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Big Data IoT-based Agile-Lean Logistic in Pharmaceutical Industries

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ABSTRACT

Purpose: In today's world, with the presence of huge volumes of data, although organizations have faced many problems, using big data analysis has been able to significantly improve their efficiency and integrate information in the supply chain through the topic of computing. Cloud and big data achieve coordination between components and improve communication. On the other hand, Internet of Things (IoT) technology tools are one of the most important sources of big data production, and understanding and correct use of this data and their timely analysis using big data analysis techniques and technologies based on artificial intelligence can be effective steps to improve supply chain processes. Also, the use of these technologies can play an important role in process agility and, as a result, supply chain resilience.

Methodology: In this study, the dimensions and key components of the use of large data obtained from the Internet of Things (IoT) in an industry's supply chain are investigated as a case study. Finally, a model for implementing an agile and lean supply chain based on IoT data analysis to improve the supply chain performance of these industries during emergency drug distribution during critical conditions is presented.

Findings: This study shows that these technologies can be used as a powerful enabler, especially in the distribution of fast-acting pharmaceutical products.

Originality/Value: In this paper a model for implementing an agile and lean supply chain based on IoT data analysis to improve the supply chain performance of these industries during emergency drug distribution during critical conditions is presented.

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1. Introduction

The dramatic increase in the amount of data generated on the Internet has led to a large amount of information. But this has not been the case in the past, and organizations have not understood big data and its use in decision making, and gradually the culture of using it and the maturity model of data analysis has emerged. Large data is a collection of data that is stored as structured or unstructured, and is complex data that consists of various dimensions. The first characteristic of large data is their volume, which refers to their quantity and quantity, and due to the large volume, their management, analysis is different and is not done by traditional databases [1]. In a complex and dynamic business environment, intelligent macro-analysis and analysis will be more than just a term that has been coined, but this approach is an important way to improve decision-making and ensure that you are superior to your competitors [2]. Supply chain management, a set of methods used for the effective and efficient integration of suppliers, manufacturers, warehouses and vendors in order to minimize system costs and meet service needs, the right number of goods in the right place at the right time Suitable for production and distribution [3]. The Internet of Things is one of the most important sources of big data. The Internet of Things, in addition to being a revolutionary technology for all industries; It has also demonstrated its potential in processes such as supply chain. Management, forecasting and monitoring applications help managers improve the operational efficiency of their company distribution and increase transparency in their decisions [4]. So more than ever, the benefits of using the Internet of Things are evident in the supply chain. The IoT provides executives with a coherent flow of big data in real time about product location and shipping environment. In this way, you will be warned if the goods are transported in the wrong direction and you can monitor the delivery of finished goods and raw materials [5].

Because of the environment sensors and the production of big data using this tool, managers can track transport conditions and actively respond to changes. For example, one of the most common IoT solutions in the supply chain is displaying information about in-car temperature, pressure, humidity, and other factors that can compromise product integrity. These conditions can also be adjusted automatically [6]. Pharmaceutical industry as one of the most important strategic industries in countries in the field of FMCG has a tremendous impact on human life and timely distribution of these products can be of great importance. Because drugs always have special characteristics in terms of storage and must be distributed and delivered in a timely manner. Using IoT-specific big data can be an effective help to improve the supply chain performance of these vital industries. Due to the importance of this issue in this research, a framework for a distribution system of the pharmaceutical industry in the supply chain affected by large data from the Internet of Things is presented. In order to investigate reputable pharmaceutical companies whose employees in the supply chain had a long history and were also familiar with the concepts of information technology and digital technologies were used as a case study (5 pharmaceutical companies due to the access of the authors). Providing this analytical framework can help to effectively implement an agile distribution system based on transformational technologies and show the relationships to the effective factors well. Therefore, understanding this framework can be useful for supply chain managers of FMCG organizations, especially the pharmaceutical industry.

