

**INFLUENCE OF RFID IMPLEMENTATION FOR LOGISTICS
MANAGEMENT IN PANDEMIC ERA**



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PLAGIARISM

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ABSTRACT

In today's world, the importance of transaction speed, cost reduction and customer satisfaction is emphasized in every subset of supply chain management. In this direction, RFID applications show several times superiority in all statistics compared to barcodes and other old systems. RFID installations were not preferred because they seemed expensive at first. Over time, the experience on the implementation has revealed that RFID implementations prevent indirect damages, save time and reduce manpower costs.

It has made product tracking very easy in warehouse management and transportation areas, which are subsets of supply chain management, and has contributed to the principle of transparency by allowing the end user to track and trace even before the product reaches his hands via mobile applications.

It has reasonably reduced the risks of loss and theft in companies that make multimodal transportation at the global level, such as UPS, DHL, FedEx. Apart from these advantages, the quality of use is higher than the old systems. Product identification can be made from distances of 10 meters and above. Many details such as the product's origin, buyer information, product type and quantity are instantly reflected on the data screen.

The fact that all these processes are carried out with computer support at this speed also reduces the cost of manpower and prevents errors that may occur by human hands. Especially during the pandemic era, its importance has increased even more as it eliminates human contact and infection.

ÖZET

Günümüz dünyasında tedarik zinciri yönetiminin her alt kümesinde işlem hızının, maliyetleri azaltmanın ve müşteri memnuniyetinin önemi vurgulanmaktadır. Bu doğrultuda barkod ve diğer eski sistemlere nazaran RFID uygulamaları tüm istatistiklerde birkaç kat üstünlük göstermekte. RFID kurulumları ilk etapta pahalı görünmesi nedeniyle tercih edilmedi. Zamanla uygulama üzerindeki tecrübeler RFID uygulamalarının dolaylı yoldan oluşan hasarların önüne geçtiği, zamandan tasarruf sağladığı ve insan gücü maliyetlerinin azaldığını göz önüne sermiştir.

Tedarik zinciri yönetiminin alt kümeleri olan depo yönetimi ve nakliye alanlarında ürün takibini çok kolay hale getirmiş ve ürün mobil uygulamalar üzerinden son kullanıcının dahi henüz eline ulaşmadan takibini yapmasına olanak sağlayarak şeffaflık ilkesine katkıda bulunmuştur.

UPS, DHL, FedEx gibi global seviyede multimodel taşımacılık yapan firmalarda kayıp ve çalıntı risklerini makul oranda düşürmüştür. Bu avantajlarının dışında kullanım kalitesi eski sistemlere göre daha yüksektir. Ürün tanımlaması 10 metre ve üzeri mesafelerden yapılabilir. Ürüne ait orijin, alıcı bilgisi, ürün çeşit ve miktarı gibi bir çok detay data ekranına anlık olarak yansımaktadır.

Tüm bu işlemlerin bu hızda bilgisayar destekli yapılması da insan gücü maliyetini düşürüp, insan elinden oluşabilecek hataların önüne geçmektedir. Özellikle pandemi döneminde insan temasını ortadan kaldırdığı için önemi daha da artmıştır.

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INTRODUCTION

In today's dynamic business ecosystem, the firms must keep up with this dynamic change to ensure flexibility, customer satisfaction and it becomes necessary to reduce production volumes and satisfy customer specific needs. Processes like globalization of the market, enormous diversity of the products, sophisticated management system and competitive rivalry lead to integration with supply chain and logistic system.

In this dynamic world, highly competitive as well, logistics firms are compelled to seek out the best technologies. In response to the increasing demand for extensive logistics services, logistics firms provide lots of new services. They also make their facilities accessible to courier companies. forces logistics centers to search for optimal technologies. With relation to the growing demand for comprehensive logistics services, logistics centers offer a wide range of services and render their infrastructure available, which is adjusted to the needs of courier firms. Only by integrating technologies like enterprise resource planning systems (ERP) and radio frequency identification (RFID) technology to increase operational efficiencies and build stronger relationships with their business partners would they be able to do this.¹ This is the part of the internal and external communication and information integration process for the enterprises.

When it comes to the radio frequency identification (RFID) technology, it is a remarkable business tool that's used in logistic and supply chain management. RFID is

¹ Gordana Matičević, Mirjana Čičak, Tadija Lovrić, RFID and Supply Chain Management for Manufacturing Digital Enterprise, www.intechopen.com

an acronym for “radio-frequency identification”. This refers to a technology in which digital data encoded in RFID tags and a reader via radio waves captures smart labels. RFID is similar to barcoding in that it collects data from a tag or label and stores it in a database. RFID, on the other hand, has many advantages over barcode asset tracking apps. The most important difference is that RFID tag data can be read without needing to be matched with an optical scanner, while barcode data must be attached with an optical scanner.² RFID is a spreading technology all around the world that enables close cooperation of the supply chain partners by real-time information visibility.³ In addition to this, RFID is one of the main tool which provides efficient solutions for the supply chain. Indeed, RFID reinforces it through application of itself and these applications facilitate to handle materials, manage assets and increase products availability. Besides, the widespread use of RFID in the supply chain has simplified the tracking of products such as assets, packages, and multi-task containers.

Since this extraordinary Covid-19 era has affected the world it has been seen that many firms should take this extraordinary situation into consideration and find a way out to not to be affected or at least to be minimally damaged. Covid-19 affected all the international trade by cutting all the supply chain management networks and logistic systems which were the key elements of the international trade. From another point of view, even though Covid-19 affected this system logistic system and supply chain managements adapted to this situation and moreover these systems were applicated against this extraordinary situation.

² <https://www.abr.com/>

³ Matičević, Čičak and Lovrić

In this context, while there has been a relation between logistic and Covid-19, it would be useful to examine this relation between Covid-19 and logistic. First, we will be studying international door to door logistic to understand the basis of the logistic system. Secondly, we are going to search for the RFID-based warehouse logistic management to understand the importance of the RFID and to understand its applications in logistic. Lastly, we are going to try to understand this mutual relation of pandemic and logistic sector by searching for the applications of RFID in this era.



1. RFID-BASED WAREHOUSE LOGISTICS MANAGEMENT

Radio-Frequency Identification (RFID) technology is a wireless sensor technology that uses electromagnetic signals. Radio frequency identification technology is a remarkable business tool for not only supply chain management but also for a specific business stage such as logistic management. RFID is a growing technology that enables close cooperation of the supply chain partners by real-time information visibility.⁴

In today's information age, it is very important not only that information exists as data, but also that it is used properly, in a coordinated and efficient way. This situation is also becoming a priority issue for the business, industrial and manufacturing sectors. In addition, the fact that information inaccuracy can affect supply chain in opposite way. These affects may be due lack of inventories, delay in shipments, sales decrease and as a whole it affects customer satisfaction.⁵

1.1.RFID in Logistic Management and Door to Door Logistic

Keeping up with the benefits of technology and being able to use data more effectively is an indispensable element of the logistics sector. In this context, this process can be made more effective by using the information obtained appropriately and making it in real time.

⁴ Matičević, Čičak, Lovrić, Ibid., p.517

⁵ Matičević, Čičak, Lovrić, Ibid., p.518

Without a doubt, real-time data or information is an essential key to make efficiency in progress. It is necessary to keep up with this real-time information. The lack of real-time information may end with some managerial inefficient decisions in supply chain such as machine breakdown, rush orders, human errors, etc.⁶ In this context, it is essential to use real-time information. Because as variation in production extends, this inefficient decisions may increase. Variation affects downstream members of internal supply chain and their designing and scheduling. Coordination, integration and notably sharing data in period of time regarding resource constraints, plans and schedules with different provide chain members are vital.⁷

In production process, all the connected information of every parts should be monitored and tracked one by one and this should be done strictly through its supply chain management. Because the data acquisition and change between is highly limited in ERP (enterprise resource planning systems), data is often not concrete and not reliable. Beyond that, it's typically seen that production standing data is not at the correct place and at the correct time to form competent selections. Consequently, issues in existing ways of identifying and chase elements and merchandise, disposition of elements and merchandise, schedule delay, late deliveries occur, and prices increase.⁸

Managing products correctly on the supply chain is only possible by automating the inputs of the products. Automated data acquisition enables process and distribution of

⁶ Matičević, Čičak, Lovrić, Ibid., p.517

⁷ Yin, X.F., Khoo, L.P., A hierarchical model for e-supply chain coordination and optimisation. *Journal of Manufacturing Technology Management*, 2007, Vol. 18, No. 1, pp. 7-24

⁸ Matičević, Čičak, Lovrić, Ibid.

information to everyone who needs it through manufacturer system. As digitalization grows all over the business environment, data integration becomes much more important. That is why, in terms of data flow, there must be an integral enterprise integration, and external integration of enterprise or companies with supply chain partners.⁹ Furthermore, it is important to increase the speed of data flow between systems and to establish conditions conducive to the growth of digital businesses. The term "digital enterprise" refers to a business where communication (such as information, messages, orders, documentation) is done digitally by employees, workers and machines, and even machines to machines.¹⁰ Indeed, RFID technology is one of the technologies that enable automatic object-to-object communication, which is unique to digital enterprises. That is why it is seen that RFID is one of the main factor in digitalization of manufacture enterprises.

In the composition of the RFID, it exists some IT technologies for both read and The composition of the infrastructure of RFID consists of IT solutions that read and advance data throughout the system. In this composition, radio waves are emitted by readers, which are made up of antennas and a transmitter with a decoder. This, in conjunction with the ERP method, offers detailed real-time information on the location of the object and its relocation.¹¹ That is why mutual relationship between ERP and RFID plays a supplementary role in whole system.

⁹ Matičević, Čičak, Lovrić, Ibid., p.519

¹⁰ Matičević, Čičak, Lovrić, Ibid., p.518

¹¹ Beata Skowron-Grabowska, Tomasz Szczepanik, Application of RFID technologies in logistics centres to improving operations of courier firms, 2018, p.141

The benefit of this method over traditional barcodes is that the tag allows for the labeling of any object and monitoring of its location using a reader that communicates with a transmitter via radio wave. This eliminates the need for direct label scanning. This offers a significant benefit in terms of data collection and filtering, resulting in increased speed and accuracy in the activities processed with the RFID system. However, the cost in this system is a problem. The outlay of radiolabels is significantly higher than that of conventional barcodes. This system requires the implementation of RFID technologies, as well as the required infrastructure and this cause significant price charges. In addition to this, since tags are always in use, their expense is easily recouped accordingly the IT system's ability to change details in order to reuse them.¹²

The other disadvantage of the RFID is the distortions of the system. The distortions evoked by certain substances, such as metals emitting heavy distortion or fully suffocating the radio transmission, are also limitations of the RFID system's operations. In such cases, the frequency of the radio waves may be selected to increase the frequency of the transmissions. In fact, this method allows for an efficient system of carrying out the activities of the warehousing process, from receiving products to their proper placement and stocking, picking, and final delivery from the warehouse. Fig. 1 illustrates the properties of RFID.

¹² Ibid Skowron-Grabowska, Tomasz Szczepanik

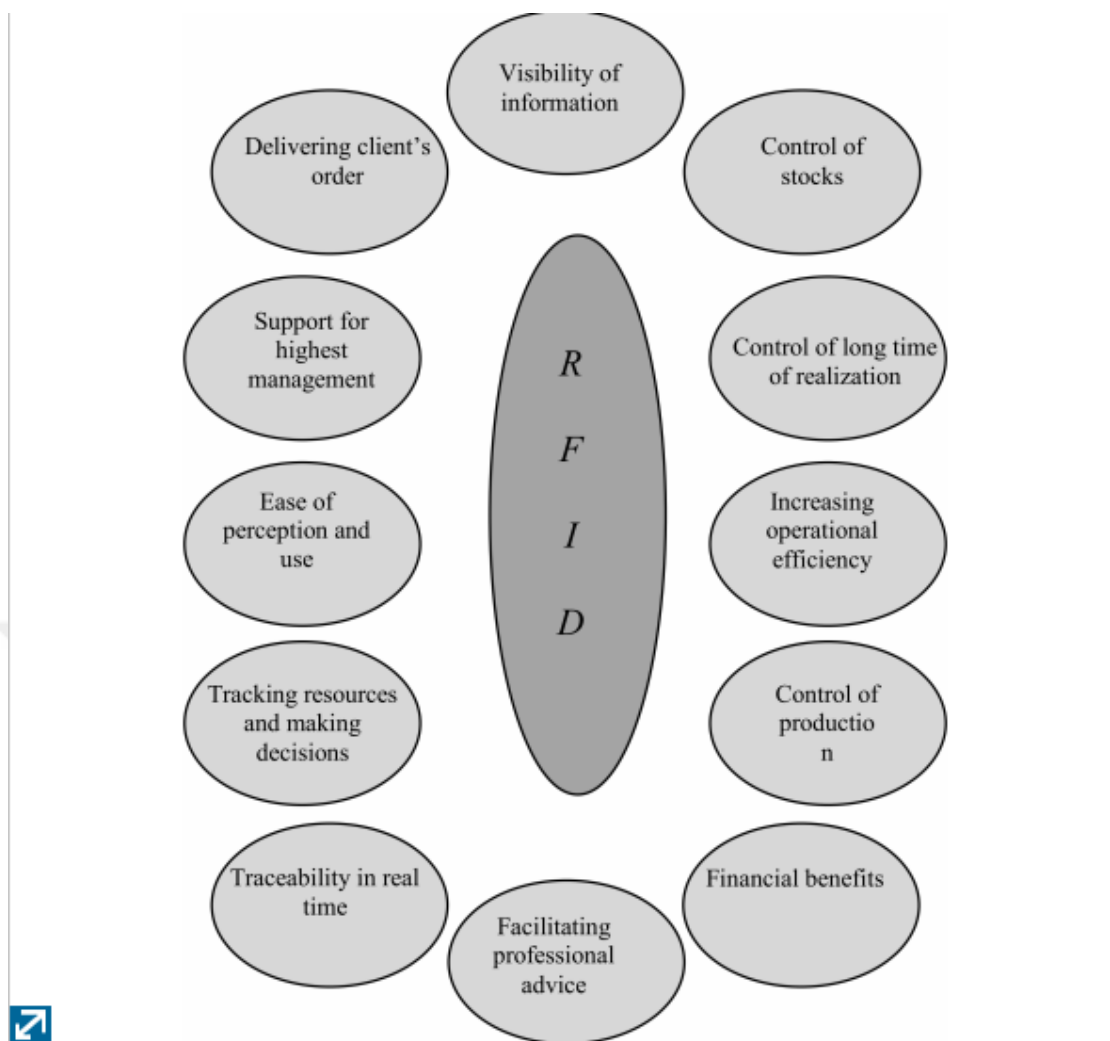


Figure 1. Properties of RFID, Source: Tomasz Szczepanik, Beata Skowron-Grabowska, Application of RFID technologies in logistics centres to improving operations of courier firms

This wireless sensor technology is based on detection electromagnetic signals. A typical RFID system includes three components: an antenna, a transceiver, and a transponder (RF tag) that is electronically programmed with unique information.¹³ The antenna emits radio signals to activate the label and to have the data read and written. The antennas establish the connection among the label and the transmitter, and the base of

¹³ K. Finkenzeller, *RFID Handbook*, second ed., Wiley, 2003, p.44

this establishment is for the acquisition of the data. The antenna is packed with the transmitter and set-top box to create a reader, which can be hand-held or fixed-mounted. The reader absorbs radio waves in ranges at this time. When an RFID tag is discovered inside the magnetism zone formed by the antenna, the reader's activation signal is detected. The input is decoded by the reader and then transferred to any device element.

