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Dr. Öğr. Üyesi Nurgül ERDAL
İstanbul Gelişim Üniversitesi, İİSBF Lojistik Yönetimi
nerdal@gelisim.edu.tr
Orcid: 0000-0002- 2961-3906

4.0 USE OF SMART TECHNOLOGIES IN LOGISTICS AND SUPPLY CHAIN MANAGEMENT: AN EXAMPLE OF SMART GLOVES[1]

Abstract

Logistics 4.0 is the transition period from hardware-oriented logistics to software-oriented logistics. The concept of "smart", which emerged with digital transformation, has made technology-based solutions gain importance. The special value-added services offered by smart logistics positively affect the logistics supply chain and can produce countless solutions to the ever-changing demands of customers. This study was planned to examine the areas of smart glove usage in logistics, their benefits, advantages, disadvantages, and domestic smart glove preference. Since smart gloves are a new technology product, publications on this subject are quite limited. However, it is anticipated that there will be more publications in the future. As a result of a detailed literature review, it has been revealed that smart gloves are used at almost every stage of the logistics supply chain, providing speed, quality, and time savings, reducing costs, and increasing the effectiveness and efficiency of companies. The most important feature of new technologies is that they are adapted in line with needs and become indispensable with their ergonomics and ease of use. Turkey produces "smart gloves" and exports the smart products it develops to 15 different countries, including Germany, England, China, the United Arab Emirates, and Poland. Many companies such as

[1] This article is an expanded version of the paper titled 12.ULTZK 2023 National Logistics and Supply Chain Congress 16-17 November 2023 4.0 Use of Smart Technologıes in Logıstıcs and Supply Chaın Management: Smart Glove Example.

MERCEDES-Benz, Renault, TOFAŞ, Bridgestone-Lassa, and Carrefoursa use these gloves in their production and logistics processes. The use of smart gloves will increase in the future and many companies will use them in the logistics and supply chain processes.

Keywords: Supply Chain, 4.0 Logistics, Wearable Technology, Smart Gloves, Digitalization

JEL Code: M10, F12

4.0 LOJİSTİK VE TEDARİK ZİNCİRİ YÖNETİMİNDE AKILLI TEKNOLOJİLERİN KULLANIMI: AKILLI ELDİVEN ÖRNEĞİ

Öz

Lojistik 4.0, donanım odaklı lojistikten yazılım odaklı lojistiğe geçiş dönemidir. Dijital dönüşümle birlikte ortaya çıkan "akıllı" kavramı teknoloji temelli çözümlerin önem kazanmasını sağlamıştır. Akıllı lojistiğin sunduğu özel katma değerli hizmetler, lojistik tedarik zincirini olumlu yönde etkilemekte ve müşterilerin sürekli değişen taleplerine sayısız çözüm üretebilmektedir. Bu çalışma lojistikte akıllı eldiven kullanım alanlarını, faydalarını, avantajlarını, dezavantajlarını ve yerli akıllı eldiven tercihini incelemek amacıyla planlandı. Akıllı eldivenler yeni bir teknoloji ürünü olduğundan bu konudaki yayınlar oldukça sınırlıdır. Ancak ilerleyen zamanlarda daha fazla yayının olacağı öngörülüyor. Detaylı literatür taraması sonucunda akıllı eldivenlerin lojistik tedarik zincirinin hemen her aşamasında kullanıldığı, hız, kalite ve zaman tasarrufu sağladığı, maliyetleri düşürdüğü, şirketlerin etkinliğini ve verimliliğini arttırdığı ortaya çıktı. Yeni teknolojilerin en önemli özelliği ihtiyaçlar doğrultusunda uyarlanıp ergonomisi ve kullanım kolaylığıyla vazgeçilmez hale gelmesidir. Türkiye "akıllı eldiven" üretiyor ve geliştirdiği akıllı ürünleri aralarında Almanya, İngiltere, Çin, Birleşik Arap Emirlikleri ve Polonya'nın da bulunduğu 15 farklı ülkeye ihraç ediyor. MERCEDES-Benz, Renault, TOFAŞ, Bridgestone-Lassa, Carrefoursa gibi pek çok firma bu eldivenleri üretim ve lojistik süreçlerinde kullanıyor. Akıllı eldivenlerin kullanımı gelecekte artacak ve birçok firma bunları lojistik ve tedarik zinciri süreçlerinde kullanacaktır.