The structure of this article is as follows in the second part of the literature review. In the third part, the most important effects of the Internet of Things and big data on the distribution system are discussed. In the fourth section, the relationships of key elements affecting the agility of the distribution system based on big data obtained from the Internet of Things in the supply chain of the pharmaceutical industry are presented. In the fifth section, a conceptual framework is drawn and finally in the sixth section, a discussion and conclusion are presented.

2. Literature Review

2.1. Big Data in Logistics

In the age of big data, due to the high volume of information, organizations, although they have faced many problems, have been able to greatly improve their efficiency by using big data analysis, and by integrating information in the supply chain by The topic of cloud computing and big data to achieve coordination between components and improve communication [6]. Data contains value, and companies must invest in a variety of data sources and their appropriate and in-depth analysis through the use of big data analytics. This technology not only allows decision makers to make faster decisions, but also allows them to analyze large amounts of data faster to determine the best course of action for a particular situation. One way to adapt to this diversity is to increase data sources through better use of big data analysis (data analysis). Companies that use business analytics believe that their performance has improved [7].

Analyzing large amounts of information from different databases provides the ability to improve supply chain performance for supply chain managers. A number of examples have been cited in which this type of analysis can affect the supply chain and distribution performance [8]. Big data has a variety of applications in various areas of human life. In the field of marketing and big business, data helps organizations understand customer behavior and set goals based on it. As a result, production and business processes improve. Since the advent of big data, they have been used in a variety of ways to make transportation easier and more efficient [9]. Metadata can be used to estimate the needs of passengers on different routes and to plan to reduce their waiting time. Like Google Maps, which helps people find the shortest and fastest routes by estimating traffic congestion on different routes and traffic patterns. Timely processing of metadata and analysis of information identifying accident-prone areas can also help reduce accidents and increase traffic safety. Despite the various challenges in the distribution industry, big data for private organizations and the government still has many applications in this area. Things like traffic control, route planning, intelligent transportation systems, congestion management (by predicting traffic conditions), revenue management, technology advances, competitive advantage (by consolidating shipments and optimizing cargo handling), route planning to save fuel, and so on. Travel time and coordination in the distribution of materials are all big data applications in distribution [10]. The evidence is clear: data-driven decisions are better decisions. Leaders will either accept this fact or give their place to other leaders who accept this fact [11]. In every industry, companies that know how to combine expertise in a particular field of work with data science will outperform their competitors. We can not say that all the winners of the game will use Big Data to change the decision. But data tells us that big data must be used to win.

2.2. IoT and Logistics

The Internet of Things, in addition to being a revolutionary technology for all industries; It has also demonstrated its potential in processes such as supply chain. Management, forecasting and monitoring applications help managers improve the operational efficiency of their company distribution and increase transparency in their decisions. So more than ever, the benefits of using the Internet of Things are evident in the supply chain. Tracking and monitoring is one of the main goals of IoT deployment in supply chain management. This technology allows warehouse and fleet managers to track their shipments and inventory. However, the IoT has more potential for the supply chain [12].

Managers use IoT devices and data analysis systems to improve decision quality and increase the accuracy of delivery forecasts. Thanks to real-time tracking, companies are able to monitor goods

during shipment and forecast delivery, as well as predict and reduce risks associated with delays [13]. The integration of IoT-based supply chain management systems is one of the most important technological trends in warehouse. Its benefits range from increasing the efficiency of warehousing processes to better inventory management and employee safety. For example, thanks to real-time location trackers, on-site employees can easily find goods and get to the exact aisle of a particular product faster. In this case, the IoT enables seamless workflow and performance that would otherwise be impossible to achieve. In addition, the Internet of Things, along with artificial intelligence, fully automates the warehouse. IoT and data analysis help supply chain managers plan for potential accidents or other delays, taking into account traffic and weather. The Internet of Things controls all the data needed to prepare for flexible scheduling and to achieve due delays. This technology immediately provides the necessary warnings to supply chain managers [14].

There are many benefits to using the Internet of Things in the pharmaceutical industry. These benefits include comprehensive monitoring through intelligent sensors, process automation using robots, drones, and other autonomous equipment for transportation, and the emergence of new models for business transactions. In addition, the technology increases the loyalty of customers concerned about the quality and health of the drug by mechanizing the production and distribution process. The integration of blockchain and artificial intelligence and the Internet of Things will be a revolutionary factor in the supply of pharmaceuticals and health products [15].

