

RFID AS AN ADVANCED TECHNOLOGY DESIGNED TO IMPROVE BUSINESS PROCESSES IN SUPPLY CHAIN MANAGEMENT

Violeta Gligorovski

Faculty of Economics – Prilep, University St.Kliment Ohridski – Bitola, North Macedonia,
violeta.gligorovski@uklo.edu.mk

Aneta Risteska Jankuloska

Faculty of Economics – Prilep, University St.Kliment Ohridski – Bitola, North Macedonia,
aneta.risteska@uklo.edu.mk

Monika Angeloska Dichovska

Faculty of Economics – Prilep, University St.Kliment Ohridski – Bitola, North Macedonia,
monika.angeloska@uklo.edu.mk

Abstract: The RFID is a useful tool for effective management of organisations' supply chain activities and competitive competencies. So, as the efficient functioning of the supply chain in any company contributes to the growth of its competitiveness and profitability, the meaning of supply chains takes on a new connotation in the changed conditions for managing business processes. The RFID system, as a technology that is implemented by more and more companies, today occupies a significant place in the agenda of every competitive company. Although this means that companies follow technological innovations, one of the reasons why this technology penetrates increasingly, mainly, is that these labels are becoming cheaper and cheaper, but the implementation of this type of technology is simpler, faster and easier to use, which, of course, is an advantage compared to other technological inventions. The purpose of this paper is to emphasize how the RFID (Radio Frequency Identification Device) technology can improve business processes in the Supply Chain Management (SCM). Business processes, through digitalization, acquire a completely different dimension in the new virtual world, following the new conditions from a completely different perspective. This paper presents a brief explanation of Radio Frequency Identification Device (RFID) integration in Supply Chain Management using literature review and analytical research approach. For the purposes of this paper, a review was made and secondary data was found in order to identify the benefits of this type of technology and to emphasize the need for its use.

Keywords: Management, SCM, RFID

1. INTRODUCTION

Digitization of business processes is becoming an important segment of every company that wants to be competitive in the global market. Namely, business processes, through digitalization, acquire a completely different dimension in the new virtual world, following the new conditions from a completely different perspective. Digitalization of business processes is a completely new system for monitoring the situation in every digitized company. The optimization of business processes is a concept that is integrated in the company that claims to be part of the global trade exchange. Today, companies, caused by globalization and increased competition, are faced with a large number of orders to which they have to respond, and at the same time they have to provide a quick transfer of information, i.e. a quick transaction of financial assets. The dynamic environment and intense changes impose the need for companies to be proactive and quickly adapt to newly created conditions. Although radio frequency technology is widely used, it must be emphasized that its benefits should be directed to the supply chain in the company, as a particularly significant segment for its overall business functioning. The aim of this paper is to emphasize the RFID (Radio Frequency Identification Device) technology for business processes improvement in the supply chain management. The rest of the paper is organized as follow. Section 2 deals with some previous work on this topic. Section 3 gives theoretical overview for supply chain management, it's elements and characteristics. Section 4 gives information about RFID technology. Section5 provides theoretical overview for the RDIF optimization in SCM business processes. Section 6 shows the challenges and benefits of RFID implementation. The last section concludes conclusion.

2. LITERATURE REVIEW

A RFID system can be very complex, and its implementations may vary greatly. (Sabbaghi & Vaidyanathan., 2008). As Viehland & Wong, (2007) point out, most research literature in RFID tends to be technical, not focused on the application of RFID in business, which is the focus of this study. Nevertheless, a comprehensive review of the RFID business-oriented literature found the following twelve issues to be related to the future of RFID, listed in

alphabetical order. (Anti-collision, Business process reengineering: Data warehousing, Integration with other systems, Lack of RFID-skilled professional, Orientation, Performance, Privacy, Range, Security, Standardization, System costs). The results indicate that standardization is the most important issue in determining the future of RFID. This does not come as a surprise as RFID is mostly being used along the supply chain at the current time. It is also not surprising that the cost of RFID systems is one of the most important issues, second only to standardization. Even though, there are issues to be resolved in the future, yet RFID is very applicable to many things, and will be the future in SCM technology. So, according to Parkash, Kundu & Kaur, (2012) RFID can be used in Healthcare Baggage, Applications, Toll Road Applications, A Review Asset Tracking and Locating Objects, Libraries of RFID Labels, Animal Identification, Anti-Theft System Waste Management, National Identification, The RFID tag can be attached to animals, plants and in particular human body. The technology is capable of preventing medical accidents in the health industry. RFID tag system is able to obtain and store blood pressure and body temperature“. The use of this technology will become increasingly sophisticated and companies will gain great effectiveness at low costs. „Companies that implement the appropriate business processes to leverage the data collected by RFID and its conversion to information and intelligence will accelerate these benefits. As companies develop their RFID strategies, they must look beyond mere compliance for ways to implement these initiatives into their total supply chain strategy and harness the true business value of the technology, hastening profits.“ (Sabbaghi & Vaidyanathan., (2008).