Anahtar kelimeler: Tedarik Zinciri, 4.0 Lojistik, Giyilebilir Teknoloji, Akıllı Eldivenler, Dijitalleşme

INTRODUCTION

With the development of national and international trade, the circulation of products in close or distant geographical areas has become possible thanks to logistics. Especially, with the industrial revolutions, there have been both theoretical and technical changes and transformations in logistics, as in all sectors. In logistics and supply chain, industry 4.0 has taken its place as Logistics 4.0. With these changes and transformations, the word "smart" came into life and became very popular. In the logistics sector, the concept of "Smart Logistics" has affected all processes of logistics and enabled the acceleration and traceability of processes. With the digitalization of wearable technologies, a revolution has occurred in logistics and logistics has become one of the most important indicators of the economy.

One of the areas most affected by technological advances is industry. Every technological innovation emerges directly in the industrial field and manifests itself in production and other processes. Industry 4.0 is also known as the 4th Industrial Revolution. This includes many contemporary automation systems, data exchanges, production technologies, and many similar applications. Industry 4.0 consists of three stages: Internet of Things, Internet services, and cyber-physical systems. It involves the integration of production and living spaces with smart equipment in the formation of the new world order. At the same time, Industry 4.0 is expressed as the digitalization of industrialization or the integration of physical production and cyber through new technologies (Vasin et al., 2018). This transformation defines the process called "Logistics 4.0 or smart logistics" (Jahn et al., 2018). These technologies enable Industry 4.0 to create a transformation that will change the entire supply chain and business models.

Supply chain technology can increase data security, reliability, traceability, and authenticity, which will increase trust in the supply chain (Issaoui, et al., 2019). Logistics is the delivery of produced goods or services at the right time and to the right place (Tang and Veelenturf, 2019). Logistics is the activity of bringing goods or materials from the center point to the destination point by using resources such as personnel, vehicles, facilities, and equipment (Li and Ma, 2020). Smart logistics is a key approach for organizing physical and information logistics more efficiently in national and international supply chain networks. Because uncertainty, unpredictability, and variability reduce service quality. With smart logistics applications, durability, flexibility, agility, durability and quality in products and services increase and become the focus of future logistics system designs (Kirch et al., 2017).

Nowadays, when technology advances at a dizzying pace, terms such as unmanned production and dark factories have come to the fore. In logistics processes, the concept of smart warehouses, smart logistics, and smart logistics entities has emerged. When we say wearable technology, products that contain technology that people can wear come to mind. These technological clothes can collect data, track user movements, and be customized according to the user's wishes (Thierer, 2015). Examples of these; are smart gloves, smart glasses, smart watches and bracelets, smart textile products, smart accessories, and jewelry (Deringöz et al., 2021).

Although wearable technologies have many features, their most distinctive feature is data transfer between the device and the network. This technology both receives and sends information between the device and the network with the Internet of Things. These are dependent on each other (Aktaş,2022). Smart gloves used in logistics are designed to enable the employee to move very comfortably. Smart gloves used in logistics and supply chain are used in areas such as goods entry-exit, collection, sorting, goods counting, and e-commerce and provide 50% savings in costs.

This research was planned to reveal how smart gloves, which have an important place in the logistics supply chain and production industry, affect the logistics supply chain, their usage areas, benefits, advantages, and disadvantages. Since smart applications are new technologies, there are very few studies on the use of smart gloves in logistics. Therefore, it is anticipated that this study will guide researchers and practitioners.

LITERATURE REVIEW

Industry 4.0 and Smart Technologies in Logistics and Supply Chain Management

Industrial revolutions are turning points in human history and have caused many rational changes. After the industrial revolution, the world entered a new period of change and transformation. The industrial revolution has progressed from Industry 1.0 to Industry 5.0. The rapid development of technology has enabled industrial revolutions to accelerate.

