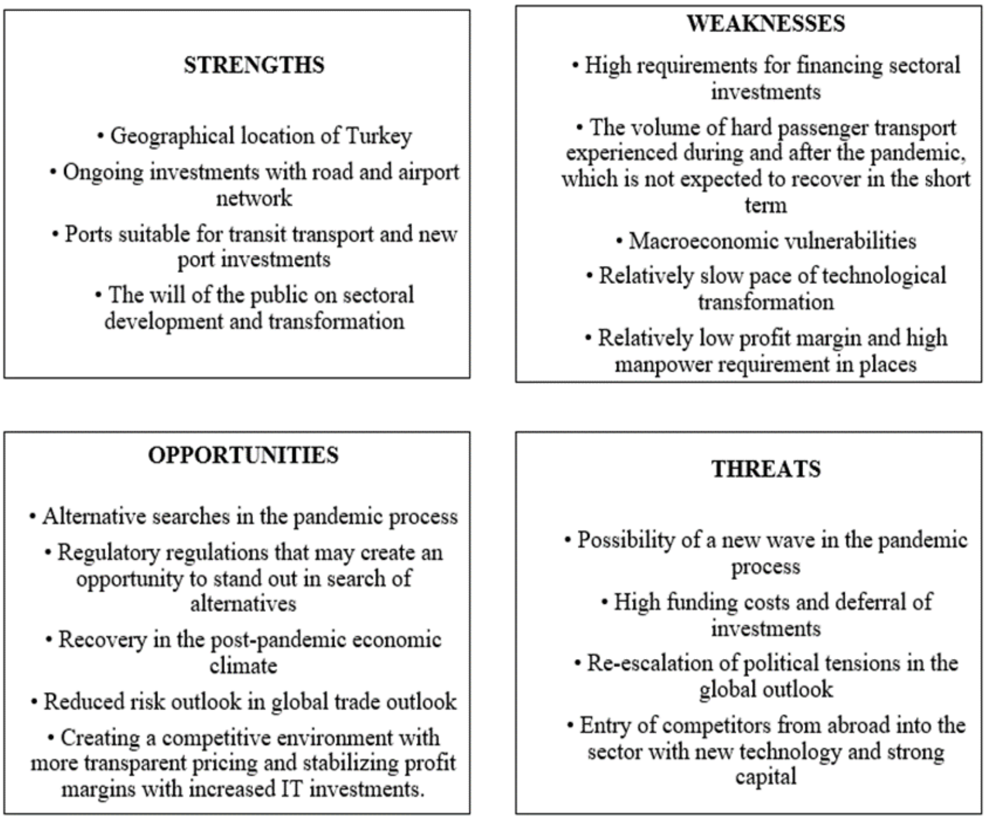


Figure 4. SWOT Analysis of Turkey

Created by the authors from data of KPMG (2021)[42]

Despite several challenges, Turkey is expanding its influence in global trade by utilizing alternative routes. The COVID-19 pandemic raised questions about the heavy reliance on China, the world's largest supplier, due to its role as the initial epicenter of the outbreak and its geographical distance, prompting developed regions to seek new production hubs. In this context, Turkey has emerged as a key alternative.

Results and Discussion

- Globally, automation systems are progressively finding broader applications within the logistics sector. It has become clear that limiting the use of A.I. and robotic technologies to storage facilities is insufficient for logistics operations within the Industry 4.0 framework.
- The demand for making logistics activities within production units both traceable and manageable is increasing. Service robots, particularly Automated Guided Vehicles (AGVs), have become the dominant tools utilized in logistics.
- The integration of previously isolated solutions for logistics and production is now imperative to achieve a fully automated intralogistics process.
- Future expectations suggest that optimized logistics operations will rely on systems governed by fleet traffic management and navigation software, enhanced by drones, human-like collaborative robots, and 5G technology, marking a shift from traditional supply chains toward advanced blockchain-based solutions.
- For instance, in pharmaceutical logistics, storage and distribution of promotional materials represent a critical need. Ekol facilitates this by providing streamlined management services to leading companies in the sector through specialized logistics systems designed for promotional items.

Conclusion

This study aims to outline the evolving expectations for Supply Chain Management (SCM) strategies necessitated by the global health crisis COVID-19. The analysis employs the Multi-Criteria Decision Making Method and begins by evaluating developments since the First Industrial Revolution, highlighting the transition from Industry 4.0 (4IR) to Industry 5.0 (5IR). A SWOT analysis examining Turkey's SCM performance was conducted. Given the global interest, the literature on this topic is extensive, revealing varied findings.

The COVID-19 pandemic highlighted that robotic technologies are designed to collaborate with humans to boost productivity rather than replace them. The crisis accelerated simpler automation implementations and increased the use of collaborative robotic arms, which facilitate safer distancing on assembly lines and confined spaces. Human-robot collaboration has also evolved through adaptive applications that respond to rapidly changing work environments. These examples demonstrate how diverse robotic systems can sustain efficiency and foster teamwork amid unpredictable conditions.

While the pandemic accelerated robotic adoption, it also paved the way for lasting changes in how humans and robots work together effectively. Concerns about workforce displacement may diminish with appropriate strategies governing the integration of A.I. and robotics. Rather than eliminating labor, the future is expected to focus on enhancing productivity through “robot power – manpower” cooperation, resulting in more efficient production and service delivery.

Industrial revolutions aim to enable workers to perform simpler tasks, such as button pressing and supervision, while recognizing that hazardous and strenuous jobs still require human involvement. Advanced, self-regulating robots capable of performing human tasks continuously and reliably are envisioned to create more humane working conditions by offering safer job opportunities.

Ultimately, the deployment of human-like robots is becoming essential, and Industry 6.0 objectives should be defined to rapidly adapt to contemporary conditions.

Turkey maintains strong prospects in the transportation and logistics sector, benefiting from its strategic geographical position and substantial tourism potential. Recent investments in land and air infrastructure reinforce this outlook, although structural challenges continue to impede full realization.

Beyond volume recovery, 2021 is expected to emphasize improvements in operational control, aligned with investments in logistics infrastructure such as pipelines. Enhanced cybersecurity measures will also be integral to this growth. While the pandemic’s worst phase appears behind, ongoing variants sustain uncertainty and concern.

A potential new surge, especially in the year's final quarter, could adversely affect projections. Therefore, businesses must develop robust recovery strategies, support investment models, and utilize data analysis effectively. Strengthening corporate adaptability remains critical during this period.

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