3. SCM MODEL - CHARACTERISTICS AND ELEMENTS

According to Kgobe & Ozor (2021) in the past, SCM appeared simple when factories activities were mainly of a routine nature and largely under the whims and caprices of human intellect. More recently, organisations responsibilities have become more complicated, compelling obvious and rapid changes in SCM administration.

The concept of supply chain management is based on two basic ideas, namely: the first is that every product that reaches the end user is, in fact, the result of cumulatively connected segments, which are collectively called the supply chain; the second idea refers to the fact that this model exists in every company, but the management did not pay adequate attention to all the actions that took place inside the company. So, Supply Chain Management, in fact, is the management of the activities related to the supply chain, mainly for the consumer to have more value from the product and at the same time to achieve a sustainable competitive advantage of the company.

Namely, there are several components that make up this model:

1. Plan. The company should have a strategy on how to manage the available resources to respond to the different needs of consumers for the products or services they use, that is, there should be a strategic planning for cost rationalization in the use of personnel and financial potential;
2. Sources. The company has to choose from which places it will be supplied with raw materials for the production sector. When defining the supply chain, managers should pay attention to the formation of prices for products/services, the method of payment, the availability of sources of funds, etc. Specifically, it should be a continuous cooperation with all those from whom they procure materials and raw materials, as well as external financial sources;
3. Production. The next component of the model is the production (as a process) of the finished products and the activities related to all the operations that follow it, which refer to testing, control, packaging and preparation for delivery. In this segment of the company's operation, the level can be measured product quality, employee productivity, financial results, etc.;
4. Delivery. This is the segment of the company's operations where managers coordinate the receipt of orders from customers, deliver products and establish a transaction system;
5. Return. The last segment is the design of the policy for tracking the return of individual purchased products. The after-sales system should provide a flexible and reliable way to return products, while the company should show readiness for good communication and provide support to those customers who had problems with the products.

So, it is a complex model, which, if implemented in every company that wants to be competitive in the global market, actually represents an opportunity for its recognition by consumers, which contributes to sales growth and profit increase. Competing companies are constantly striving to reduce costs, improve the services they offer and return some of the investments made through the supply chain. But "it's hard to manage what you can't see. Therefore, RFID increases the visibility of equipment, inventory and business processes in companies. Market conditions are constantly changing and dictate new ways of perceiving business processes. "In changed conditions of business functioning, it is not enough for the management to be only focused on operations, but it should also be innovation-oriented in order to be competitive. Managers need to understand that their work is only part of the supply chain they are in, and it is the functioning of the supply chain that can make or break competitiveness. (Dawei, 2011).

So, as the efficient functioning of the supply chain in any company contributes to the growth of its competitiveness and profitability, the meaning of supply chains takes on a new connotation in the changed conditions for managing business processes. Technological development implies a new way of working for companies, which are in conditions of adaptation and absorption of dynamic technological innovations. "Technology is a vital part of the supply chain management because the management of relationships with consumers, suppliers and intermediaries is based on the exchange of information and transactions (Cahffey, 2009).

4. RFID TECHNOLOGY

RFID (Radio Frequency Identification Technology) is a technology that appeared in the seventies of the last century, but its more intensive use has been emphasized in the last decade of this century. This technology, in fact, consists of a system of small electronic chips and an antenna, which transmit data via radio signals to a reader that reads the data. The technology comprises hardware and software infrastructure. So, the chips are placed on products, containers or pallets, animals, etc., and the transmitters on those who read the products through a program that receives direct information about the movement of the products. The RFID label contains a microchip that has the necessary information about the product or products, an antenna connected to the microchip and electronics for wireless connection with the reader, as well as a coating that covers these segments. Microchips can contain a large amount of information, up to 8 MB. The information can be an order number for shipping history, then customer information or company information, serial number, etc. There are several types of labels, namely: active, passive and semi-active, depending on whether they have their own battery to use the energy or use the energy from the reader. According to (Ahuja & Potti, 2010) „An active tag requires a power source and is either connected to a powered de-vice or to a battery and is often limited by the lifetime of its source. Being dependent on a powered source puts limitations on Active RFID tags. Cost, size, lifetime make them impractical for regular use. On the other side, passive RFID is of interest because of the fact they are independent of power source and maintenance. Passive RFID also have advantages of long life and being small enough to fit into a practical adhesive label“