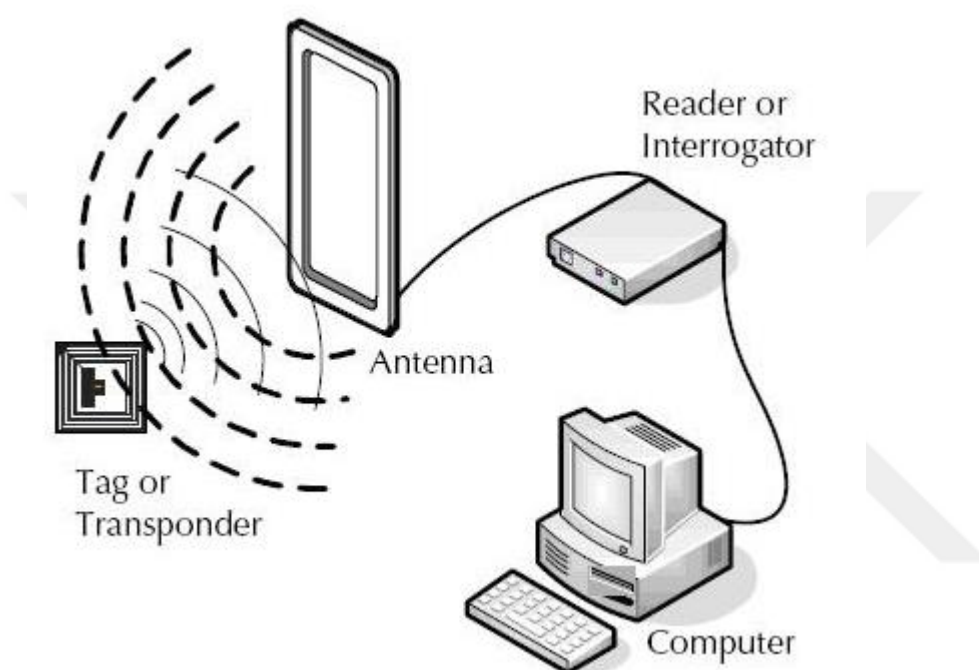


Figure 2. Basic RFID System. Source: Suvash Rijal, RFID Technology in Logistical Activities, Arcada University of Applied Sciences, April-2015 p.10

RFID technology allows for non-contact automatic detection and reading of data through the use of radio waves of varied frequencies. The technology here is, in reality, a refinement of barcode technology. It uses low-power radio signals for wireless data transmission between the RFID mark, which in this case an electrical device, label or tag, and a reader. The reader facilitates contact between information and, as a result, the tag and indirect software framework. This compresses the data, filters it to prevent

inaccuracy, and submits the enterprise's intended resources (ERP) for operations management. There is a small chip known as a tag is used in the form of labels on products and packages and contains a processor, referred to as an "IC," as well as antennas that are normally sputter coated on the material layer. The input is processed within a mobile IC, which is then transmitted through antennas. However, the range may vary as transmission depends on some causes such as the size of components, radiation amount, utilized frequency and broken signals.

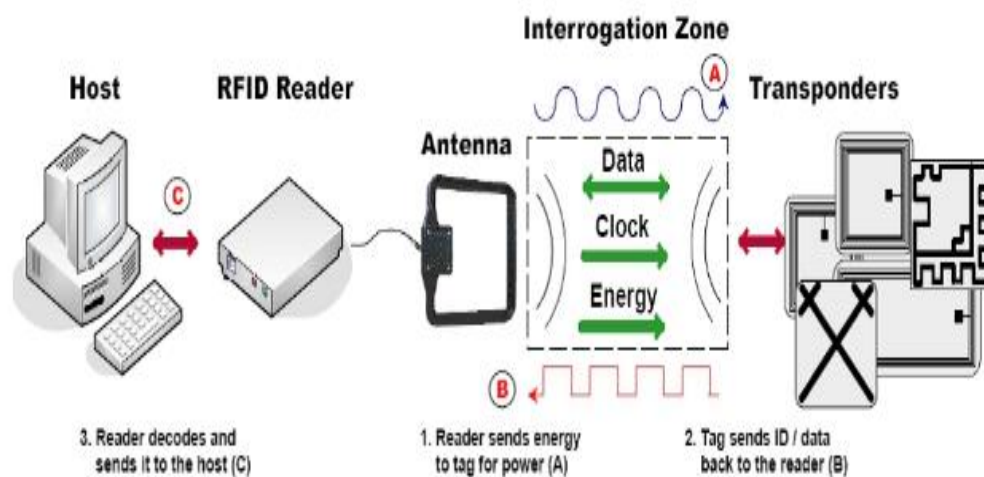


Figure 3.Process of RFID. Source: GlasserD. J.GoodmanK. W. .EinspruchN. G., Chips, Tags and Scanners: Ethical Challenges for Radio Frequency Identification. Ethics and Information Technology, 2007

As an efficient technology, RFID provides some notable advantages to users. Major advantages of using RFID are:

- RFID readers don't need a line of sight to access knowledge from the RFID tags.

- RFID systems will scan knowledge over varied vary from few centimeters to few hundred meters.
- RFID readers will interrogate, and build RFID tags readings a lot of quicker.
- RFID systems will scan and write totally different sizes of knowledge from / to the tag, supported the kind of tag.
- RFID systems will scan tags in harsh environments, with none human interference.¹⁴

As an efficient and advantageous technology, RFID is employed in numerous sectors like warehouse and inventory, freight transportation, producing-manufacturing and merchandising.

In freight transportation, RFID technology allows a reasonable product inventory control and intelligent logistics technology possible. With RFID, goods can be achieved on raw materials, semifinished and finished products, transportation, warehousing, distribution, shelves, the final sale, or even return processing and other areas to conduct real-time monitoring.

¹⁴ EL KHADDAR Mehdi Ajana, BOULMALF Mohammed, HARROUD Hamid and ELKOUTBI Mohammed, RFID Middleware Design and Architecture, June 15th 2011

Data science, and especially big data, is gaining importance every year, and this field will improve in the coming years as data science works integrated with many technologies. In this context, the development of data science together with RFID, GPS, EDI and many other similar technologies allows supply chain and logistics to develop in parallel with each passing year. Companies working in this sector have realized the potential advantage in this field. In addition, understanding the concept that efficient use of data science, especially in the supply chain and transportation, significantly reduces costs will help to expand the use of technology in this field. At this point, data science is at the heart of technology development in this field. Continuous modernizations on condition of containers in their systems can be relied on by all transporters as time goes on. The intermodal freight is an expanding business and it necessitates a greater exchange of know-how between companies. RFID plays an important role at this stage, and it is crucial in data technology.¹⁵

With the development of data science, RFID technology has also developed and started to be used in various areas of transportation. The main areas listed as follows. First, RFID is an important tool in the automating of field management and is often used. During the facet, the RFID technology is often used to robotize workflows and processes. It is used when collecting data on half-track assets across various sites and identifying shipping bottlenecks so that distribution schedules can be easily changed

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- ¹⁵ Xiaoqiang ZHANG, Qin DONG, Fangjie HU, Applications of RFID in Logistics and Supply Chains: An Overview, International Conference of Logistics Engineering and Management 2012, p.1401

within the availability chain. It also eliminates the need for written logs by allowing access to previous inputs on asset placement and status. It helps fulfill service level obligations by providing cumulative visibility into the availability chain.¹⁶

Second, RFID is an utile instrument to track and identify vehicles. This backs labor costs for vehicle processing and reduce on-site living time and this allows for better field management. Besides, it improves responsiveness to supplier and finally it fulfills the customer demands. It also increases efficiency by ensuring that no process steps are skipped and that each vehicle leaves according to dealer requirements. Last of all, it improves control of the container cargo station (SCF) and support for all types of roll and roll operations (Ro-Ro).

In recent years, RFID created a rapid development in the global circulation of commodities, tracking and logistics management. The technology improved, and obviously promoted of China's pursuit and development of RFID. Particularly, demands from large-scale manufacturing enterprises in the retail, supplying and other sectors, will promote RFID developing rapidly in the Chinese market.

RFID has become an indispensable tool for industrialists today. Because RFID allows a company to track its own production processes in real time. RFID-enabled applications would make it easier to report critical anomalies or aberrations and exceptions to any system. Firms have been able to transform authentication and

¹⁶ Chris Brown, 2011, Part 1: 5 Advantages of RFID in Transportation & Logistics, [HTTP://blogs.zebra.com](http://blogs.zebra.com), Accessed: 10.03.2021

validation within previous or current error-prone processes thanks to RFID. RFID reduces significant overlooked errors that can be costly for the company. Misused raw material or element or an incorrectly processed error in the system can be easily detected by RFID. RFID is not only used to detect errors, but also to prevent costs caused by delays. In particular, it locates semi-finished goods and finds improperly stocked inventory and by that way it reduces costs.¹⁷

In addition to rising producing enforcement, RFID is being employed to boost assurance while it is validating system users to confirm that the sensitive data is solely accessible for the competent personnel.¹⁸

In sum, benefits of RFID in manufacturing includes:

- Real-time trailing of inventory, half kits and sub-assemblies,
- Maintaining current item data on the tag - ideal for managing production of complicated or bespoke product and assemblies, eliminating the requirement for separate work on assembly standing and content,
- Automatically notifies the central product database when each process has been completed,
- Field personnel can use RFID tag data to see product options, date of manufacture, and revision levels,
- When errors square measure detected, the power to trace at the item level reduces the impact of quality remembers

¹⁷ Ibid., Zhang, Dong, Hu, p. 1402

¹⁸ Ibid., Zhang, Dong, Hu

One of the sectors where the potential use of the RFID system is very vital is the retail sector. Thanks to this system, retail companies can make competition sustainable in both the long and short term and increase their profitability.¹⁹ Indeed, with 25 trillion US dollars in worldwide, retail industry represents of the largest industry in the world.

Total retail sales worldwide from 2018 to 2022

(in trillion U.S. dollars)

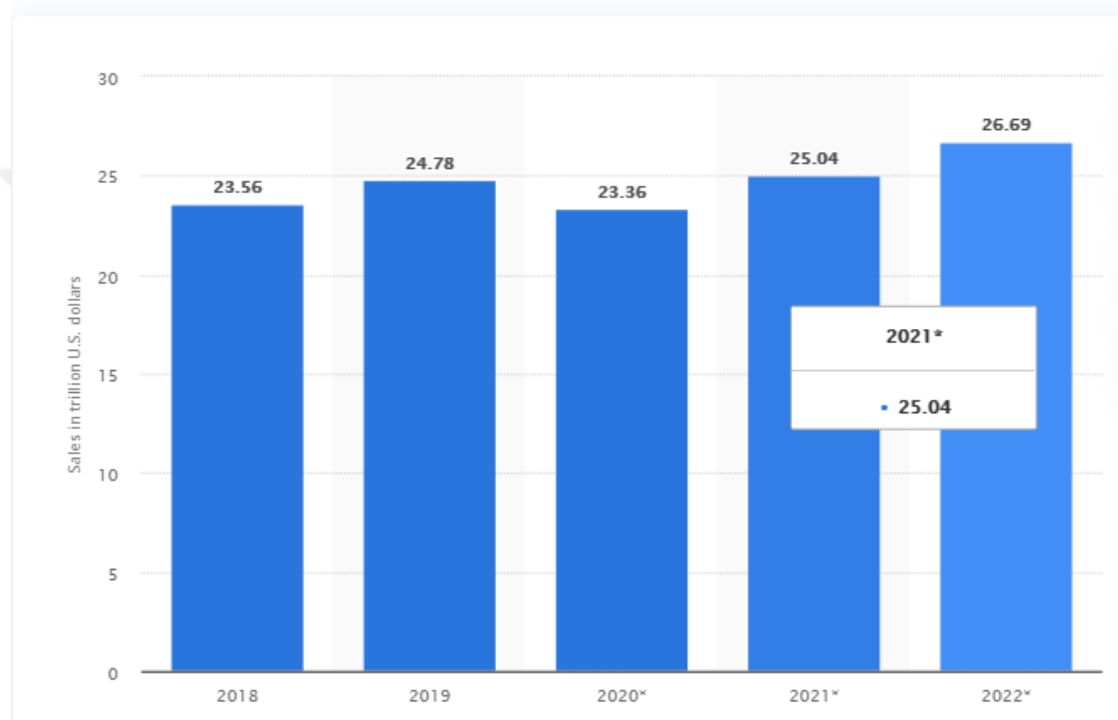


Figure 4.Total Retail Sales. Source:

<https://www.statista.com/statistics/443522/global-retail-sales/>

The expected growth of RFID usage within the retail trade may be a results of the perceived edges that would be obtained by implementing the technology. RFID will give edges like operational potency, improved visibility, reduced price, improved

¹⁹ Ibid., Zhang, Dong, Hu. p. 1403

security, improved client service levels, higher info accuracy, and accumulated sales.