The Internet of Things can be used in the supply chain to improve the efficiency of information transfer between parts of the supply chain. Unnecessary transaction costs are eliminated due to the effectiveness of the information exchange because companies will have a closer relationship with each other. On the other hand, inventory is reduced because supply and demand information is transferred in a timely manner and improves the use of stored information, as well as costs of storage and labor in the logistics center are reduced.

3. The Effects of Big Data and the Internet of Things on Lean-Agile Systems

Despite this growing acceptance, some organizations are implementing IoT technologies because of uncertainty about whether they are equipped to manage big data, costs, skills shortages, and security concerns.

As 5G technology becomes more ubiquitous, small chips are capable of transmitting huge amounts of data. These chips can be placed on the collar of the shirt or on the base of the table, or attached to the cardboard packaging of a cup of coffee. With this technology, anything you want to track can be tracked [16]. They can report location and state of consciousness (temperature, humidity, slope, etc.). Data can be accessed from anywhere in the world in real time - anyone who needs to be notified of delays, deviations, unexpected stops and crashes. IoT device data can be encrypted and shared using blockchain, so that customers and suppliers have an instantaneous record of a transaction as the transaction progresses. This facilitates immediate payments and reduces the need for credit lines [17]. The Internet of Things is creating a global network, but with a focus on individuals. Instead of using barcode scanners, it will be economical to use sensors to track property in the near future. Showing the exact location of the goods at any time allows the customer to be informed of the exact time of delivery of the goods. The supply chain is moving to a place that is primarily dependent on technology for advancement. Organizations are looking for quick, easy, and prompt solutions to optimize supply chain performance and minimize supply chain risk to better equip themselves to meet customer needs.

However, modern supply chains are global and complex [18]. This complexity makes optimizing supply chain performance more challenging because a wider range of demands must be met. The key characteristics of an agile supply chain are shown in Figure (1).

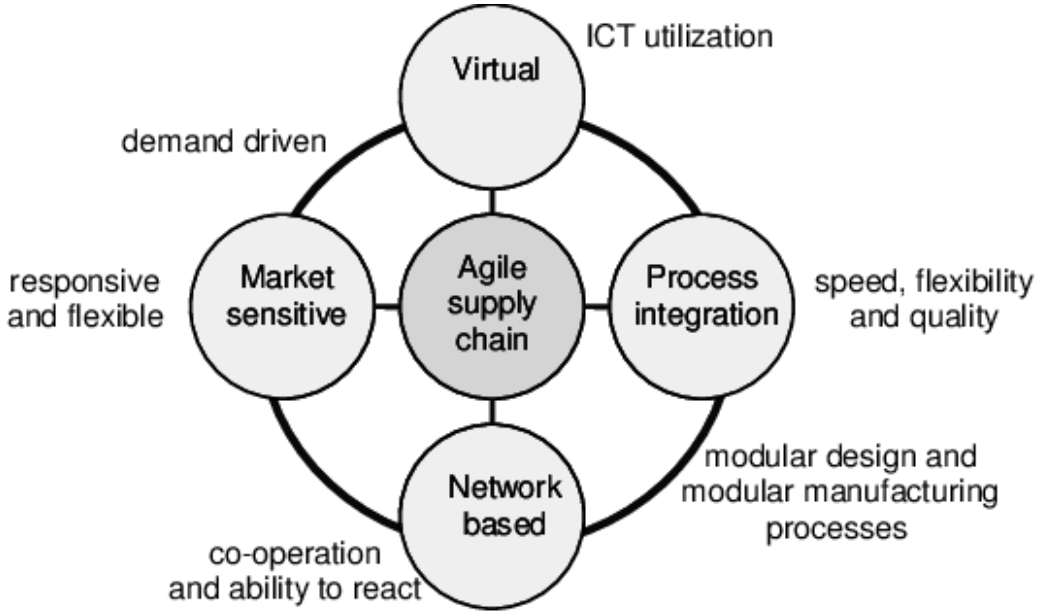

Fig. 1. Key features of an agile supply chain [19]