The transmitters can be placed anywhere where there is a probability of detecting the movement of products. The information, which is on the chips, is read after passing through the installed reader, and the movement of the product is noted through the direction that has already been established. Another segment of this technology is the RFID controller, that is, it is a computer or server on which the software runs and is the brain of this system of operation. The RFID antenna is also an integral part of this system and represents the connection between the reader and the labels.

In fact, a kind of connection between the digital and the physical world is established, without human interaction. Technological innovations and their consequences have obviously become inseparable parts of modern life, and RFID (as one of those technological innovations) is a system that provides an easy, reliable and fast way to enter data, store it and transact with users (Yüksel & Yüksel, 2011)

Acceptance of this technology by companies is a very significant moment, because it gives the company a technological advantage compared to all others, who do not use these innovation facilities.

"These ideas are realized through two assumptions (Hanns-Christian & Hanebeck, 2010):

- 1) the company can recognize the full potential of RFID technology in the context of business processes; and
- 2) it can be realized through adequate changes to business processes in the company. So, it is a question of technology that should be implemented in the very structure of business processes in the company and become an integral part of its operation. RFID technology in the company's supply chain enables faster and more accurate movement of products from the factory to the stores. According to (Kaur., Sandhu et al., (2021)) RFID isn't as cheap as traditional labeling technologies, but it does offer added value and is now at a critical price point that could enable its large-scale adoption for managing consumer retail goods.

5. RFID AS OPTIMIZATION OF BUSINESS PROCESSES

"Technology and its impact on business strategy continue to be the most important segment for top managers of companies. Digital business has taken the form of a mantra for a large number of managers who want to have a competitive advantage in a world driven by rapid technological change "(Mc Kinsey, 2012). One of the ways to optimization of business processes is the timely adaptation of dynamic technological innovations, systems and models. Automatic identification systems or AUTO-ID (barcode, techniques that work on sensors), which includes RFID technology, enable automatic identification of objects, data collection for those objects and their computer visualization and processing. RFID technology has the potential to fundamentally change the way business processes operate. The integration of RFID in the business processes of a separate competitive company is a business decision that has a great impact on the changes that will occur in the overall structure, that is, they will

contribute to changing the company's actions. The implementation of this system is a complex task for the company, which should have prepared a plan and carried out analysis of each segment of the operation.

According to Blecker & Huang, (2008) each segment of the company should be independently evaluated to determine how and in what way the RFID system can increase the functionality of the individual segments. "Because the implementation of this technology is a significant business decision of the company's management, it takes place in several stages, as follow:

- business analysis;
- testing;
- pilot implementation, and
- installation of the new technology.

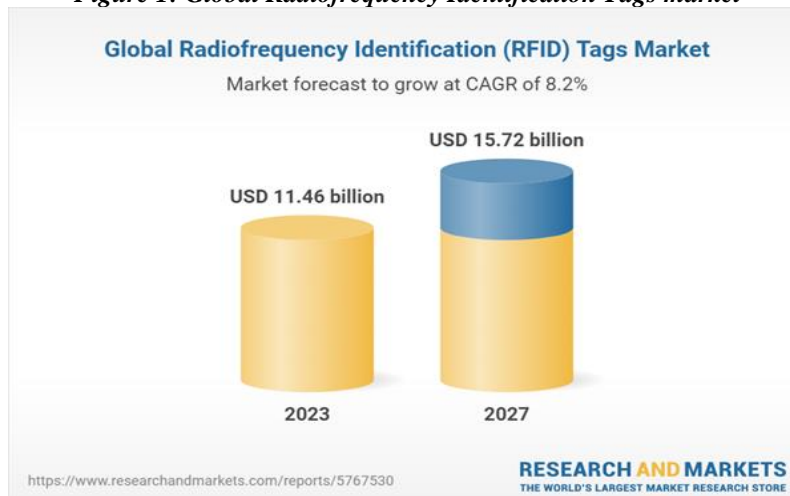
So, before starting the implementation of this system, a complete business analysis should be carried out, i.e. economic analysis, all in order to see if this process would make business processes more efficient, would reduce the costs of operation and in general would enable the formulation of a comprehensive record and visualization of the movement of products/services throughout the company and outside it. This system plays an important role in the structure of business processes, because the loss of producers' income is great, because the products (while moving to the stores) for their realization through sales ... are often lost. Every year, according to a proven expert from the Federal Trade Commission, US manufacturers lose \$300 billion in revenue because they lose track of products from factories to stores.