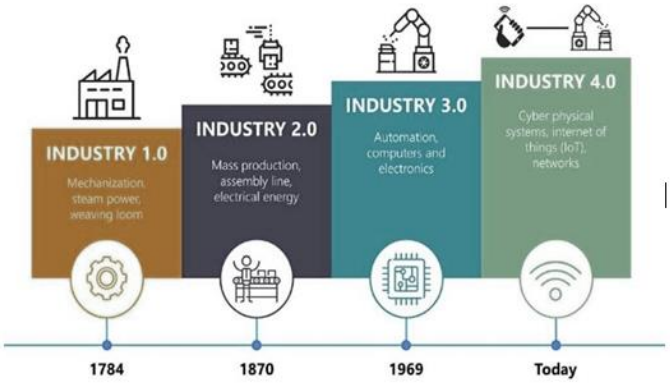

Figure 1. Industrial Revolution Process

Reference:https://www.google.com/search?q=end%C3%BCstri+devrimi+s%C3%BCreci

Figure 1 shows the industry stages. Industry 1.0 or the first industrial revolution started in England. The power of water and steam was used, production increased and costs decreased (Allen, 2009). With Industry 2.0, electrical appliances came to the fore, division of labor emerged and mass production increased (Sagdıc, 2022). The most prominent feature of Industry 3.0 is the internet. The Internet has changed the lives of individuals, societies, and businesses. Thus, new lifestyles and new ways of doing business have emerged (Smith, 1996). Industry 4.0, on the other hand, has been a transformation built on Industry 3.0 and includes the elements of speed, scope, and system impact. Industry 4.0 is also called "Smart Production". It enables the integration of machines with each other through cyber-physical systems, the management of big data through cloud computing, and the establishment of communication between machines through the Internet of Things (Kamble et al., 2018). Unlike previous industrial revolutions, Industry 5.0 has not only affected society but has also led to the transition to a new social phase called super smart society (Skobelev and Borovik, 2017).

Use of Logıstıcs 4.0 and Smart Technologies

In the globalizing world, innovations in industry and technology have affected the logistics and supply chain (Lin and Jones, 2009). The industrial revolution has changed the processes of logistics and supply chains and revealed new applications (Timm and Lorig, 2015). The logistics 4.0 process is similar to the industry 4.0 process. The logistics development process (Figure 2) is also shown in detail (Galindo, 2016).

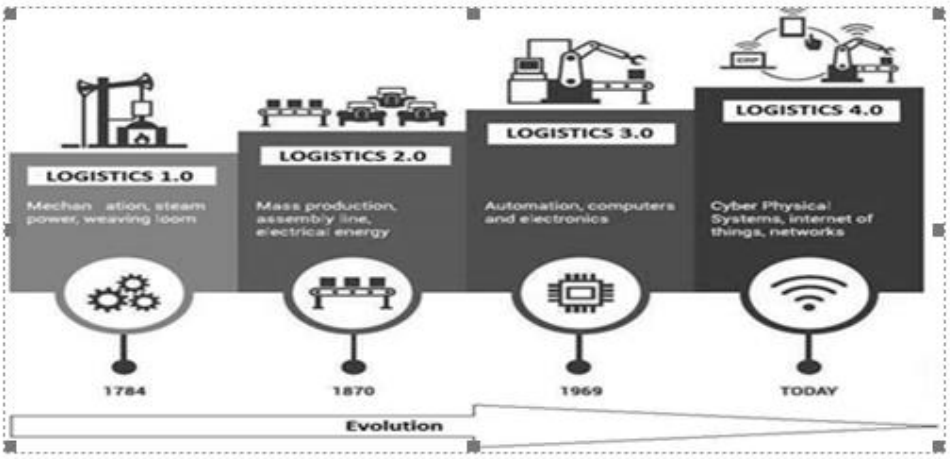

Figure 2. Logistic Revolution Process

References: The History of the Industrial Revolution, https://cdn.sindonews.net

Logistics 1.0: The first period (Industry 1.0) started with the invention of the Steam Engine in 1712 (Demiral, 2021). With the invention of the steam engine, rural life was moved away from large settlements and industrialization began. Production and transportation, which were previously done with manual vehicles or animals, started to be done with machines. Although road transportation was used more in the beginning, later railway transportation became more widespread. The warehouses contained finished products or raw materials. The products in the warehouses were handled and transported manually by people. Distribution was mostly carried out by sea or railway (Şekkeli and Bakan, 2018).