4. Agile-Lean Logistics Framework based on Big Data-IoT in the Pharmaceutical Industry

4.1. IoT-based Smart Logistics Architecture

When a batch of rare vaccines and drugs leaves a pharmaceutical company for another country, each of the thousands of small vials has the potential to save a child's life. But only if the contents of the container are kept cool during the long journey can this be saved. Medications have been tracked since the drugs were shipped. The chips record their location and accurately show the route and movement conditions. Importantly, controllable chips and sensors also control the temperature of vaccines and drugs. From refrigerated trucks, cargo warehouses, sensors return this information to both the manufacturer and the medical center that sent the order [20]. So doctors and medical staff can see where the medicines are and when they are available. Are they certainly in excellent condition and will they reach their destination in accurate time treasures or not? These technological tools, such as the Internet of Things and the big data that are extracted and transmitted by them, can plan an immunization program that will keep a community away from a deadly disease for a generation. Due to the importance of the issue and the need for rapid activities without maximum waste wastage, in this study was attempted to provide an analytical framework to show the dimensions and key components of this logistics system in the pharmaceutical industry. For this purpose, the opinions of experts active in 5 reputable pharmaceutical companies (due to the authors' access) who had high work experience and were familiar with the concepts of information technology as well as digital developments were used. The IoT

architecture is used to access this framework. This architecture has three stages as shown in Figure (2) and is based on a logistics system in the pharmaceutical supply chain.