The expected usage areas and levels of RFID in retail trade is as follows:²⁰

- Merchandise planning: it is associate approach aimed toward maximizing ROI through correct planning of sales and inventory. This approach is all concerning maintaining a balance between sales and inventory to extend profitableness.
- Assortment Planning: It is the way of planning that sellers or producers make their trades taking into account factors such as debt and supply.
- Sales arrangement: It is the planning method of sales that regulates all processes of the product until it reaches the customer and puts direct customer focus at the forefront.
- Cost Analysis: Cost analysis is a method of estimation that involves analyzing all financial and accounting records of a company and reducing costs where they are needed. With this estimation method, extra costs and expenses are calculated and profitability can be increased.
- Promotion planning: In this method, it is aimed to bring the planning method to the forefront and to implement the correct planning method in the balance of supply and demand.

²⁰ Mithu Bhattacharya, Chao-Hsien Chu, Tracy Mullen, 2007, RFID Implementation in Retail Industry: Current Status, Issues, and Challenges, Decision Science Institute (DSI) Conference, Phoenix AZ, 2007.

- Proper Allocation: This method aims to reduce inventory or prevent inventory absence for an order.
- Warehouse management: In this method, it is aimed to evaluate the stocks efficiently and distribute them correctly.
- Distribution: It is aimed to deliver the final product produced to the full address, complete and timely, thus improving customer focus.
- In-store operation: If the company is a multi-branch retail company, it is aimed to make the branch management properly. Beyond in-branch management, inter-branch delivery, orders and stocking must be appropriate as well.
- Sales: Managing the sales method that is directly related to revenue generation.
- Return: Managing come merchandise to form reverse provision efficient.

Warehouse and inventory are the areas which enterprises and manufacturers want to manage perfectly. That is why this warehouse and inventory management are important in global and all manufacturers have asserted this management.

While many businesses already use bar codes for inventory control, bar codes have a number of drawbacks. Therefore, in recent years, some businesses have shifted to wireless radio frequency identification (RFID) systems. Traditional inventory counts require a lot of manpower, money and time, and it is control of the quantity of goods stocks is highly inefficient and influences the time effect of the value of stocks. Using RFID technology and image combined entry with an Oracle back-end database, inventory management system can be implemented using the features of instant playback RFID tags to count regional stocks in the warehouse. This inventory management system built into a database can be used to identify slow sales items caused by long storage or an almost due period of time. Each item of goods has its own own

serial number, and the first in the first management of goods can be used to keep the product fresh and improve traditional inventory gaps.²¹

To effectively manage whether the goods have a fault or are bad products, all goods can be traced to the original supplier via the label on the goods and subsequently returned to the original supplier. This whole element tracking system can increase the company's competitiveness, and it is a set of intact product life cycles.²²

1.2.Application of RFID in Logistic and Warehouse Management System

RFID is for enhancing the systems in the supply chain management and in the transportation. More effective process of materials, particularly raw materials, more reliable asset and stock management, and improved product selection are among these enhancements. Tracking items like multitask containers is robotized by the implementation of RFID. As a result, courier firms' use of RFID allows them to streamline the processes that go into making courier deliveries. The goal is the gaining a competitive edge by disseminating vast volumes of accurate and factual input for a more efficient flow of information.²³

There are many different definitions of the concept of logistics. If we make a general definition without entering into detailed description, logistics can be characterized as a movement in trade with the right timing and proper planning of this as a whole. However, when this process is considered as a whole, it is even thought to be science.

²¹ Ibid., Zhang, Dong, Hu., p.1400

²² Chen,Hui-Ling, Inventory Issuing and Receiving Tracking System By Using RFID,ASIA UNIVERSITY, thesis, 2009

²³ Ibid Skowron-Grabowska, Tomasz Szczepanik

Nevertheless, it would be necessary to say that logistics is a very dynamic concept. Because when viewed, it is possible to say that logistics are constantly changing in operational terms with the developing technologies.²⁴²⁵ Last of all, for The Council of Supply Chain Management Professionals (CSCMP), logistics is “A major part of supply chain management that plans, implements, and controls the economical, effective forward. It also reverses flow and storage of products, services and related data between the point of origin and the point of consumption so as to meet customers’ needs.”

Basic function and objective of logistics includes procurement, maintenance, distribution, and replacement of personnel and material.²⁶ As a process, logistic comprises of different activities. Basically, logistic simplifies the flow of product from beginning, industry center point, to the final destination. In logistic, there are some activities defined from beginning to the end. These activities are Customer Response, Inventory Management, Supply Handling, Warehousing and Transportation.²⁷

The customer response is a customer-related issue and involves the commissioning of many processes to optimize customer service. There are a number of stages in these processes, such as the existence of a customer service policy and its preparation and implementation. These processes include many activities from passing the order to the delivery and billing of the order, and the ultimate goal is to ensure customer satisfaction.

²⁴ NATO.2016. NATO-Logistics, Available at: http://www.nato.int/cps/en/natohq/topics_61741.html, Accessed: 13.04.2021

²⁵ Ibid, Suvash Rijal, p.16

²⁶ Logistics World. 2016. What is logistics? Available at: <http://www.logisticsworld.com/logistics.htm>. Accessed: 13.04.2021

²⁷ Ibid, Suvash Rijal, p.17

In all this process, the main target is to reduce the cost as much as possible while delivering the product to the right address with the right timing.²⁸

Inventory management may be one of the most difficult logistics process. The main idea in inventory management is achieving higher customer levels while keeping the cost in the lowest level. Inventory management should keep their main concerns on these ideas. The only way to surpass the possible obstacles is to keep inventories as low as possible in order to satisfy the customer service policy's requirements. Stocks are treated as capital in companies. Accordingly, lacking of supply and overstocking should be taken into consideration in logistics processes. Controlling and fixing as a process, for example, is used by inventory management to ensure that all stocks are released, truly accounted, and maintained properly in the organization while handling the inventory. Controlling and in inventory management aims to make the most of a company's inventory by using technologies.²⁹

Supply planning and management always support inventory processing. Companies carry out this supply-handling activity by building inventories, either through manufacturing or procurement processes, to meet the requirements set out in inventory planning and management. It includes activities such as preparing supplier service policy, sourcing, processing purchase orders and payments. Supply handling is used to minimize the total cost of acquisition (TAC) and, at the same time, it should respect availability, response time, and inventory quality.³⁰

²⁸ Logistics Blog. 2010. Logistics activities, Available at: <https://txemainlogisticsworld.wordpress.com/2010/04/12/logistics-activities/>. Accessed: 13.04.2021

²⁹ Akrani Gaurav. 2012. What is Inventory Control? Available at: <http://kalyan-city.blogspot.fi/2012/10/what-is-inventory-control-definition.html>. Accessed: 13.04.2021

³⁰ Logistics Blog,2010

Transportation of goods does not establish a link between the different process points to final point or contrary, but also establishes a direct relationship with customer satisfaction and the cost of all process. The cost of transportation is often the highest cost within the logistics activities. As a result, they can be managed by the well preparation. That means a good network design, shipment management, cargo management and process management etc.³¹

Another part of the logistics industry and chain is warehouse. In ports, these large warehouses are called entrepots, and both the entrepots related to the port and the large warehouses used outside the port play an important role in this chain. Because these large warehouses and their management systems play an important role in maintaining and keeping the produced products in stock, as well as in stocking them in quality and in the appropriate amount. At this point, the right timing and orientation to the right place are critical administrative points. If storage management is progressed correctly, labor costs will be reduced and filling and backup operations will be made efficient. The system will be optimized by managing the timeline correctly. The most important start in ensuring administrative efficiency is the central placement of these warehouses in services and productions. Today, many companies have started to cooperate with third parties which already make these works efficient from the first step.³²

The use of RFID is becoming more common in storage areas where streaming and inputs and outputs are fast. Because RFID is an effective tool for making inventory management easier to track. As an industry where inputs and outputs are fast, the fast consumer goods sector can be cited as an example. There is always a mutual flow in

³¹ Inman Anthony. 2016. Logistics and Transportation. Available at: <http://www.referenceforbusiness.com/management/Log-Mar/Logistics-andTransportation.html>. Accessed: 13.04.2021

³² Suvash Rijal, RFID Technology in Logistical Activities, Arcada University of Applied Sciences, April-2015 p.18

the warehouses of the sector and the speed of this flow is high. Due to the rapid flow of this flow and the constant renewal of demand, the sector is constantly facing the problem of out of stock. Therefore, the control, monitoring and management of products can be seen as a challenge and rfid systems come into play at this point. The RFID system automates inventory management and prevents the problem of out-of-stock by activating when inventory in warehouses or distribution areas falls below a certain level. The problem is largely resolved because the system follows RFID tags simultaneously.³³

The retail sector is a very dynamic sector and its trends are changing with each passing day. Therefore, following trends strictly, reading customer demands correctly and directing things accordingly is essential for the success of the business. While following these developments, applying to RFID systems is a facilitating method for success. In addition, these systems are used to solve the most common problems faced by the sector, such as out-of-stocking, misplacement of products. Companies that use these RFID systems that enable monitoring systems manage to avoid these turbulences and wobbles in a serious way.³⁴

Outdated systems cause inputs from all supply chain processes not to be used properly due to their limited facilities. In this context, RFID separates from these old systems, resulting in both clear and simultaneous data and therefore a more efficient business management process. In addition, it foresees the negative consequences of problems in the supply-demand balance and ensures to overcome these problems. Changes in the balance of demand that may come to the mine are predictable thanks to these systems,

³³ Decision-craft. 2010. RFID Applications in Inventory Control. Available at: <http://www.decisioncraft.com/dmdirect/rfidapplications.htm>. Accessed: 13.04.2021

³⁴ Ibid., Decision-craft. 2010

and in the balance of supply, it increases the visibility of the product and facilitates follow-up, making it conveniently available. Because now companies use these systems to track estimated shipping times to the hour and prevent possible mishaps and interruptions. Controls prevent the cost of filling and unloading. Because it automatically processes the information of the products by reading from a distance. As a result, it offers the possibility of saving time, cost and effort.³⁵

Despite the setbacks that may occur at the macroeconomic level, it is possible to have human-induced problems in trade and industry. In addition, when technical glitches are added, the costs of the company can increase significantly and negatively affect revenues. For example, in storage processes and even in merchandising, there may be both technical and human-induced problems in the classification and proper collection and distribution of products. Sometimes problems occur even in the availability of these products. Barcode scanner systems cannot provide adequate solutions to these human-induced problems. Because barcode systems also have a partial manuality. Physically, processes create human costs such as research, scanning and replacement of products can be stretched. The biggest feature of RFID systems is that they eliminate all these processes. Thanks to the data it has, the technology follows the location of the product, checks the presence of the product and finally provides information about the products. There is no need for labor at almost any point in the processes. RFID systems do not include errors and robotically perform the entire process up to billing.³⁶

Today, the evaluation of products that are easy to spoil in stocks has become an important issue in terms of effectiveness. Because such products are sensitive, the

³⁵ Ibid., Decision-craft. 2010

³⁶ Ibid., Decision-craft. 2010

slightest carelessness may result in the wrong and defective product going to the customer. This causes the company's prestige to be lost and as a result, revenues are negatively affected. When RFID systems are activated, this issue is dealt with effectively. According to the information in the document that constitutes all inventory data kept in the computer system, it is transferred to the relevant systems at the correct time. Therefore, possible negative consequences are prevented. Thanks to this system, each product reaches the right place on time as the place and time are automatically tracked. The system holds unlimited information in its memory, and fewer people get involved. RFID not only does all this, but keeps the information from the labels up to date. As a result, the more digitalization is increased in this context, the greater the efficiency.³⁷

RFID can be seen as a world of opportunities. This applies to many industrial and manufacturing companies. While we observe the companies with large warehouses, such as Amazon, it seems that these systems are the most efficient and almost entirely robotic. Companies like Amazon improve their storage systems by increasing digitalization. This digitization is done with RFID systems in such sectors and shelves including all stores are automated. All these processes increase customer focus as product information is shared with the customer instantly.³⁸

From the beginning, that is, until the product is produced and sold, RFID technology finishes and automates manual scanning and monitoring. Therefore, perhaps the most

³⁷ Ibid. Suvash Rijal, p.19

³⁸ Ibid. Chris Brown

important cost of labor is eliminated.³⁹ Inventory registers is simpler and more automatic and can be done in the calculated time. These reduces a considerable amount of labor. Automatic shelving and automatic checkout service would replace human service in stores and so. In addition, RFID technology helps reduce costs associated with security such as cargo theft. In addition to directed labor costs, RFID can reduce many indirect costs related to human such as resource management, insurance, training, security and others.⁴⁰

As a result, RFID systems bring many advantages as mentioned above. Such innovations increase productivity and reveal competitive divergence in the sector in which the company is located. Competitive advantage are the advantages that put the company at the forefront of the existing sector conjuncture. These are the advantages that make a company sustainable and prevent it from being wiped out of the market. RFID is an important innovation that benefits today and is not only a reliable tool for sustainability in the current conjuncture, but also an important technological innovation in the separation of one company from another.⁴¹

1.3.Warehouse Management System and RFID

The vigorous development of the intelligent warehousing and logistic industry require nowadays efficient, accurate and large-scale asset identification solutions. Traditional warehouse management generally uses non-automated, paper-based documents as the basis for tracking and recording of inbound and outbound goods. This management

³⁹ Ibid. Suvash Rijal

⁴⁰ Ibid. Suvash Rijal, p.21

⁴¹ QuickMBA. 2016. Competitive Advantage. Available at: <http://www.quickmba.com/strategy/competitive-advantage/>. Accessed: 17.04.2021

method is completely manual and inefficient. With the material types of storage management, the frequency of storage and storage, and the automation of the storage and storage equipment, the storage operations have become very complicated and diverse. Traditional manual operation modes and data collection methods have been unable to meet the requirements of high-speed and accurate warehouse management.⁴²

Since the late 1950s, systems such as automatic guided vehicles (AGV), shelves, robotics, and robotic identification have been developed and adopted.⁴³ In the 1970s, rotating racks, mobile racks, roadway stackers, and other helpful equipment were added to the automatic control line, but only the local automation of the equipment and their independent application. On the basis of automated warehousing, the integration with other information decision-making systems is realized, and the direction of intelligent control is developed.⁴⁴ Artificial intelligence stimulates the development of warehousing technology. At present, in most warehousing and logistics systems, bar code recognition is still used as a means of identification of inbound and outbound assets. Traditional bar code recognition methods are intuitive and simple to use.