Logistics 2.0: In the second period (Industry 2.0) it is between 1870-1914. Thanks to technological changes in the world, new materials such as steel, copper, or aluminum have begun to be used in machine construction. There have been great advances in the chemical industry, and power sources such as electricity and oil have begun to be used in production, transportation, and communication. During this period, road transportation continued; Railway and steamship transportation became more widespread. Especially in this period, the use of container ships provided significant gains in logistics (Çizmecioğlu, 2022). Thanks to electricity, electric logistics equipment has begun to be used in logistics warehouses. Thus, products could be placed and removed from the shelves automatically. In addition, hand-pulled forklifts have been replaced by engine-powered handling vehicles (Mercimek and Geçkil, 2021).

Logistics 3.0: Two important developments have been made in the third industrial (Industry 3.0) revolution. The first is numerically controlled machines (CNC and DNC machine tools such as lathes and milling machines) that provide the necessary flexibility in production. The second is industrial robots that enable automatic production. In this period, thanks to rapid access to information, more attention was paid to the customer, product, and service supply, and classical transportation was continued (Poli et al., 2018). In addition, technology-based logistics WMS (Warehouse Management System), and TMS (Transport Management System) - Management systems (transportation management system) have begun to form.

With the application of software to logistics, plans, schedules and routes of fleet

vehicles can be planned during the process of accessing orders and transporting final products or raw materials. There have been developments in production logistics, and products are generally produced and transported within the business on automatic moving belts or with the help of forklifts. Some companies have carried out this process through programmed, state-of-the-art robots. All of these processes were planned before the product was produced and managed according to planning (Galindo, 2016).

Logistics 4.0: The fourth industry (Industry 4.0) is the transition period from hardware-oriented logistics to software-oriented logistics. Customer demands are realized thanks to digital technology (Winkelhaus and Grosse,2020). According to some sources, Logistics 4.0 is called a new method, a new toolset, and a new paradigm (Szymańska et al., 2017). In this context, systems that can connect all logistics processes have been developed. Developing communication and sensor technologies has contributed to the emergence of more adaptable logistics systems through the acquisition and analysis of data (Frazzon et al., 2015; Ertemel and Gürdal, 2016). Among the most important goals of Logistics 4.0 These include increasing storage capability and using access, operation, compatibility, information, and communication at a high level in logistics facilities (Schlott, 2017).

The concept of smart logistics has created the concept of a smart logistics entity. These assets are not only the assets used in the warehouse and connected to the intranet within the warehouse, but also all logistics assets that have access authority after being equipped with various equipment (Çetinkaya, 2022). Assets used in logistics businesses can be converted into virtual logistics assets by connecting to the internet and can be programmed once from a center and become operational on their own. In addition, even non-networked entities used in the warehouse can connect to the network through various methods, receive commands, and establish connections with other objects in the network (Kong et al., 2020). The use of electronic identification and tracking systems such as barcodes and RFID in the monitoring of logistics processes prevents overproduction and excessive stock-keeping and therefore reduces costs (Karlı and Tanyaş, 2020).

With the use of information-communication technologies and the influence of digitalization in logistics, smart logistics systems (smart transportation, warehouse, order management, etc.) have emerged. Smart logistics; It is a system in which logistics processes are equipped with computer support systems and smart technologies are used in logistics tasks, and these systems are environmentally friendly and based on technologies that use less space (Kauf, 2018). In logistics, information and communication technologies are used to improve routes and logistics processes. These provide benefits in many areas, from big data to planning and customer analysis (Demiral, 2021).

In recent years, technological products such as drones, wearable industrial assets, and virtualized logistics assets have increased effectiveness and efficiency in the logistics and supply chain (Çetinkaya, 2022). The widespread use of drones in warehouse management systems and shipping is effective in reducing errors, preventing labor loss, and saving time (Osterbrink et al., 2021). Autonomous robots are managed entirely by computers without human intervention. These work faster and more efficiently than traditional transportation, packaging, and inspection studies (Fitzgerald et al., 2017).