By implementing this technology in the supply chain, companies will be able to save and thus, reduce the price of the products, which is the ultimate goal of every competitive company, to survive in the market and maintain vital relations with consumers. Also it can improve the supply chain process of a company by reducing the time to reach the customer's end, proper inventory management, proper follow up of information, etc. RFID gives identification to each of the pallet, container and product to be produced, supplied and sold . (Mall & Mirsha, 2012)

The RFID system, as a technology that is implemented by more and more companies, today occupies a significant place in the agenda of every competitive company. Although this means that companies follow technological innovations, one of the reasons why this technology penetrates increasingly, mainly, is that these labels are becoming cheaper and cheaper, but the implementation of this type of technology is simpler, faster and easier to use, which, of course, is an advantage compared to other technological inventions.

According to [Research and Markets report](#), (2023), the global radiofrequency identification (RFID) tags market grew from \$10.3 billion in 2022 to \$11.46 billion in 2023 at a compound annual growth rate (CAGR) of 11.3%. The radiofrequency identification (RFID) tags market is expected to grow to \$15.72 billion in 2027 at a CAGR of 8.2% (Figure 1).

Figure 1: Global Radiofrequency Identification Tags market



„Despite the fact that RFID innovation was found numerous years prior, it has progressed and developed just during the most recent decade since expense has been the fundamental limitation in all usage. RFID labels come in a wide range of shapes, sizes, and capacities“ (Yadav & Jha, (2019).

Even though numerous limitations and unresolved issues still hinder the widespread application of RFID. Regardless of these challenges, RFID continues to make inroads into inventory control systems, and it's only a matter of time before the component costs fall low enough to make RFID an attractive economic proposition. Furthermore, extensive engineering efforts are under way to overcome current technical limitations and to build accurate and reliable tag reading systems.

According to (liu., (2022)) nowadays, the application of this technology is inseparable from the clothing, food, housing, and transportation needs of life. However, there is still a certain gap between my country's RFID technology and international technology in terms of standardization, cost, and security. The further application of RFID technology still has a long way to go.

6. CHALLENGES AND BENEFITS OF RFID IMPLEMENTATION

The RFID implementation in supply chain is very important but it's related with many challenges.

One of the major challenge is the price and return on investment (ROI) in the implementation of RFID technology. Albano & Engels (2002) reveals that the majority of problems related to RFID implementation are the technical and hardware issues. The cost of tags was quite high initially, and henceforth it has been a challenge for the organization to go for item level tagging (Trebilcock, 2007). The cost of the tag has reduced a lot from the initial period, but there is a lack of standards which acts as a challenge in the adoption and implementation of the technology (Curtin et al. 2007; Attaran, 2012).

According to Diljeetkaur et al (2017) seven important challenges for RFID implementation have been identified: technical issues, lack of industry standards, cost issues, privacy issues, security issues, manpower issues, compliance issues.

According to Owunwanne & Goel (2010) there are several benefits for companies who are implementing RFID technology in their business processes:

- Improves overall supply chain performance primarily because it provides managers with real-time data that enhances decision-making.
- Facilitate contingency planning and proactive practices.
- Improve and strengthen customer-supplier relationships by fostering communication and information sharing between business firms, suppliers and customers.
- Mitigates costs by reducing the time and labor needed to manually input data. These systems improve data accuracy, which directly benefits sales and operations planning and is a practical way to help firms stay afloat given the current economic climate.
- Cost Savings: Estimated savings of at least 30% of the 2 to 4% in operational expenses that organizations typically spend on warehouse and distribution costs.