When it comes to the system architecture, the traditional bar code system is a simple system composed of different widths and different reflectance and it is a code system to express a set of digital symbol information. However, the barcode reading distance

⁴² Shi H, Ren P, Zhang X, Research on Electronic Commerce Warehouse Logistic Management System Based on Cloud Computing, *Advanced Materials Research*, 2014, p.1605-1609

⁴³ Tsai Y S, Chen R S, Chen Y C, et al., An RFID-based Manufacture Process Control and Supply Chain Management in the Semiconductor Industry, *International Journal of Information, Technology and Management*, 2013, p. 85-105

⁴⁴ Yao Z M, Liu X O, Liu W, RFID Technology-Based the Railway Package Management Platform Design, *Advanced Materials Research*, 2013, p.1653-1656

is no greater than 1 m, which limits the distance and efficiency of identification of goods in large warehouses. While this limits efficiency, the RFID identification system consists of a radio frequency electronic tag and a reader/author. The electronic label and reader/author perform the spatial coupling of the radio frequency signal by the coupling component, and perform energy transfer and data exchange according to the synchronization relationship in the coupling channel.⁴⁵

The RF equipment in the intelligent warehousing and logistics system is mainly divided into two categories. One type is the radio frequency identification door when the warehousing and warehousing is stored, and the high-speed identification of the warehousing and warehousing is used for high-speed identification; the other is the hand-held radio frequency identification at the work site. Equipment for the identification of scattered equipment outside the warehouse. The main function of the RFID server is to receive the identification data uploaded by each radio frequency identification device on the network, and use high-speed parallel algorithm to filter the data redundancy. At the same time, the Web service is used to interact with the background application service, and various related verification and processing rules are set to control and monitor related devices. To ensure the smooth and accurate of the entire system. The RFID service program also communicates with various electrical devices on site through OPC, and receives and controls the signal volume of various transmission devices to ensure the automation and intelligence of the entire inbound and outbound library.⁴⁶

⁴⁵ Lin Yuan, Research and Practice of RFID-Based Warehouse Logistic Management System, International Conference on Smart Grid and Electrical Automation(ICSGEA), 2019, p.514

⁴⁶ Ibid, Lin Yuan

The implementation of intelligent warehouse logistic system plays an important role to understand the basis. Traditional warehouse management generally relies on manual management which include tracking of incoming and outgoing goods.

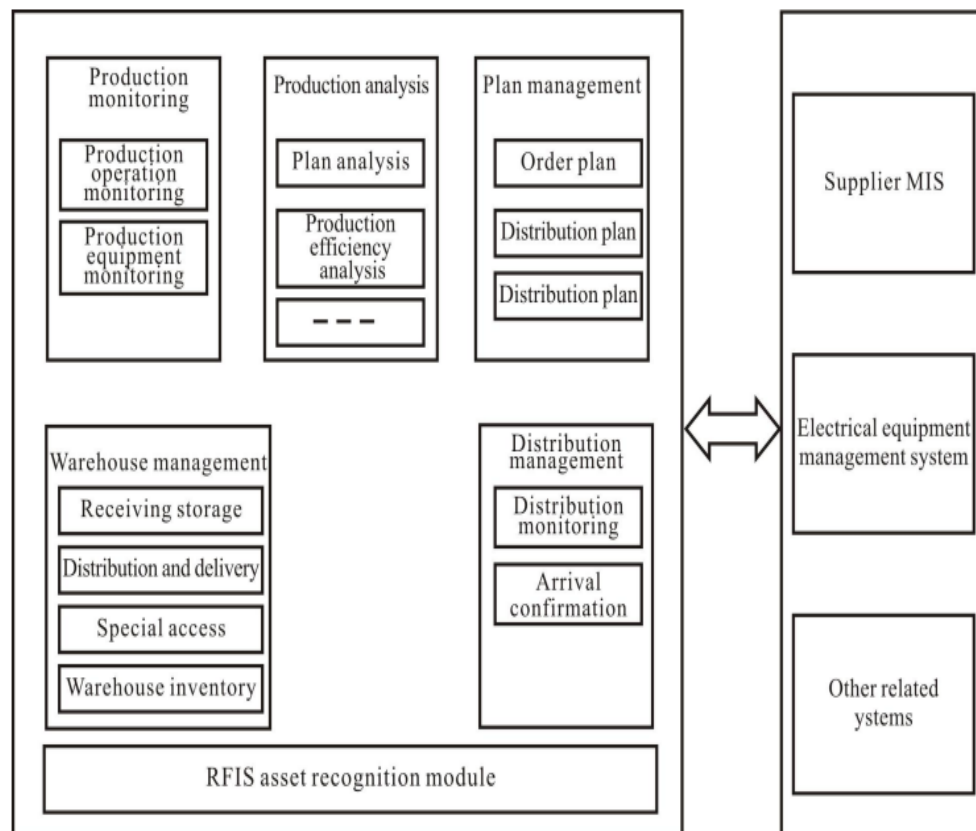


Figure 5. Module Structure of Int. Warehouse Logistic System. Source: Lin Yuan, Research and Practice of RFID-Based Warehouse Logistic Management System, International Conference on Smart Grid and Electrical Automation(ICSGEA), 2019

With the popularity of computer and bar code reading and writing applications, most of the current warehouse management has used computers to collect and count data, and uses barcodes to identify individual goods. However, it still cannot solve the problem of high-speed identification of bulk goods. The promotion and application of

RFID technology can fundamentally solve the above problems. Not only can the electronic label be attached to the package of each goods for batch identification, but also the electronic label can be attached to the warehouse tray and the shelf to facilitate automatic handling of various automatic transportation equipment such as AGV (Automatic Navigation Cart).⁴⁷

As you can see, the overall solution of the system is mainly divided into production monitoring, production analysis, plan management, warehouse management, distribution management and interface with supplier MIS, on-site electrical equipment management system, and other related systems (Figure 5).

As an important component, RFID hardware server plays a role as a program for the system between the application server and the card reader. The main functions of this hardware server are; as a client, interacting with the card reader, reading the recognized card information and then sending the card information to the application server; as a server, responds to the commands of the application server, interacts with the card reader and executes.⁴⁸

When the system is running, the main thread receives the configuration information of the upper application and attaches it to the message queue. The message processing function is distributed to each working sub-thread according to the message type. When the PLC monitoring thread receives the state change of the automatic transmission device operation, it notifies the card reading thread to start reading the card, and after reading the card, uploads the card reading data, and the main thread controls the LED

⁴⁷ Ibid, Lin Yuan, p.515

⁴⁸ Ibid, Lin Yuan, p.515

display according to the verification result and the configuration of the upper application system. Real-time prompts for current work. (Figure 6)⁴⁹

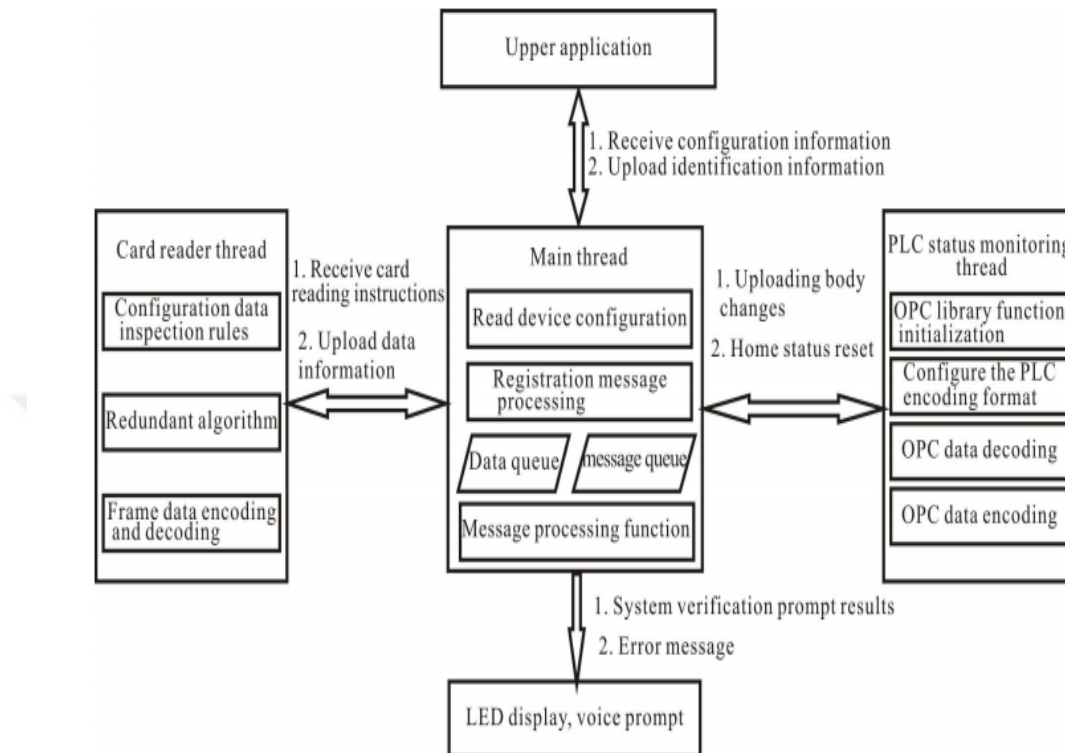


Figure 6. RFID Hardware Server Overall Framework Source: Research and Practice of RFID-Based Warehouse Logistic Management System, International Conference on Smart Grid and Electrical Automation(ICSGEA), 2019⁵⁰

System Implementation; the main thread of the RFID hardware service program primarily completes the initialization function, reads the variables of the system environment, reads the configuration file, initiates the log, reads the information from the card reader's device and the group of card readers in the database, and generates the child thread according to the information read. The implementation process is shown in Figure 3. After the start of the main service thread, it first initiates by reading the

⁴⁹ Ibid, Lin Yuan, p.515

⁵⁰ Ibid, Lin Yuan, p.516

different parameters of the card reader set in the database, and at the same time, according to the configuration information, the card playback thread and the PLC processing thread are produced, and messages from various events are monitored in real time for the control and processing of the hardware.⁵¹

The amount of raw RFID data reported from the hardware is very large. Depending on the specific configuration, each reader can report hundreds to thousands of label data per second, but only a small portion of it is significant to the user. Non-repetitive data, such a large amount of directly downloaded data without deduplication, will place a heavy burden on the entire RFID system.⁵² In this system there is a RFID parallel filtering algorithm to check the massive data from hardware. After checking, it validates the package and submit it to the high-level application module. This parallel filtering algorithm analyzes each new data.

⁵¹ Ibid, Lin Yuan, p.516

⁵² Ibid, Lin Yuan, p.516

The process will be as following:

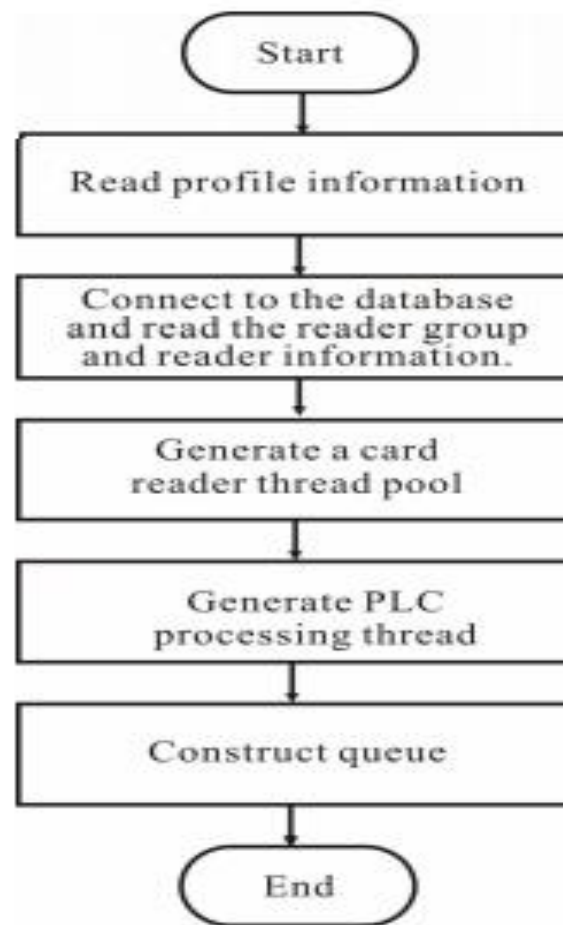


Figure 7.Main Thread Program Flow Chart: Source: Research and Practice of RFID-Based Warehouse Logistic Management System, International Conference on Smart Grid and Electrical Automation(ICSGEA), 2019⁵³

1.4.RFID Based Tracking Systems

As with many other manufacturing processes, RFID has become an important tool in tracking systems. RFID ensures that products are tracked and this tracking is maintained effectively. Companies working in large industries where data becomes important can reduce these management system costs thanks to RFID and have the opportunity to

⁵³ Ibid, Lin Yuan, p.517

provide high quality service thanks to these RFID tags.⁵⁴ Anyway, when we examine the big companies today, we may observe how much they give importance to this tracking system.