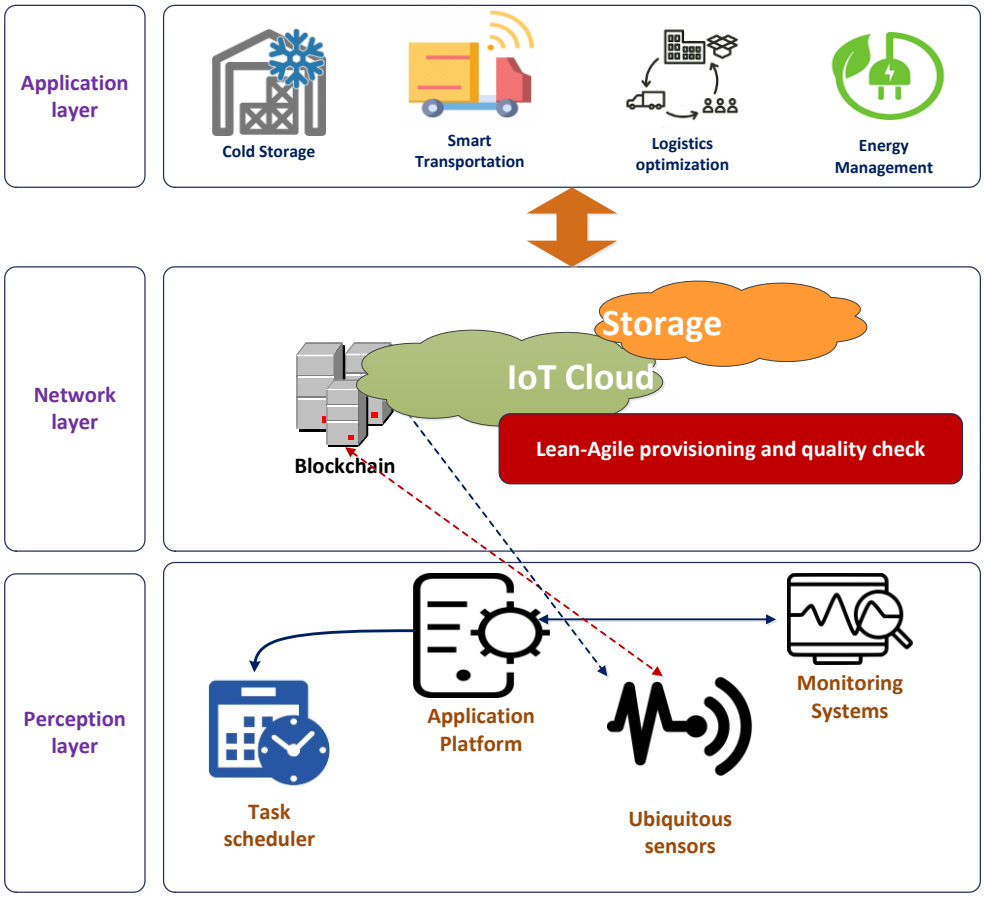

Fig. 2. IoT architecture based on logistics system

The architecture presented in Figure (2) includes the layer of technology applications in the logistics system, network layers and big data storage, and finally the perception layer. The perceptual layer actually represents IoT-based tools that are responsible for extracting, refining, and monitoring generated data [21].

4.2. Agile Smart Logistics based on Big Data and IoT

Agility drivers are the elements that motivate a company to understand the need for improved agility. In agile supply chain, the goal is to achieve supply chain goals such as customer satisfaction, cost effectiveness, timeliness, reliability, quality and profitability. As mentioned, the Internet of Things is one of the most important sources of big data production [22, 23]. This data is extracted and absorbed using sensors in different parts of the transportation, warehousing and distribution system. Adds and analyzes data using analytical tools such as machine learning and helps with quick decision-making and timely performance. In the pharmaceutical industry, the storage of products and raw materials are all highly sensitive and require serious attention. Some materials must be stored at a certain temperature, so the use of chips and IoT sensors can be a good tool for temperature control and monitoring. Fast and timely distribution of certain drugs and transportation conditions are other features that can increase its power and capability by using the IoT-based control system and analyzing the big data obtained from these technologies. Dimensions and components of agile smart logistics are shown in Figure (3).