Smart Technology Use Cases

Nowadays, technology is very advanced. There are technologies that the individual can touch, perceive, and feel, affect the place he is in, and enrich the image the person perceives with virtual objects (Gülel and Arabacıoğlu, 2019). These are realized thanks to advanced software and hardware (Özdemir and Seymen, 2021). For example, the German Company Siemens produced a machine with an AR application with the software it developed, and the simulation of the entire process saved 80% of the time (Rübmann et al., 2015). Logistics company Knapp gained approximately 40% by preventing confusion and human errors in warehouse systems (Carmigniami et al., 2011). Audi, on the other hand, visualized all the logistics structures and objects planned to be built in the production facility as a three-dimensional hologram using computer-aided design technology and reflected them in the real environment in their original size. In 2017, DHL company DHL launched the Vision Picking pilot project, which brought AR smart glasses-based visual collection feature to warehouse operations and implemented Augmented reality, providing a 25% increase in total efficiency, as well as preventing human error and speeding up operations (Morozova, 2021).

Smart gloves are widely used in production facilities as well as logistics. For example, while 60 million seconds are spent per day with a handheld terminal in an automobile factory, this figure decreases to 30 million seconds in total with this device. Our IoT devices were improved with the sensors inside and personnel data was transferred to cloud servers (Utikat, 2018).

Smart Gloves

Nowadays, wearable technology stands out in the rapidly developing technological process. The concept of wearable technology is not new and is known to date back to the 17th century. The first wearable technology was the abacus ring, used in the 17th century in the Kingdom of China. This is considered the most important invention of that period and is estimated to have been used by constantly traveling merchants (Değerli, 2019). Wearable technologies have emerged in different forms over time.

Smart gloves, one of the wearable technologies, are widely used in production and logistics enterprises. Smart gloves are created by adapting information and communication technologies to wearable technology products, accessories, or clothing. They create an interface between humans and computers with the technology of sensing environmental variables. When designing smart gloves, care should be taken to ensure that they are user-friendly (Mocan and Draghici, 2018). The main feature of the smart glove is that the device is connected to the body, does not require muscle effort to remain in contact with the body, is not affected by the orientation or movements of the body, and remains attached to the body. The device does not need to be disconnected for interaction. There are different types of these devices—head-mounted scanners (glasses-like); Wrist-mounted scanners (watch-like); and Hand-molded scanners like gloves.

Figure 3. Gloves with integrated RFID reader (Mocan and Draghici, 2018)

As technology advances, the models and functions of the products also change. Wearable technological products are developed to support daily tasks. A small idea at the beginning emerges as a product and can change all functions. Figure 3. shows how wearable technology has become an essential product for production and logistics, starting from the idea of creating a conductive thread.

Figure 4. Various Smart Gloves Models (Thread in Motion,2023).

As seen in Figure 4, there are different types of smart gloves. These smart gloves contain different sensors, do not require wiring, have a 'haptic feedback' mechanism, and can work hands-free. Additionally, functions can be added as needed.

Usage Area of Smart Gloves

The trend in the logistics industry in recent years is the acceleration of processes and the realization of traceability. Digitalized wearable technologies increase the efficiency of these processes. The smart glove developed in Turkey provides speed, efficiency, and traceability in production and logistics warehouses with sensors and screens. All operations are carried out using gloves, reducing errors and saving time. He stated that smart gloves can be used in many areas. Some of these are in production lines, logistics, warehouses, sorting areas, and packaging.

Smart gloves are resistant to working conditions on production lines and compatible with hand ergonomics. They have modular barcode readers that use wireless communication infrastructure. Gloves can be produced with or without a screen. It is very easy to use and the barcode reader will be triggered with a button that the employee can easily press with his thumb. Data can be collected about employee performance and health status. It will be possible to visually report every moment of production with a camera.

In logistics, it is necessary to be fast in providing service to the customer as well as tracking the materials in the warehouse. The faster the warehouse processes are, the faster the customer receives his order. In addition, quality is important; expired, faulty, or defective products reduce customer satisfaction. At this point, smart gloves not only function as barcode readers but also increase customer satisfaction by performing quality control procedures (Aktaş, 2022).

METHOD

Purpose of the Research

With Industry 4.0, smart applications have entered all sectors. With the reflections of Industry 4.0 in logistics, striking improvements have emerged in logistics and supply chain processes. In recent years, speed, efficiency, and traceability have increased with the use of wearable technologies in the production and logistics sector. The company, which develops smart gloves, industrial wearable technologies, and integrated software, uses "smart gloves" to serve the logistics processes of all sectors, especially operations such as warehouse, goods entry-exit, goods counting, collection, and sorting. This study aims to reveal the usage areas, advantages, and disadvantages of smart glove applications in logistics and supply chains.