It is important to study system architectures in the creation of RFID system. There are already various RFID uses such as the development of sensor technologies in the real world environment and the use of them in a mobile environment. However, the use of RFID technologies appeals to a wider range of industries. The important point here is to understand and accurately evaluate the labels, air interface, protocols and middlewares that form the basis of RFID.

In sectors such as manufacturing, logistics and retail sales, a system called EPC (Electronic Product Code) is currently used to connect all physical objects in enterprise applications.⁵⁵ However, due to the high adaptability of RFID devices for different applications, many RFID applications are still being developed as non-EPC systems.⁵⁶

As it is mentioned before, RFID readers read the data via its tags. This is almost the logic of using RFID in monitoring and tracking systems. In this system, RFID readers can communicate with the product through a protocol called ONS (The Object Naming Service).⁵⁷

⁵⁴ K. Finkenzeller, *RFID Handbook*, Wiley, 2003, p.44

⁵⁵ EPCglobal Inc. Home Page, <http://www.epcglobalinc.org>, Accessed:28.04.2021

⁵⁶ B. Nath, F. Reynolds, R. Want, RFID technology and applications, *IEEE Pervasive Computing* 5 (1) (2006) 22–24.

⁵⁷ Jiann-Liang Chen, Ming-Chiao Chen, Chien-Wu Chen, Yao-Chung Chang, Architecture design and performance evaluation of RFID object tracking systems, *Science Direct, Computer Communications* 30 (2007) 2070–2086, 2007, p.2070

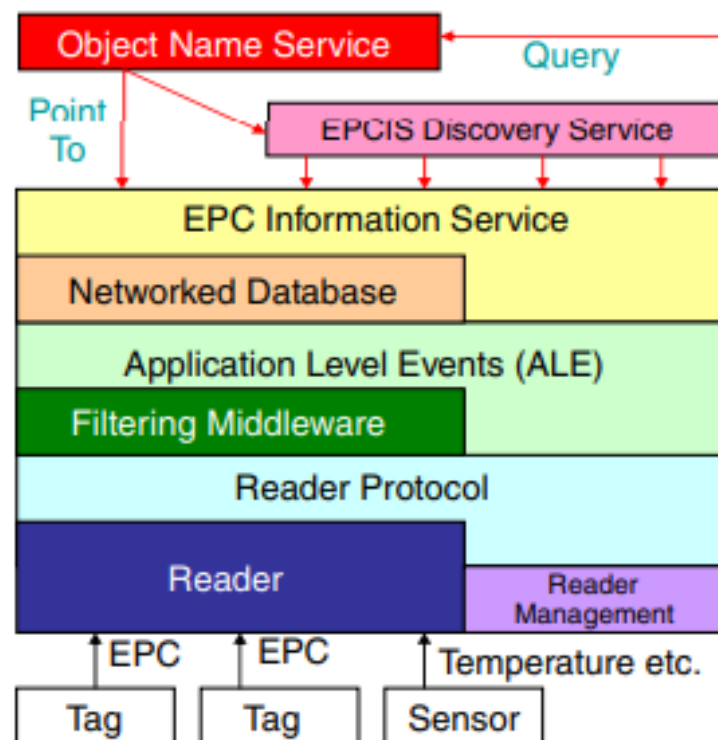


Figure 8. RFID ONS architecture, Source: Jiann-Liang et Al, Architecture design and performance evaluation of RFID object tracking systems, 2007

In the remaining RFID tracking process, the process progresses as in other processes. As always, there are three important parts in the progress of the system, RFID readers, tags and software-backend systems.⁵⁸

⁵⁸ Ibid. Jiann-Liang et al. p.2071

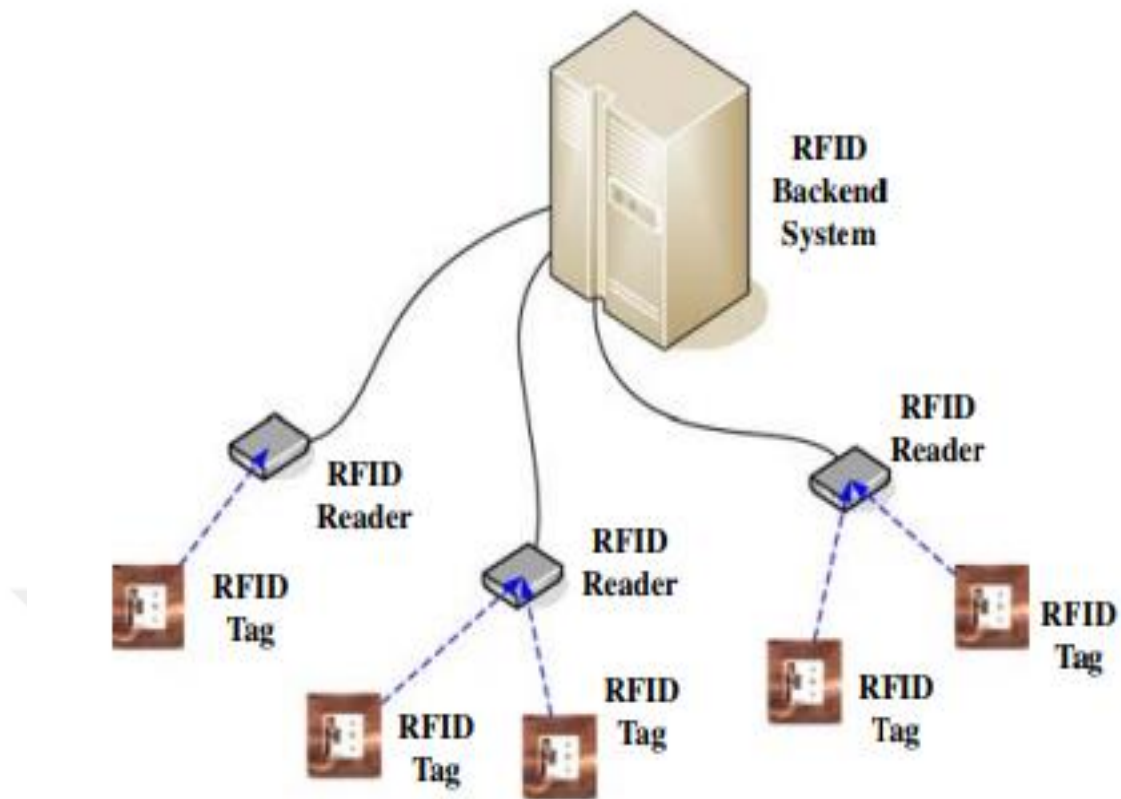


Figure 9. System Architecture. Source: Source: Jiann-Liang et Al, Architecture design and performance evaluation of RFID object tracking systems, 2007

One of the most important part of RFID is the software engineering systems. It is already third basic part of RFID nearby tags and readers. This software engineering systems are called “ Backend” in engineering. The connection of the web system to backend is EPC (Electronic Product Code). The web systems as EPC filter the specific ID information of the product tag that had been received by reader. These information flow are been forwarded to necessary supporter systems or services via EPC.

There are three elements that make up the EPC network system; savant, EPC Information Service (EPCIS) and ONS. In fact, these three systems come together to

form the reader who performs the query-response process of the system.⁵⁹ The figure showing the principle of operation of the EPC system is shared below.

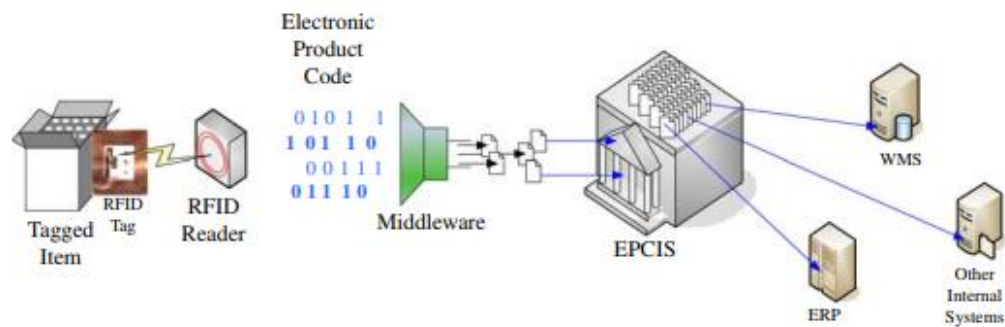


Figure 10. EPC Network. Source: Jiann-Liang et Al, Architecture design and performance evaluation of RFID object tracking systems, 2007

As this network system begins to function, many software is also put into operation and objects are monitored. Here, it will be explained how to follow up objects with RFID without going into the details of these software systems. Behind the object tracking system is a library that stores all data and entries. Thanks to this library, which stores data, all rfid-tagged objects are tracked.⁶⁰ RFID readers work integrated with these libraries. Rfid tags play a role in detecting any movement in the operation of the system, while the library is tasked with transferring the requested data to the desired stations.

⁵⁹ Ibid. Jiann-Liang et al. p.2072

⁶⁰ Ibid. Jiann-Liang et al. p.2073

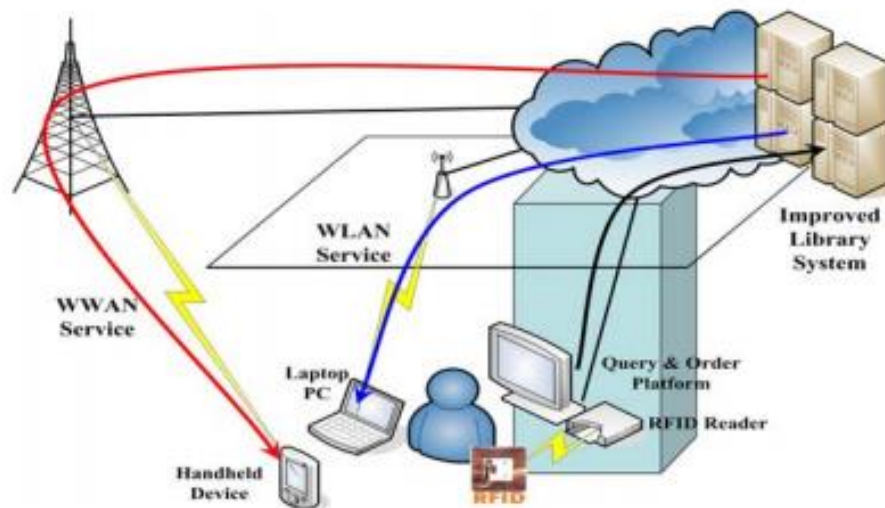


Figure 11.Library Function in RFID Tracking System, Source: Jiann-Liang et Al, Architecture design and performance evaluation of RFID object tracking systems, 2007

2. LAST MILE DELIVERY WITH RFID

E-commerce, facilitated by the social media marketing, has grown rapidly over the past years. In 2016, the online retailer Amazon was reported to serve 310 million customers worldwide.⁶¹ In Europe, the number of online shoppers can be estimated between 300 and 340 million (estimated by Amazon).⁶² As it becomes so much wider in today's digital life and in this Covid-19 health crisis, it would be useful to better understand the last mile delivery.

2.1.Last Mile Delivery in Logistic and in International Trade

Transport is one of the main pillars of both the supply chain and logistic in today's e-commerce world. Transportation systems comprise a wide range of physical and organizational elements. These elements may have direct and/or indirect influence, linearly or non-linearly, also having potential feedback cycles.⁶³ Thus, it is characterized by huge global complexity. As this first part, we are going to deep into this complex system and we are going to analyze last mile delivery and transportation modes.

As the last segment of delivery process, last mile delivery is one of key element of the complex transportation process. Last mile delivery is a series of activities and processes necessary for the delivery process, from the last transit point to the final drop point of

⁶¹ Statista (2018) Statistics and Facts about Amazon, Statista. <https://www.statista.com/topics/846/amazon/>. Accessed 11 March 2021

⁶² Aurambout Jean-Philippe, Gkoumas Konstantinos and Ciuffo Biagio, Last mile delivery by drones, *European Transport Research Review*, p. 1, 2019, 11:30

⁶³ Aurambout, Gkoumas, Ciuffo, Ibid., p.2

the delivery chain.⁶⁴ While each step of the logistic and delivery should be taken seriously, there is no doubt that last mile delivery has a higher priority in which the goods from a center move to their final delivery destination.

There are some key modes of last mile delivery. These delivery modes have various efficiencies and properties. Indeed, it does not only make the delivery efficient but also makes it sustainable. In this context provider selects a convenient delivery mode regarding time frame, local density, intense of orders.