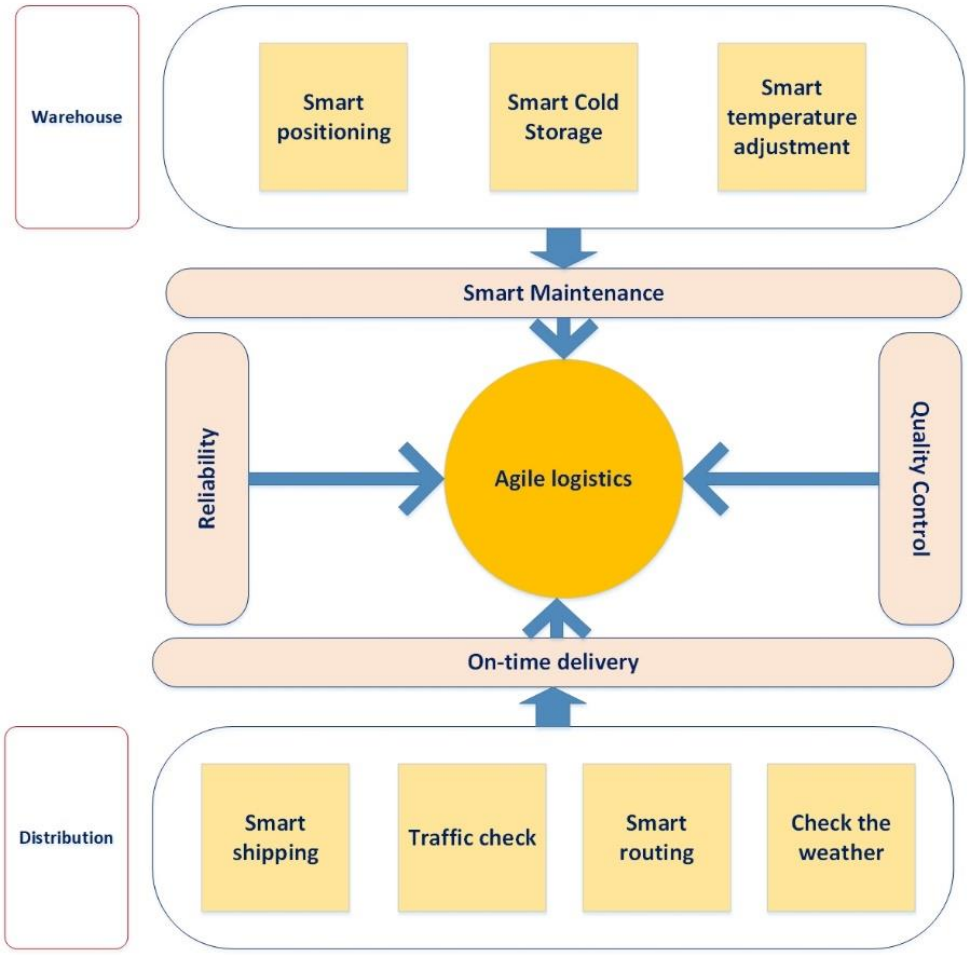

Fig. 3. Agile Smart logistics components

The big data sense and decision response aspects as well as the balance between maintenance and distribution in a logistics network for the pharmaceutical industry are included in the proposed framework.

4.3. Lean Smart Logistics based on Big Data and IoT

The IoT provides real-time insight into every move your goods make in the supply chain, and more responsibility than ever before. In addition, IoT eliminates many of the paperwork requirements prone to supply chain management error and simplifies processes for less efficient and efficient management of your product from warehouse to final destination. Using the big data from the Internet of Things, you can select accurate and traffic-free mirrors with the least amount of climate change, which can be timely and effective in distribution. Reduce excess energy consumption with the right timing to move towards lean logistics.

If a truck is delayed in traffic, a box is forgotten at a transfer stop, or a driver's office documents do not match, medications can be effectively left in limbo, requiring special distribution and storage of the medication. It is not desirable at all. In this case, while you wait to find out what happens and your end customer will remain undecided. Delayed, misdirected or lost goods are one of the most important reasons for the failure of transactions in the field of arbitration industry and related to the health of communities. With the power of the Internet of Things and the analysis of the big data it generates, one can rely on data received from a wide range of sources. This tool provides a clear picture of the route

the consignment is taking, allowing you to quickly resolve any strokes before they affect your business. IoT sensors can send you real-time information not only about the physical location of the package, but also about how it is transported, proper temperature control, time to arrival, and much more.

4.4. Proposed Framework

Provides instant tracking with an IoT-enabled smart tracker, great connectivity and deep coverage of all aspects of your supply chain, minimizes costly errors and lets you integrate and separate supply lines as needed to store space And maximize the load and minimize the waste of resource space. By using and emphasizing the types of data obtained from timely distribution maintenance, based on the Internet of Things and up-to-date technology such as blockchain, it can ensure high time and energy waste as well as accuracy and health of products.

Therefore, in this study, an attempt was made to design a framework for intelligent logistics system and the power of big data and the Internet of Things by examining the dimensions and components of a lean and agile supply chain system. For this purpose, the pharmaceutical industry was considered as a case study due to the nature of products as well as raw materials and the direct relationship with human health. Therefore, the opinions of experts active in these organizations were used for analysis, evaluation and validation.

Smart and timely maintenance and distribution is one of the most important dimensions of this framework. IoT tools are responsible for receiving, refining and storing data. Data analysis in the context of technologies such as machine learning and artificial intelligence can multiply decision-making power. Transparency and performance-based data are the most important features of IoT-derived data. Therefore, routing, traffic analysis and transportation. Optimal quotation is considered as the output of an intelligent logistics system based on transformational technologies.

In addition, the optimal layout with emphasis on the properties of materials and products will also emphasize energy waste. The combination of these actuators and tools creates a powerful agile-Lean logistics system. Figure (4) shows the proposed framework for the agile-lean time chain with an emphasis on big data technologies and the Internet of Things in the pharmaceutical industry.