7. CONCLUSION

RFID technology has the potential to fundamentally change the way business processes work. The integration of RFID into the business processes of every modern competitive company is a business decision that has a great impact on business functioning, the reliability of product movement and the tracking of information in the supply chain of values, which changes the overall structure of the company. The implementation of this technology is rapidly increasing and is increasingly evident in a large number of industries that have recognized the benefits of this way of working, and thus gained a direct impact on business processes - especially when it comes to supply models. In this way, the companies that have completed the implementation of this technology already feel the benefits, that is, the loss of goods is reduced, and at the same time the costs are reduced because the presence of the human factor is replaced, i.e. the process is automated and product tracking is accurately traced, visible and recorded. So, as the efficient functioning of the supply chain in any company contributes to the growth of its competitiveness and profitability, the meaning of supply chains takes on a new connotation in the changed conditions for managing business processes.

REFERENCES

- Ahuja, S., Potti, S. (2010). An Introduction to RFID Technology Communications and Network.183-186doi:10.4236/cn.2010.23026.Published Online August <http://www.SciRP.org/journal/cn>.
- Blecker., H. (2009). RFID in Operations and Supply Chain Management.© Erich Schmidt Verlag GmbH & Co., Berlin.
- Cahffey, D. (2002). E-business And E- Commerce Managemant, Prentece Hall.

- Diljeetkaur G., Makhija, Pawan K. Chugan, (2017) Challenges in adoption of RFID Technology: A study of manufacturing organizations, PEZZOTTAITE JOURNALS, Volume 6, Number 3, July – September
- Hanebeck, L., Hanns, C., (2010) Processes Management and RFID, Globe Ranger.
- Hansen, W., R., Gillert, F., (2006). RFID for the Optimization of Business Processes, John Willy & Sons Ltd., 2006.
- Kgobe, P Ozor, P., A. (2021). Integration of Radio Frequency Identification Technology in Supply Chain Management: A Critical Review. Operations And Supply Chain Management. Vol. 14, No. 3, 2021, pp. 289 – 300 ISSN 1979-3561 | EISSN 2759-9363.
- Kaur, M., Sandhu, M., Mohan, N and Parvinder, S., (2011) RFID Technology Principles, Advantages, Limitations & Its Applications .International Journal of Computer and Electrical Engineering, Vol.3, No.1, February, 2011)
- Liu., X, (2022) G. Ali et al. RFID'S Applications and Future Prospects (Eds.): ISEMSS 2022, ASSEHR 687, pp. 3287–3294.
- Mall S. Sidharth, (2012) RFID and Supply Chain Management: A Brief Outline. https://www.researchgate.net/publication/255856999_RFID_and_Supply_Chain_Management_A_Brief_Outline [accessed Sep 13 2023].
- Mc Kinsey, (2012) Perspectives on Digital Business, Mc Kisey & Company.
- Owunwanne D., Goel R, (2010) Radio Frequency Identification (RFID) Technology: Gaining A Competitive Value Through Cloud Computing, International Journal of Management & Information Systems – Fourth Quarter, Volume 14, Number 5
- Parkash, D., Kundu, T., Kaur , P., (2012) Rfid Technology And Its Applications: A Review 1davinder, 2twinkle & 3preet , International Journal Of Electronics, Communication & Instrumentation Engineering Research And Development (Ijecierd) Issn 2249-684x Vol.2, Issue 3 Sep 2012 109-120.
- Viehland, D., Wong, A., (2007) The Future of Radio Frequency Identification , The future of radio frequency identification Journal of Theoretical and Applied Electronic Commerce Research, vol. 2, núm. 2, august, 2007, pp. 74-81 Universidad de Talca Curicó, Chile.
- Yadav, S., Jha, P., (2019) RFID Technology: An Overview Sapna, Pratibha, International Journal of Trend in Scientific Research and Development (IJTSRD)
- Yüksel, M., E., Yüksel, A., S., (2019) RFID Technology In Business System And Supply Chain Management, Journal Of Economic And Social Studies, Volume: 3 | Issue: 3 | Mar-Apr 2019 Available Online: www.Ijtsrd.Com E-Issn: 2456 – 6470)
- Research and Markets (2023). Available at [reporthttps://www.researchandmarkets.com/reports/5767530/radiofrequency-identification-rfid-tags-global](https://www.researchandmarkets.com/reports/5767530/radiofrequency-identification-rfid-tags-global) . Accessed on 12.09.2023