One of the main modes is called “reception box”. In this mode, the goal is to avoid shipping problems and the choice is left entirely to the customer. the customer can choose this method depending on various variables such as location, cargo type, public space.⁶⁵

One of the reception box type is “shared reception box”. In this system, the product is left in a locked box and this locked box is left in a public area. These places can be common squares, stations, shopping malls etc. These reception boxes are shared so many customers can use them. The client will receive the box via a code, which unlocks

⁶⁴ J Lindner, Last Mile Logistics Capability: a Multidimensional System Requirements Analysis for a General Modeling and Evaluation Approach, Dipl Technical university of Munich, p.2, 2011

⁶⁵ X. Wang, L. Zhan, J. Ruan, and J. Zhang, “How to Choose “Last Mile” delivery modes for E-Fulfillment,” Mathematical Problems in Engineering, Volume 1, May 2014, p.17

the box. Even more than one product in this system is delivered to the consumer thanks to this box method.⁶⁶

The second box type is called “own reception box”. This is the type, which the box is installed at the outside of the client’s house. This place may be a garage, yard, shelter. The client must use the passcode set by himself/herself to unlock the box. The effective point of this type is that delivery is out of period. The provider will send the items at any time. In addition to this, this type has a place disadvantage.⁶⁷

The last box type is called “delivery box.” delivery box is a secured box equipped with a mechanism. In this type, the box owner is the last mile delivery provider. The boxes will be hooked up on a hard and fast protection device in a secure place at the client’s house. Customers can take his/her items from the delivery box. Then, the empty delivery boxes are going to be collected and reused by the last mile delivery supplier. The delivery boxes are going to be collected or utilized in subsequent delivery.⁶⁸ Delivery box is convenient for the customer similar to the own reception box type. However, the place of this box is highly important due to safety. Because it may be stolen easily.⁶⁹

The other mode in last mile delivery is “attended home delivery (ahd)”. Attended home delivery is used largely and still be a preferred mode. LMD supplier sends items to the

⁶⁶ Noppakun Tiwapat, Choosak Pornsing, Peerapop Jomthong, Last Mile Delivery: Modes, Efficiencies, Sustainability, and Trends, 3rd International Conference on Intelligent Transportation Engineering, 2018, p.313

⁶⁷ Ibid, Tiwapat, Pornsing, Jomthong, p.314

⁶⁸ S. Iwan, K. Kijewska, and J. Lemke, “Analysis of parcel lockers’ efficiency as the last mile delivery solution – the results of the research in Poland,” Transportation Research Procedia, vol. 12, 2016, p. 412

⁶⁹ Ibid, Tiwapat, Pornsing, Jomthong, p.314

client threshold. She should sit up for client receiving the item. While the AHD supplier contact with the customer, it is not a efficient way.⁷⁰

Besides, this concept requires delivery car routing designing with time period.⁷¹ That's why it needs an optimization. In sum, generally, it has a high operation price. To supply a high service level and to avoid AHD failures the maximum amount as attainable, AHD supplier ought to contact the client so as to line the delivery time windows before dispatching the delivery vehicle. The time windows providing isn't solely impact the client satisfaction, however additionally the expected delivery potency.⁷²

One of the other delivery mode is "Unattended home delivery (UAHD)". Mainly, this delivery method is for time problems and for the clients who are not at home. In this model the items delivered on neighbor's mailbox or etc.⁷³ For time period it is quite efficient but the concern here is the security for some cases. Beyond that this models provides better vehicle routing regarding to cost and it decreases failed first-time delivery. So, basically it increases the saved time.⁷⁴

The other method is "collection point". The collection point, or collection-and-delivery points, is currently a popular delivery option (CDPs). There are two kinds of CDPs: locker points and service points. A shared reception box, also known as a locker point

⁷⁰ Ibid., X. Wang, L. Zhan, J. Ruan, and J. Zhang.

⁷¹ S. Zuglian, Evaluation of the cost of time windows in home delivery applications, Dissertion of Degree, Technical University of Denmark- Department of Transport, Kongens Lyngb, 2009, p.56

⁷² N. Agatz, A. M. Campbell, M. Fleischmann, and M. Savelsbergh, "Time slot management in attended home delivery," *Transportation Science* 2011, Vol. 45, No. 3, August 2011, pp. 435–449

⁷³ R Gevaers, E. Van de Voorde, and T. Vanelander, *Characteristics and Typology of Last-mile Logistics from an Innovation Perspective in an Urban Context. City Distribution and Urban Freight Transport: Multiple Perspectives*, Edward Elgar Publishing (2011). P.56

⁷⁴ Ibid. Zuglian

or an unattended point, is located in a public location.⁷⁵ The products are shipped to an unattended location where the customer can pay, pick up, and return the items. These locations may be a local store, a stop or a school etc. The service point is a face-to-face mode and it is more preferable than locker point.⁷⁶ In addition, locker point is highly risky for the products. As a sum, CDPs provides a flexibility to last mile delivery and it has various service options.⁷⁷

Last of all, “post office” mode is being used as a traditional mode. Nowadays, this method is used for the products, which failed first-time shipment. These first-time failed items will return to the post office. With that, customer can take his item from post office. The main advantage of this method that any customer can make multiple operations such as picking-up, payment or returning.⁷⁸ It is more like collection point mode because post office method is face-to-face as well.⁷⁹ However, as a traditional method, it does not have any flexibility for the customers.

There are important keys in the last mile delivery process that customers are looking for such as speed, timeliness, accuracy, and precision of the product deliveries after reaching their last destination. Thus, fast delivery, precise order tracking, security and insurance, specialization, and convenience⁸⁰ are the important factors taken into consideration by customers. Additionally, over the past decade, increasing customer

⁷⁵ J. W. Weltevreden, “B2c e-commerce logistics: the rise of collection and delivery points in the Netherlands,” *International Journal of Retail & Distribution Management*, Vol. 36(8) , 2008, pp.640

⁷⁶ J. Xu, L. Hong, and L. Yiliang, “Designing of collection and delivery point for E-commerce logistics,” *Information Technology, Computer Engineering and Management Sciences (ICM)*, 2011 International Conference on, IEEE, Vol. 3, September 2011, pp. 350

⁷⁷ Ibid, Tiwapat, Pornsing, Jomthong

⁷⁸ L. Song, T.J. Cherrett, F.N. McLeod, and W. Guan, “Addressing the last mile problem - the transport impacts of collection/delivery points,” *Transportation Research Record*, Vol. 2097, 2009, pp. 13.

⁷⁹ Ibid, Tiwapat, Pornsing, Jomthong

⁸⁰ Wang Wayne, Last Mile Delivery Explained: Identifying the Challenges to Find Solutions, gopeople.com.au, 2018, Accessed 11 March 2021

expectations for quality of service, speed and product availability has brought new market opportunities and delivery models to online retailers and LMD service providers.⁸¹ These model deliveries have been adapted to meet different product segments and service needs. These LMD models had a certain topology which introduced by Winkenbach and Janjevic. By this topology Winkenbach and Janjevic introduced these models' topology with key variables: product exchange, customer service, distribution, and order preparation.⁸²

In the model, product exchange is one of the variables. Despite the fact that delivery models have usually operated under a home-delivery paradigm, in last years, designated collection, and delivery points (CDPs) have emerged as a viable option that benefits both e-retailers and customers. It is also convenient for consumers because of CDP's reliability of the delivery tour. Because this tour consolidates multiple delivery in a single stop. Thus, it is a useful tool for both retailers and customers. Since CDPs allow for more service versatility, but they must fly to specific locations. As an example, Walmart's B2W's in-store pickups, and the Amazon lockers.⁸³

The implementation of CDPs has significant consequences for capacity and pricing. It frees up distribution capacity and/or improves routing efficiency at the cost of customer travel. That's why appropriate rewards, typically in the form of price discounts or shorter lead times, must be established. Retailers can need to decide the type and

⁸¹ Snoeck Andre, Merchan Daniel, Winkenbach Matthias, Revenue management in last-mile delivery: state-of-the-art and future research directions, *Transportation Research Procedia* 46 (2020) 109–116, p.112

⁸² Winkenbach, M., Janjevic, M., 2018. Classification of last-mile delivery models for e-commerce distribution: A global perspective. *City Logistics*, 1: New Opportunities and Challenges , 209–229.

⁸³ Ibid., Snoeck Andre et AL., p. 112

position of CDPs at the tactical (static) stage. Plus, Retailers will need to identify price or service levels based on available resources and order forecasts at the operational (dynamic) level.⁸⁴

As one of the variables, customer service plays a vital role in last mile delivery. Grocery deliveries are usually scheduled in time slots that are not necessarily set in length and can overlap. Walmart, for example, provides overlapping two-hour time slots, while Peapod plans time slots ranging from two to six hours. Time slots guide pricing decisions in such situations. Dry products, on the other hand, typically follow a distribution lead-time rationale with differentiated pricing. For example, at different price points, B2W provides three delivery lead-time options: same-day, up to three days, and up to five days. In such circumstances, pricing decisions are based on lead time. This lead time is important, because lead-time-driven problems have gotten very little attention. Besides, given their significant consequences for route planning and execution, time-slot decisions are unquestionably more complex problems to analyze. However, as delivery lead times shorten (e.g., two hours or same day), the effect of related lead-time pricing and capacity decisions has a greater consequences on the overall performance of the last-mile service.⁸⁵

⁸⁴ Ibid., Snoeck Andre et AL., p. 113

⁸⁵ Ibid., Snoeck Andre et AL.

Variables	Assumptions in AHD	Relevant Extensions
Product exchange	Home or office	Collection and Delivery Points
	Attended delivery	Unattended Delivery
Customer service	Time-slot driven choice	Lead-time driven choice
Distribution	Homogeneous fleet	Heterogeneous fleet
	Fixed short-term capacity	Crowd-sourced capacity
Order preparation	Unrestricted product availability	Inventory delays

Figure 12. Source: A topological analysis of AHD and extensions (adapted from Winkenbach and Janjevic (2018))

As a second variable related to customer service, there is distribution process in last mile delivery. The options for fleet ownership vary from fully owned to fully outsourced, with hybrid approaches being popular in practice. Crowd-sourced models have recently become a new trend.⁸⁶ Instacart and Walmart have also conducted LMD pilots using ride-sharing platforms such as Uber and Lyft. Current models presume the availability of a fixed fleet with fixed capability and that the expense of owning this fleet has been sunk. The ability to use ride-sharing systems, on the other hand, modifies this presumption. The computation of opportunity cost in dynamic pricing models is influenced by the availability of such versatile capacity. As a result, a grocer will invest more to its own fixed capacity, even if higher-value customers are expected later.⁸⁷

In last mile delivery, order preparation plays an important role in today's competitive world. E-retailers are becoming highly competitive in the way of customer service

⁸⁶ Buldeo Rai, H., Verlinde, S., Merckx, J., Macharis, C., 2017. Crowd logistics: an opportunity for more sustainable urban freight transport? *European Transport Research Review* 9, 2–13

⁸⁷ Ibid., Snoeck Andre et AL.

speed. Companies plan their inventory networks to provide efficient service. They do it by keeping inventory of the majority of fast-moving goods close to major consumer centers, while slow-moving products are held in vast warehouses in lower-cost regions. While an order may contain a mix of slow and fast-moving items, the total order's lead time is equal to the longest lead time of any of the goods. This may be inconvenient consumers, who may decide to cancel the order and position one with a competitor. To have the best possible customer support and to prevent product profits being lost, ship both products separately. The rules for splitting an order into multiple deliveries are the most important consideration when splitting an order into multiple deliveries. Offering an individual delivery choice and associated fee for a wide range of product categories does not seem to be desirable from a marketing and communication standpoint. However, two commodity groups, slow-movers and fast-movers, are logical assumptions.⁸⁸

In transportation process, transports were carried out from port to port in advance. As the concept of rational transport has become widespread in the transportation sector, the service has been done through door to door. The place of delivery of the cargo has shifted to the consignees warehouse. In this case, the back-port transports have developed in the form of a transport chain by integrating with the main transport. Therefore, the transport service is now evolving in the direction of integrated transport. In the future, port-to-port transport services include crude oil, grain, mineral ores etc. transport of large diameter bulk raw materials; industrial goods will use door-to-door transportation in a market fight.

⁸⁸ Ibid., Snoeck Andre et AL., p.114

The system as a whole, last mile delivery does not only provide flexibility, but it also yields a high sustainability. In today's world, people become more sensible to the world saving issues such as global warming, naturel disasters.

Transportation accounts for the majority of greenhouse gas emissions, which is the main factor of global warming. GHG emissions from transportation are mainly caused by the combustion of fossil fuels. That is why, inefficient last mile delivery affects the world. It worsens traffic congestion, raises carbon emissions, and pollutes the environment.⁸⁹ The bulk of GHG emissions in last-mile distribution are due to failed first-time deliveries. After the proportion of missed first-time deliveries rises, the share of GHG emissions rises.⁹⁰ Furthermore, CO2 from the second period delivery has raised emissions per drop by between 9% and 75%.⁹¹ Consequently, the choices of last mile delivery mode is highly vital for the environment.

In this part, it will be useful to look at new development in last mile delivery. Because, as a competitive component last mile delivery users must constantly develop their ability regarding to the development or to the trends on this area. Beyond the development this will provide a huge efficiency and also it lowers the cost of

⁸⁹ O. Bates, A. Friday, J. Allen, T. Cherrett, F. McLeod, T. Bektas, T. Nguyen, M. Piecyk, M. Piotrowska, S. Wise, and N. Davies, "Transforming Last-Mile Logistics: Opportunities for more Sustainable Deliveries," *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*. ACM, 2018. p. 526

⁹⁰ L. Song, T. J. Cherrett, W. Guan, B. Li, "Quantifying the greenhouse gas emissions of local collection-and-delivery points for last-mile deliveries," *Journal of the Transportation Research Board*, Vol.2340, 2013, pp.67

⁹¹ Ibid, Tiwapat, Pornsing, Jomthong

operations.⁹² Especially The Internet of Things – IOT brings new facilities to the manufacturing, retailing, supply management. The new trends on this area are new mobile applications, smart reception boxes and drone technologies.