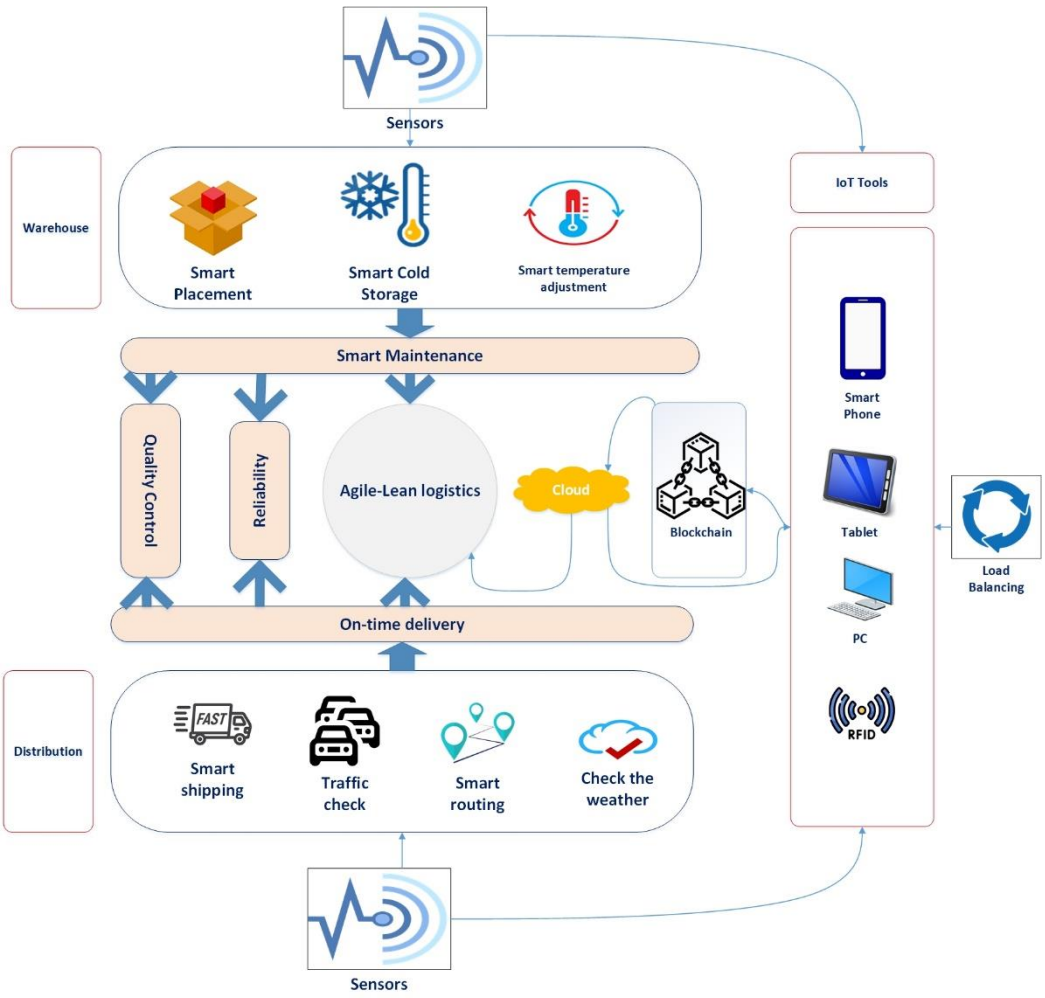

Fig. 4. Agile-lean smart logistics conceptual framework

In the agile-lean logistics network, all products are always traceable by IoT-based sensors, and the data received from the devices of this technology can be combined with the data sent from the fleet vehicles and warehouse locations to Get a clear picture of each shipment and its journey. Warehouse failure, traffic increase, network gap, change of destination; All of this can be managed in real time, and on-the-go adaptation keeps customers satisfied. The implementation of this logistics system in the pharmaceutical industry has affected various parameters. The growth rate of the percentage of efficiency effects on agile-lean logistics parameters according to the case studies on 5 pharmaceutical companies is shown in Figure (5). The growth chart clearly shows the efficiency in different sectors.