Method

Data on smart gloves was collected between 1 July and 30 October. Searches were made through Google, Google Academic, Web of Science, Scopus, EBSCO, ULAKBİM, and the national thesis center, and the use of smart gloves in logistics was examined. Quite a few publications have been found on this subject. At the end of the review, it is seen that smart gloves are produced in Turkey and exported to 15 different countries. In addition, it is seen that well-known companies such as MERCEDES-Benz, Renault, TOFAŞ, Bridgestone-Lassa, and Carrefoursa prefer these products. It is shown in Table 1.

Tablo. 1. Studies on The Use of Smart Gloves in Logistics

Author	Year	Issue
Çetinkaya, O	2022	Lojistikte akıllı varlıklar (Intelligent assets in logistics)
Aktaş, İ.	2022	Giyilebilir teknolojilerin lojistik faaliyetlerde kullanımının ve etkilerinin değerlendirilmesi (Evaluation of the use and effects of wearable technologies in logistics activities)
Jurenka, R., Cagáňová, D., & Horňáková, N.	2020	The smart logistics
Scheuermann, C., Heinz, F., Bruegge, B., & Verclas, S.	2017	Real-time support during a logistic process using smart gloves.
Krzywdzinski, M., Pfeiffer, S., Evers, M., & Gerber, C.	2022	Measuring work and workers: wearables and digital assistance systems in manufacturing and logistics.
Scheuermann, C., Strobel, M.,	2016	Increasing the support to humans in factory

Bruegge, B., & Verclas, S.	environments using a smart glove: An evaluation.
Kong, X. T., Zhong, R. Y., Zhao, Z., Shao, S., Li, M., Lin, P., ... & Huang, G. Q. 2020	Ccyber-physical e-commerce logistics system: An implementation case in Hong Kong.

Source: Created by the author

Table 1 shows research on the use of smart gloves in logistics. Since smart technologies are new technologies, there are very few studies on this subject. Companies that use smart gloves gain speed and time.

Table. 2. Usage Areas of Smart Gloves in Logistics (Thread in Motion,2023)

USAGE AREA OF SMART GLOVES	
Kanban in the Manufacturing Industry	Smart gloves are used to transport and notify the missing material from the warehouse next to the line. Employees report deficiencies in using gloves. Transactions are completed completely, error-free, and quickly.
Smart Gloves in the Manufacturing Industry	It is used in parameters such as part traceability, assembly time, and follow-up time. Pick-and-drop operation of classical handheld terminals is a cause of inefficiency. Smart gloves can read from a distance of 1 km. It can work independently of the line, and the ergonomics of having it on hand ensures complete and error-free assembly in sequential operations. It saves approximately 30 million seconds daily.
Quality Control with Smart Gloves	Although fixed cameras analyze parts on the visible surface at the same angle and light intensity, smart gloves can also analyze parts further inside. Thus, complete quality is ensured. It facilitates the full performance of employees' duties and the suitability of these duties.
Picking Operation in Logistics and Manufacturing Industries	It is the most error-collecting operation in the logistics industry. These gloves speed up operations and save time in processes as a result of free use, operating hand traceability, and ergonomics. Up to 54% savings in collection operations are preferred by many 3PL, e-commerce, and retail brands.
Classification in Production and Logistics Sectors	Placing the right products on the right, shelves prevent errors. Using smart gloves in classification is faster than using illuminated systems.
Goods Receipt in Manufacturing and Logistics Industries	Warehouse and logistics processes last 24 hours without interruption. While warehouse tracking is important, the faster it should be in preparing customer orders. With these gloves, acceptance of goods and preparation of orders can be completed quickly.

Smart gloves, which develop industrial wearable technologies and integrated software are used to serve the logistics processes of all sectors, especially operations such as warehouses, goods entry-exit, goods counting, collection, and sorting. The advantages and disadvantages are shown below.