In terms of distribution, there are mobile applications that allow you to monitor the status of your shipment using GPS technology on the cloud for accurate location and other tracking details.⁹³ It allows logistics companies to coordinate and distribute information to customers. As a result, the shipping time could be correctly estimated. Smart reception box, which is controlled by RFID, is also a new trend in this area. By this RFID tags it is easier to track the system as it provides real-time data reading and writing.

On all the last-mile delivery process, RFID plays a huge role integrated with both GPS technology and Internet of Thing. Thanks to RFID tag, the reader here keeps the data in the warehouse computer system. Beyond this, it makes all the necessary updating in this computer system. The data collected and kept aids in the precise monitoring of items. It also aids in the strategic planning of product locations. On the other side of the logistics cycle, the RFID method operates similarly. It improves the distribution management system's speed. It aids in the correct selection of products for further distribution. The reader mounted at the entry-exit points registers the products that have passed out of the warehouse. In addition, it is by this way that all the data and entry-exit information is updated in real-time to the warehouse's computer.⁹⁴

⁹² Ibid, Tiwapat, Pornsing, Jomthong, p.315

⁹³ Ibid. O. Bates et AL.

⁹⁴ RFID and Logistics: A Welcome Revolution, <http://www.mktalt.com/blogs> , Accessed: 24.04.2021

Briefly, last-time delivery is a process, which is integrated with technology such as IOT, RFID, GPS, or CDP as it was mentioned before. As keeping the data up to date to all of these technologies, RFID contributes to reducing errors, to tracking the items in real-time, to facilitating supply chain management. Moreover, it provides a remarkable reduction on operating cost and eventually, helping to increase customer satisfaction.

2.2.Transportation Modes and Multimodal Transportation

With what the concept of globalization brings to our lives, international Market races have accelerated. This situation has revealed that many manufacturers, foreign trade companies and the transportation companies that mediate them should also improve themselves.⁹⁵ Because in this age when production, trade and transportation are so integrated, companies can only survive by improving themselves and following innovations. That is why in this section we are going to examine multimodal transport and talk about developments in this field.

Multimodal transportation is a mode of transportation that combines various modes of transportation and transport vehicles or units.⁹⁶ In multimodal transportation, loads continue their way with different means of transportation by transferring them from the

⁹⁵ Oana Vasilica BARNĂ, Maria Claudia SURUGIU, Ionel PETRESCU, Radu Virgiliu ALEXANDRESCU, RFID Technology in Containers Multimodal Transport, Journal of Supply Chain Management, 2013, Volume 4, Number 2, p.1

⁹⁶ Ibid, Barnă et AL. P.2

container or box to another box or container. It entails the use of several modes of transportation in succession, such as a combination of truck, railcar, airplane, or ship.⁹⁷

There are some advantages of multimodal transportation:

- As it decreases the time loss of deliveries. This transportation system, which is well coordinated, saves time and reduces the risk of cargo loss, theft, and damage at shipment points. At trans-shipment points, the multimodal transport operator establishes his own contact connections and seamlessly coordinates interchange and onward carriage.
- It fastens the transit of productions of items. Because, this modal decreases the loss of slowness of transit due to distance loss from market and production origin.
- It reduces bureaucratic loss of transportation as it reduces documentation process and bylaws.
- Most important of them all is that it saves cost. The cost savings succeeds from the benefits of the multimodal transport operator's such as freight prices, as well as the cost of cargo insurance. Thus, demand rises as savings are reflected on to the customer. Moreover, it reduces cost of exports while it develops the competitiveness in the global market.⁹⁸

⁹⁷ Ibid, Barna et AL

⁹⁸ Ibid, Barna et AL

There are some transportation modes concerning last mile delivery and parallel most of the famous cargo companies use these transportation modes. In this section we are going to analyze transportation modes and multimodal transportation. In the end we are going to take a look those cargo firms which use these models.

In the past, transports were carried out from port to port. As the concept of rational transport has become widespread in the transportation sector, the service has been done through door to door. The place of delivery of the cargo has shifted to the consignees warehouse. In this case, the back-port transports have developed in the form of a transport chain by integrating with the main transport. Therefore, the transport service is now evolving in the direction of integrated transport. In the future, port-to-port transport services include crude oil, grain, mineral ores etc. transport of large diameter bulk raw materials; industrial goods will use door-to-door transportation in a market fight.

Today, almost all of the international cargo transportation is carried out by private firms. These companies are responsible for delivering the cargo in the agreed time. They use all transportation models and determine the transit time and freight charge according to the selected model and these companies also provide customs services. Best known companies around the World are DHL , UPS and TNT & FedEx.

2.1.1. UPS

United Parcel Service (UPS) was founded in 1907 as a courier company in the US, UPS grew to become a multi-billion dollar company, focusing on the purpose of enabling

world trade.⁹⁹ Today, UPS is a global company which is one of the most known and popular brands in the world. Became one of the world's largest package transport company and a worldwide leading specialist transportation and logistics service provider.

Headquarters: Atlanta, Ga.

Worldwide Web Address: www.ups.com

Chief Executive Officer: David Abney

Annual revenue: \$61 billion

Employees: More than 434,000

Global Delivery Volume: 4.9 billion packages and documents

Daily Global Delivery Volume: 19.1 million packages and documents

Daily U.S. Air Volume: 2.7 million packages and documents

Daily international volume: 2.8 million packages and documents

Service Area: More than 220 countries and territories; Every address in North America and Europe

Customers: 1.6 million pick-up, 8.7 million delivery

Online Tracking: 101.5 million tracking requests per business day

⁹⁹ Lewis Robert, United Parcel Service, Encyclopedia Britannica, www.britannica.com, Accessed 15 March 2021

Retail Access: The UPS Store, 4,945; UPS Customer Centers, 1,052; Authorized outlets, 9,070; UPS Drop Boxes, 38,200; UPS Access Point locations, more than 26,000

Operating Facilities: More than 1,800

Delivery Fleet: 108,210 package cars, vans, tractors, motorcycles, including more than 8,100 alternative fuel and advanced technology vehicles

UPS Jet Aircraft: 237

Short-termed Leased or Chartered Aircraft: 420

Daily Flight Segments: Domestic – 1,077; International – 1,090

Airports Served: Domestic – 374; International – 313

Air Hubs:

- United States: Louisville, Ky. (main Global Air Hub) Philadelphia, Pa.; Dallas, Texas; Ontario, Calif.; Rockford, Ill.; Columbia, S.C.
- Europe: Cologne/Bonn, Germany
- Asia / Pacific: Shanghai; Shenzhen; Hong Kong
- Latin America and Caribbean: Miami, Fla.
- Canada: Hamilton, Ontario¹⁰⁰

¹⁰⁰ Ups Fact Sheet, www.ups.com, Accessed 15 March 2021

2.1.2. DHL

DHL was founded in 1969 by Larry Hillblom, Adrian Dalsey and Plymouth Duster to carry paperwork from San Francisco to Honolulu. The company, which has grown significantly in its first years, has started international activities. DHL, whose international network is expanding, was acquired in 2001 by Deutsche Post.¹⁰¹

Headquarters: Bonn, Germany

Worldwide Web Address: www.dhl.com

Chief Executive Officer: John Pearson

Annual revenue: \$60 billion

Employees: More than 380,000

Global Delivery Volume: 1,5 billion packages and documents

Daily Global Delivery Volume: 19 million packages and documents

Service Area: More than 220 countries and territories

Operating Facilities: More than 1,800

Delivery Fleet: More than 90000 package cars, vans, tractors, motorcycles, including more than 7500 alternative fuel and advanced technology vehicles

UPS Jet Aircraft: 198

¹⁰¹ Our Story, www.dhlexpress.be, Accessed 15 March 2021

Short-termed Leased or Chartered Aircraft: 364

Airports Served: International – 336

Air Hubs:

- United States: Cincinnati, US
- Europe: Leipzig, Germany
- Asia / Pacific: Hong Kong ¹⁰²

2.1.3. TNT & FedEx

TNT & FedEx were founded as two separate companies. FedEx was founded in 1973 in US and TNT was found in 1946 by Ken Thomas in Australia. TNT was acquired by Fedex in 2015. Fedex acquired TNT for 4,4 Billion Euros. Four years are estimated for integration process. ¹⁰³

Headquarters: Memphis, Tennessee, USA

Worldwide Web Address: www.fedex.com

Chief Executive Officer: Frederick Wallace Smith

Annual revenue: \$36 billion

Employees: More than 280,000

Global Delivery Volume: 1 billion packages and documents

¹⁰² Our Story, www.dhlexpress.be, Accessed 15 March 2021

¹⁰³ Keating Eloise, FedEx to swallow up TNT in \$6.25 billion deal: What it means for your business, Smart Company, www.smartcompany.com, Accessed 15 March 2021

Daily Global Delivery Volume: 6,5 million packages and documents

Service Area: More than 220 countries and territories

Operating Facilities: More than 1,800

Delivery Fleet: 75000 package cars, vans, tractors, motorcycles

UPS Jet Aircraft : 284

Short-termed Leased or Chartered Aircraft: 284

Airports Served: International – 375

Superhub : Memphis , US

Air Hubs:

- Paris , France
- Guangzhou , China
- Kansai , Japan
- Toronro , Canada
- Cologne , Germany¹⁰⁴

In transportation and logistic, it is essential to construct some intelligent system such as RFID, IOT etc. This does not only provides increasing efficiency but also it helps companies to be able to compete in the global market. This can be achieved by an

¹⁰⁴ www.fedex.com, Accessed 15 March 2021

intelligent tracking system. First and foremost, an intelligent traffic monitoring system relies on automated vehicle detection.¹⁰⁵

Due to its low recognition rate, traditional tracking method based on picture and licence plate is currently in jeopardy. As a result, emerging technology must be used to address this issue, and technologies based on the Internet of Things offer a novel solution. That is why, RFID technology in the supply chain has the potential to help transportation and logistics companies significantly. Wal-Mart, the Department of Defense, and others have mandated RFID enforcement for the receipt of goods and assets into logistics operations.

This system expands the potential service scale and give logistic companies new opportunities:

- Providing RFID integrated services,
- Using RFID tags to identify new information-based services, you can expand your service and revenue base to suppliers and consumers,
- Increasing productivity through the use of EPC in cross-docking operation
- Quicker arrival times Quicker customs clearance
- Theft deterrence

In this sectors, RFID technology helps improving efficiency. Individual products, cases, and pallets are tagged, identified, and tracked using RFID technology as they pass from the manufacturing place through the supply chain and lastly to the clients. Wireless

¹⁰⁵ Ibid, Barna et AL, p.3

RFID readers can interact with an RFID tag on an object as it moves through the supply chain, gather information about the object (such as a unique number), and match that number in a database to access a full record about the object. In the supply chain, this real-time technology offers unparalleled speed and precision.¹⁰⁶

RFID technology is especially useful in situations where transparency of the flow of products in an organization and their ease of location are important considerations, as well as monitoring the movement of valuable resources, components, or finished goods.¹⁰⁷ Some major companies have started the implementation of RFID in this sector and some others declared that they will start implementation. Therefore, it is quite sure that the usage of RFID in the sector will expand. This huge expansion is because of speed and visibility benefit of RFID.

As Radio Frequency Identification Systems provide direct identifying it is useful for logistic companies. Each RFID object contains a tiny, low-cost tag. These tags give each product a unique identity, which is called the Electronic Product Code (EPC). The RFID tag responds to the reader's and writing requests after the reader sends a request. RFID enables nonline-of-sight readability between tags and readers. It is doing that by removing the need for manual data collection and introducing the possibility of an automated identification method.¹⁰⁸

¹⁰⁶ Ibid, Barna et AL, p.3

¹⁰⁷ Beata Skowron-Grabowska, Tomasz Szczepanik, Application of RFID technologies in logistics centres to improving operations of courier firms, 2018, p.141

¹⁰⁸ Wolf-Ruediger, H., Frank Gillert, F., RFID for the Optimization of Business Processes, Wiley, London, 2006

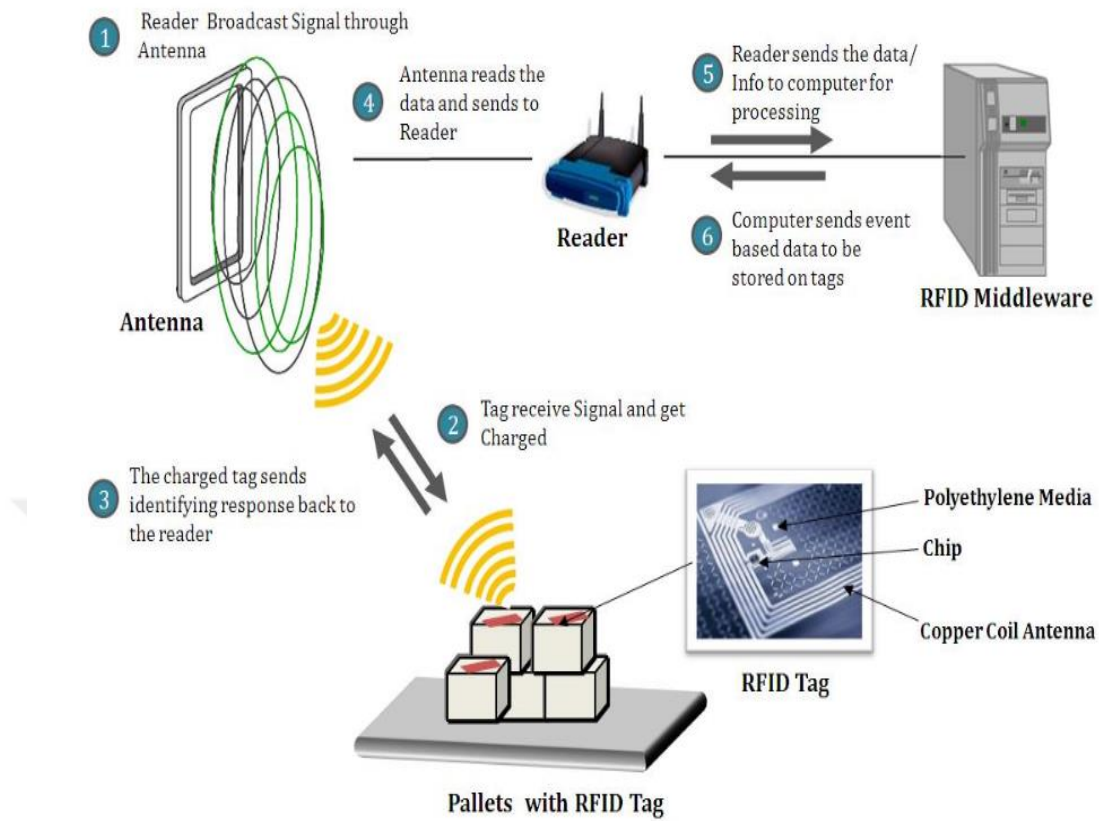


Figure 13. RFID System Logic in Logistic, Source: The blog of Logistics at MGEPS at UPV, <https://logisticsmgepsupv.wordpress.com/> , Accessed: 25.04.2021

In the tag system, there are two types, active and passive tags. Active tags have some optional features such as environment sensing, whereas passive ones do not have this feature and they rely on the energy of the reader. Completely rewritable tags have a fully rewritable memory, while read-only tags have a read-only memory. Since an RFID reader is able to store and transmit GPS positioning data for tracking, a passive tag can be used in intelligent traffic management systems to save money.¹⁰⁹

¹⁰⁹ Ibid, Barna et AL, p.5

When it comes to the courier firms, RFID technology provides many profits. RFID can facilitate the flow of products and information by influencing supply and demand, as well as the quality of customer service. Thereby increasing revenue and innovation will follow, while also having a positive impact on the development of value, not only in terms of cost reduction, but also in terms of enhancing the firm's reputation and gaining a competitive advantage.