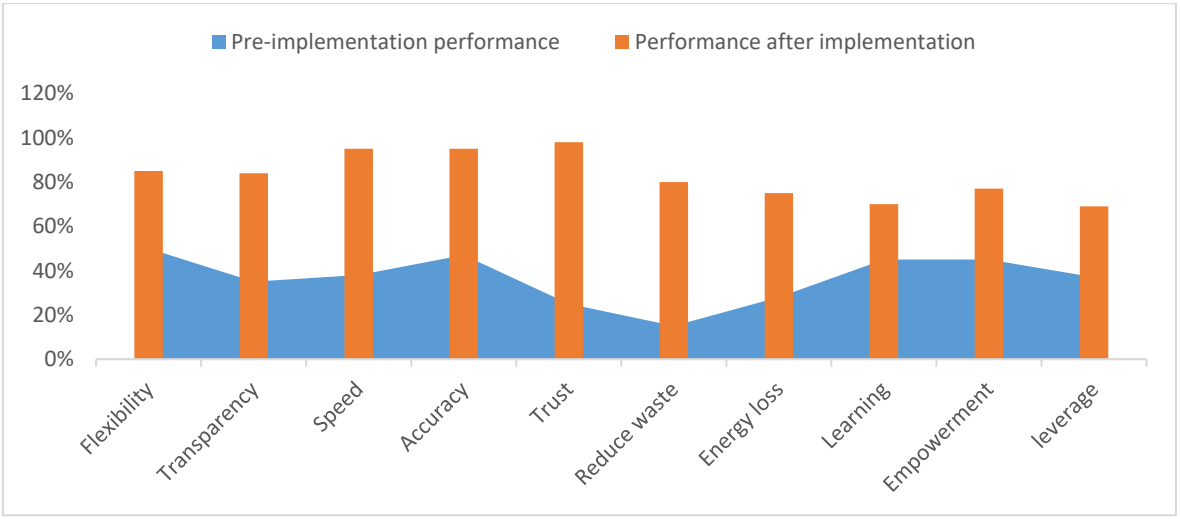

Fig. 5. Percentage of performance changes on various parameters in lean-agile logistics network based on big data and IoT

5. Conclusion

Lean thinking and agile production have been widely considered two new philosophies of supply chain management. Lean thinking is related to concepts such as total quality management and timely production, and agile production is associated with flexible production and mass customer orientation. In recent years, another business philosophy called agile, which is a combination of agile-lean thinking, has emerged as one of the options for the supply chain of organizations, so the benefits of being lean (eliminating waste) and also has the flexibility of agile production. An agile-lean logistics system is a tensile system with successive product replacements in small shipments, which are deployed between companies and facilities along the value stream.

Due to the complexity of the supply chain and in order to better manage those companies, new technologies are considered as a potential factor in improving the performance of their supply chain. The use of these technologies can help companies as a competitive advantage and improve their performance in the supply chain. One of these emerging IoT technologies is one of the most important sources of big data generation. Coverage of this information accurately and in an instant facilitates matters and makes the progress of processes in logistics systems more transparent. In addition, other IoT capabilities such as facilitating object communication, integrating monitoring devices and data analysis, and cyberspace can be used to provide the customer with supply chain management. To do this, we need to provide a model that defines how Internet technology relates to objects, cloud computing, and logistics systems.

In the present study, an attempt was made to provide a framework for an agile-lean logistics system based on big data and the Internet of Things. In order to extract the components of this system, the opinions of experts active in the supply chain of the pharmaceutical industry have been used. These industries are of great importance in people's lives and due to the nature of their products and raw materials, the maintenance and distribution of these products is of great importance. Therefore, the framework has been created by emphasizing the characteristics of these industries. This framework demonstrates the key dimensions, components, and indicators that affect the agility and purity of the intelligent supply chain with big data from the Internet of Things.

Implementation of smart supply chain in pharmaceutical organizations shows that using this approach, in addition to increasing organizational efficiency and increasing the speed of audience access to products and ensuring the health of products, prevent energy loss and increase the volume of waste in the organization and thus play a significant role in It has the satisfaction of customers and at the same time the owners of these industries. This satisfaction is one of the most important results of the agile-lean logistics system.

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