Table. 3. Advantages and Disadvantages of Smart Gloves in Logistics

ADVANTAGES OF SMART GLOVES	DISADVANTAGES OF SMART GLOVES
Using less raw materials and producing more energy, small smart gloves can achieve more functions than traditional functions. • Smart gloves can create a wide application area with nanotechnology. • It is lightweight and ergonomic. • There is no movement restriction. • Suitable for material and process technology research and can be further developed. • It affects business models and economic performance in the future. • It is durable and washable • Measures employee performance • Measures employee health information • Using energy resources economically is important for sustainability. • Separates poor quality and defective products • It has an alarm feature and gives warnings.	• Sharing of personal data with third parties • Some smart gloves do not include a Web interface • Security is compromised due to too many open-access networks. • Since it continuously records data, problems may be encountered in processing large data. • Selling data to different businesses in digital environments • Installation of malware and cybersecurity breaches • Cross-device integration • Lack of internet infrastructure • Ethical elements • Social Concerns • Products are expensive

As seen in Table. 3, the advantages and disadvantages of smart gloves in logistics are listed in line with the extensive literature. Technology advances every day and new needs emerge. To meet these needs, much research is carried out and new technologies are adapted to business and business processes. Smart gloves are one of them and can be developed according to need.

DISCUSSION AND CONCONCLUSION

The increase in national and international trade and the replacement of traditional trade with e-commerce have enabled the further development of logistics. Especially in recent years, with the impact of COVID-19, e-commerce has developed and logistics services have also gained momentum. Many logistics companies continue their activities in an environment of globalization and fierce competition. Logistics companies that want to gain a competitive advantage in a fiercely competitive environment also improve their processes by investing in technology and proving that they are superior to other companies. When choosing technology, it is necessary to make some strategic decisions to determine which technology will be used. The aim of technology selection is that the technological element to be invested in should positively affect the business and increase its effectiveness and efficiency of the business. Speed, efficiency, and traceability are very important concepts for logistics. With Logistics 4.0, significant successes have been achieved in logistics and supply chain. Smart logistics

applications have positively affected logistics processes and increased their performance. In recent years, wearable technological products have been widely used in production and logistics areas. Smart gloves, especially used in logistics, have reduced processes by 50%.

This study was planned to emphasize the use of smart technologies and the importance of smart gloves in 4.0 logistics and supply chain management. Wearable technologies are current technologies, and since they are new, studies on the subject are quite limited. Çetinkaya (2022). He examined smart assets in logistics, including smart gloves, and gave examples. Müezzinoğlu and Karaköse (2021) designed a wearable smart glove to ensure interaction and control of Unmanned Aerial Vehicles (UAV). In the basic structure of the smart glove; Recognition of hand movements was carried out with equipment containing flexibility sensors. Hand movement types were determined by taking hand movement samples from 20 different people. The accuracy rate of the classification was determined as 96.8%. UAV control was carried out in the simulation environment. Real-time data was transmitted to the UAV simulation that we developed in the Unity environment. It has been observed that our wearable smart glove system works with a minimum of 96% and a maximum of 97.6% accuracy when operated 10 times.

Jurenka et al., (2020). He stated that smart gloves are widely used in the automotive and logistics sectors and increase efficiency and performance in business processes. Scheuermann et al., (2017). They evaluated smart glove design in the design of wearable technologies in 27 participants. While 59% of the participants accepted the two-glove design, 41% preferred the single-glove design.

Scheuermann, et al., (2016). He developed a smartwatch and smart gloves. They stated that, compared to the smallest handheld scanning devices sold on the market, it offers benefits in terms of human support, reduces physical fatigue of arms, hands, and fingers, and increases user acceptance. They stated that the time difference when using smart glove types is smaller compared to the handheld version and the amount of error is reduced by 66 percent. Aiming for sustainability, CarrefourSA saves 50 percent in time and cost by using the smart glove Glogi.

Türkiye produces smart gloves. Smart gloves are produced in Turkey and exported to many countries around the world. The reason why domestic smart gloves are preferred in logistics is that the reliability of manual systems of other products is low, and foreign companies working on product-stock tracking systems are not preferred because their systems are not integrated. Users prefer Turkish brands because they think they will receive timely and sufficient technical support. Studies on wearable technologies are few. As smart gloves are used in logistics and production, research will increase.

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