Despite the fact that RFID technology provides lots of benefits, there are some questionings as well. While it is widely accepted as a promising and universal technology, its application raises a slew of questions. These issues arise as a result of the technological hurdles that must be overcome before it can really become a universal type of technology.¹¹⁰ Equipment costs, standards, lack of cooperation between different layers in terms of logistics processes that are central to maintaining information transparency, interferences that disrupt the signal transmission between the tag and the reader, and all fears relating to privacy are just a few of the risks associated with RFID adoption.¹¹¹

While implementing the system, some significant issues must be taken into consideration by courier firms:

- standardization,
- cost of system,
- reengineering of business processes,

¹¹⁰ Ibid., Grabowska, Szczepanik, p.142

¹¹¹ K. Michael, and L. McCathie, "The pros and cons of RFID in supply chain management", Proceedings of the International Conference on Mobile Business, Sydney, Australia, pp. 623, 2005 available at: <http://works.bepress.com/kmichael/92>

- integration,
- privacy,
- lack of professionals in field of RFID technology,
- warehousing.¹¹²



¹¹² Ibid., Grabowska, Szczepanik.

3. THE RELATION BETWEEN COVID-19 AND LOGISTIC SECTOR

3.1. The Importance of Logistics and RFID in the COVID era

In pandemic era business conditions had been restructured according to Covid – 19 effects all around the world. The requirement of social distance, restriction for the number of people in indoor areas and curfew caused remote working or off working days. In the pandemic era absence of manpower indicates RFID is a necessity more than an optional investment in pandemic era. In logistic sector operations never stop, three shift working is familiar, decreasing manpower due to restrictions forces the companies to invest on automation systems for logistic sector.

3.1.Case Study

RFID SOLUTION FOR FERTILIZING PROCESS IN FARMING

A farmer who produce citrus implemented RFID solutions for fertilizing process. He says : Fertilizing is one of the business processes in farming. Fertilizing has a direct effect on quality and the size of the citrus fruit. In last years he could't reach to his sales and production target in harvesting due to small sizes of the citrus fruits therefore it made him get suspicious of theft in fertilizing operations.

Fertilizing operations starts in farming facility with loading the fertilizer to trailer in warehouse. Till the trailer leaves the facility to citrus gardens it is available to track and trace via security cams but in fields and citrus gardens it is possible a few sacks can be transfered to an other vehicle and stolen because no track and trace possible via security cams.

The key point in this case is every single adult citrus tree must have at least 7 KGs of fertilizer per year. If they had been fed less than 7 KGs of fertilizer they will have no ability to grow the fruits enough. In a manner of speaking there is no differences to feed the tree by 6KGs of fertilizer or 2 KGs of fertilizer. The result will be negatively same.

According to this case the farmer decided to implement RFID solutions for fertilizer sacks. 700 Sacks of fertilizer has been handled per year. Due to low efficiency and small sizes of the fruits farmers loss was 400 000 TL last year. With RFID implementation the farmer will be sure that every single tree will be fed enough in fertilizing process.

The cost of implementation of RFID solution is as below :

- 20 USD / Cent for Per Tag
- 1500 USD for Per Reader
- 4000 USD for Software Driver

Software and readers are fixed costs for once to be paid but the tags are for single usage. For every sack a new tag needs to be identified.

35 Tons of fertilizer handled with 50 KGs / Sack which equals to 700 sacks handled per year.

700 Tags x 0,20 USD / Cent = 140 USD

2 Reader x 1500 USD = 3000 USD

1 Software Driver x 4000 USD = 4000 USD

TOTAL COST	= 7140 USD	7140 USD = 97 650 TL
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When the cost of RFID (97 650 TL) compared with the loss last year (400 000 TL) it is almost % 75 profitable and worth to invest.

3.2.Expert Opinions About RFID Implementation

RFID bizim gibi taşınan parsiyel yük sayılısı çok fazla olan firmalarda hasar, kayıp, çalıntı ve teslimatta gecikme gibi müşteri memnuniyetsizliği yaratacak riskleri indirgemektedir. Örnek olarak sektörel jargonda “ Kayıp Gönderi” ibaresi yerine “ Yeri Tespit Edilemeyen Gönderi “ ibaresini kullanırız, çünkü biliriz ki gönderi aslında transferinin sağlandığı transit depolardan birinde ancak üzerindeki barkod hasar aldığı ve okunamadığı için gönderinin alıcı – gönderici bilgileri ve teslimat lokasyonu tanımlanamamaktadır. RFID bu hata payını oldukça düşürmektedir.

Pandemi sürecinde kapalı alanlarda metrekare başına düşen insan sayısı sınırlandırıldığı için rotasyonlu çalışma gereği duyuldu. Bu dönemde RFID kullanımı bulaş riskini düşürdüğü için verimliliğe katkıda bulundu. Bulaş riski sadece teşhis konulan hastanın işten uzak kalmasına neden olmuyor, hasta ile temas eden personellerin de karantina altına alınarak iki hafta işyerinden uzak kalmasına neden oluyor. Bazı personeller şirket içerisindeki pozisyonları nedeniyle kritik görevler üstlenmekte, bu personellerin iki hafta karantinaya girdikleri süreçte back-up vermek mümkün olmak ile beraber periyotun uzun olması nedeniyle yeterli verimlilik sağlanamıyor. Verimliliğin düşmesi birimler arasında koordinasyon kopukluğuna neden oluyor. RFID özellikle pandemi döneminde maliyeti ve bulaş riskini düşürüp, operasyonel hızı yükselterek verimliliği arttıracak özelliklere sahip bir uygulamadır.

Erkan Pekel

FedEx Türkiye IT Direktörü

Söz konusu RFID uygulamaları olunca nakliye ve lojistik sektörünün operasyonel segmentleri arasında aşırı farklılık bulunmamaktadır. 3. Parti Lojistik yapan firmalar RFID kullanmakta veya yakın gelecekte kullanmak üzere gündemlerine almakta. RFID entegre lojistik yapan firmaların yaşadığı sorunlar için uygun bir çözüm önerisidir. RFID uygulayanların %70 - %85 'i yükselen verimlilik oranları, bilgi akışındaki kalite ve operasyonların şeffaflığı konusunda ayrıca da müşteri taleplerini karşılamadaki yeterliliği konusunda da çok önemli olduğunu belirtmekte.

RFID konusundaki dezavantajların başını sıfırdan kurulan bir sistem olması ve hali hazırda işleyen başka bir sistemin yerine getirilecek olması nedeniyle maliyeti çekmekte ancak maliyetleri düşmekte ve daha da düşeceği öngörülmektedir. Örneğin birkaç yıl önce ortalama 1 USD maliyeti olan etiketleri şu anda 15 – 20 USD / Cent maliyetle tedarik etmek mümkün. RFID teknolojisinin en büyük maliyet kalemi tek kullanımlık olmaları nedeniyle etiketlerdir bu yüzden düşen etiket maliyetleri ile RFID kullanımının daha da artacağı öngörülmektedir.

Atilla Yıldıztekin

Tedarik Zinciri ve Lojistik Yönetim Danışmanı

RFID sistemlerinde görsel temas gerekli olmadığı için hız konusu ön plandadır. Genellikle ürün RFID antenli kapıdan ya da sabit bir noktada duran okuyucu anten önünden geçirilerek okuma sağlanır. Uygulamada ürünlerin çoğu zaman konveyör veya bant üzerinde hızla okuyucudan geçirildiği kurulumlar vardır. Barkod ile karşılaştırıldığında ciddi anlamda hız ve doğruluk avantajı vardır. Operasyonel hatalar tamamen insan kaynaklı olduğu için RFID tabanlı sistemlerde görülmez. Kayıp, çalıntı ve hasar sistem açısından bakıldığında herhangi bir insan müdahalesi olmadan olması zordur.

Derman Aydoğan

Tedarik Zinciri ve Lojistik Yönetim Danışmanı

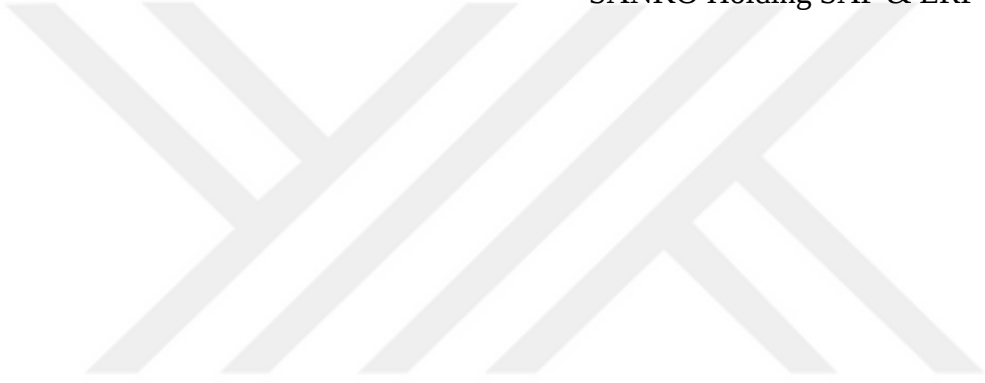
Öncelikle RFID hem hız, hem de ürün takibi açısından eski sistemlere göre çok fark yaratmaktadır. Pasif RF etiketleri çimento kamyonlarının plakalarına tanımlanarak irsaliyelerinin basılmaları sırasında ; Hangi ürün yüklenmiş ? Hangi müşterinin ürünü ? Hangi lokasyona teslimat sağlanacak ? gibi soruların yanıtlarını ortalama beş saniye içerisinde cevaplayarak daha önce burada insan gücü ile yapılan bu işlemi ortalama 35 kat daha hızlandırmaktadır. Bunun dışında müşteriler transfer sürecini uygulamalar üzerinden takip ederek ürünlerinin tahmini varış sürelerini görebilmekteler.

Yine RFID sayesinde kantarlarımız insansız çalışmaya başlayarak insan gücü ile 5 dakikada yapılan işlemleri 30 saniye gibi çok kısa bir süreye indirdi. RFID etiketleri çimento kamyonunun kantara girmesi ile yük bilgileri SAP sistemine aktarılıyor, SAP kantara geri bildirim yapıyor, kantar fişi ve irsaliye faturası basılıyor, bariyer kalkıyor ve sıradaki kamyon kantara giriyor. Bu işlem yaklaşık 30 saniye

sürüyor. Bizim gibi günde üç vardiya çalışan firmalarda RFID kantar başına aylık üç personel maliyetinden tasarruf sağlamakla birlikte günde ortalama 5000 irsaliye kestiğimizi düşünürsek rakamın büyüklüğü bütçeye ve günlük taartılan kamyon sayısındaki artışa makul oranda katkı sağlamaktadır. Bu nedenle maliyetine katlanarak RFID kurulumu yaptırmak kesinlikle yapılan yatırıma değer.

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CONCLUSION

Implementation of RFID in supply chain management is one of those best examples of “ Reduce the time, reduce the cost. “ motto in order to provide efficiency principle. RFID implementations enable supply chain management operations free of problems for an efficient process. RFID decreases the risk of damages and losses, speeds up the transportation process, upgrades the security, eases to track and trace, improves the transparency, reduces the cost, avoids the human mistakes and etc.

A few years ago, RFID costs were high, but in recent years, depending on the development of technology, especially tag costs have come to a very reasonable level, which has made RFID application more logical in today's World.

Another importance of RFID is avoiding physical human contact in pandemic era. According to extraordinary conditions of pandemic era, companies started rotation in working hours for labors.

First of all we attached great importance to environment and human health. On the other hand presence of an infected person in a department may cause a “ Keep in quarantine. “ process for whole department. Even if back up is possible, communication problems between departments will occur.

Day by day need for speed in supply chain management remains higher. The demand of faster process will be supplied by RFID implementations. Past experiences and backgrounds has shown us the implementation of RFID will become a necessity rather than an option in the future all around the World.

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