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ỨNG DỤNG CÔNG NGHỆ NHẬN DẠNG QUA TẦN SỐ VÔ TUYẾN (RFID) TRONG LOGISTICS CHO NGÀNH DỆT MAY VIỆT NAM

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Tóm tắt

Là trung tâm dệt may lớn của Đông Nam Á, ngành dệt may của Việt Nam đang trên đà phát triển mạnh mẽ nhưng cũng đối diện với không ít thách thức. Những thách thức này đến từ nhu cầu ngày càng tăng cao từ thị trường và sự quan tâm của người tiêu dùng đối với việc tiêu thụ sản phẩm tuân thủ đạo đức và bảo vệ môi trường từ phía doanh nghiệp. Đối mặt với áp lực trên, công nghệ Radio Frequency Identification (RFID) được ngành dệt may Việt Nam tiếp thu và áp dụng, vận hành theo cơ chế không tiếp xúc và không dây để truyền dữ liệu từ thẻ gắn vào mỗi sản phẩm nhằm nhận diện và theo dõi tự động. Bài viết này tập trung vào công nghệ RFID và khai thác các ứng dụng quan trọng của RFID ở các giai đoạn khác nhau trong quy trình logistics của ngành dệt may nói chung và tại Việt nam nói riêng, bao gồm sản xuất, quản lý kho và vận chuyển hàng hóa. Tiếp đó, bài viết đề xuất một số khuyến nghị cho các doanh nghiệp Việt Nam nhằm triển khai chiến lược sử dụng công nghệ RFID một cách hiệu quả và tối ưu.

Từ khóa: RFID, logistics, ngành dệt may, ứng dụng, Việt Nam

APPLICATION OF RADIO FREQUENCY IDENTIFICATION (RFID) IN LOGISTICS FOR VIETNAMESE TEXTILE INDUSTRY

Abstract

The booming textile industry, particularly in Vietnam, a major textile manufacturing hub in Southeast Asia, faces increasing pressure to optimize its operations. This pressure stems from

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both the demand for increased efficiency and transparency in logistics, and the rising consumer interest in ethical and environmentally responsible practices. Radio Frequency Identification (RFID) technology, which is the process of using a wireless, non-contact method to send data from a tag attached to an item for automated identification and tracking, emerges as a potential game-changer for the textile industry. This paper addresses the technology of RFID as well as explores significant RFID applications in various stages of textile logistics and Vietnamese textile logistics such as manufacturing, warehouse management and freight transportation. Thereafter, several recommendations are provided for Vietnamese enterprises to strategically implement RFID technology in textile logistics.

Keywords: RFID, logistics, textile industry, application, Vietnam

1. Introduction

Radio Frequency Identification (RFID) is a technology that employs radio waves to automatically identify objects or animals even from a significant distance (De Brito and Van Der Laan, 2009; Nayak, 2019). RFID stands out as a highly promising contemporary technology capable of automatically identifying, tracking, and tracing various items in logistics activities. Radio Frequency Identification (RFID) technology, along with the Internet of Things (IoT), has witnessed significant advancements and is now extensively employed across various sectors including logistics.

The utilization of RFID technologies has the potential to enhance the advantages of logistics by minimizing inventory losses, improving process efficiency and speed, and enhancing information accuracy. In the textile industry, RFID technology has found diverse applications, such as monitoring fabrics, garments, and accessories, enabling more precise and rapid tracking of these items. This technological advancement has led to enhanced inventory management and heightened productivity levels. However, the key to achieving success lies in comprehending the technology and its accompanying features to mitigate potential issues effectively. Despite being in existence for several years, the widespread adoption of RFID faces significant obstacles due to technological challenges and cost-related concerns. RFID brings about not only benefits but also major challenges to overcome.

While numerous research publications have delved into different applications of RFID in the textile industry, few studies have investigated the use of RFID technology in Vietnamese textile logistics in specific. Therefore, this study focuses on analyzing the current situation of the textile logistics in our country within the framework of RFID technology applications in three stages of manufacturing, warehouse & inventory management and freight transportation; evaluates the pros and cons; and gives suggestions for Vietnamese companies to advance and foster the industry.

2. Theoretical framework

2.1. Definition of logistics

Logistics is a part of the supply chain that plans, implements and controls the efficient, effective forward and reverse flow and storage of goods, services and related information

between the point of origin and the point of consumption in order to meet customer's requirements (The Council of Supply Chain Management Professionals). It can also be defined as the process of coordinating and moving resources such as equipment, food, liquids, inventory, materials and people from one location to the storage of the desired destination. The goal of logistics is to meet customer requirements in a timely, cost-effective manner.

Logistics play an important role in contributing to the value chain of a company (Porter, 1985). Value chains analyze the connection between different activities in firms that add value to the product or services as well as strategies to minimize the cost. The more value created and the less cost used to create that value, the higher would be the profit margin. For this reason, companies are constantly upgrading logistics activities to be more efficient with the goal of optimizing cost to gain competitive advantages and providing better customer service.

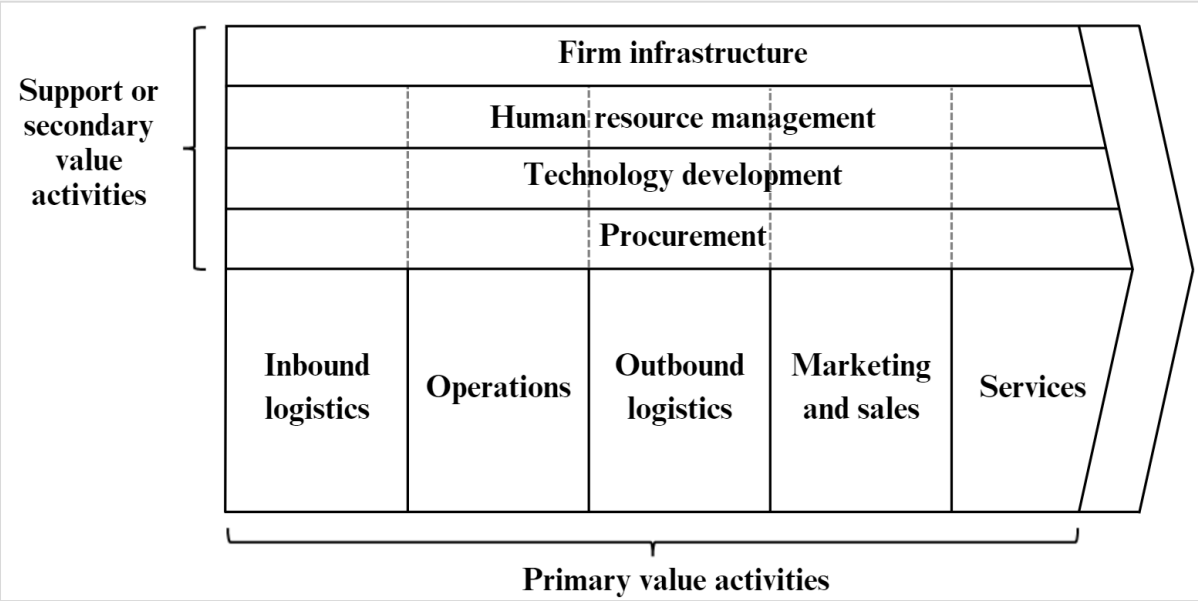

Figure 1. Porter's Value Chain

Source: Porter, 1985

2.2. Overview of Radio Frequency Identification (RFID)

Radio Frequency Identification (RFID) is a technology being used increasingly in logistics activities. It supports the activity of identifying, inventory tracking, building access and many more. This technology can be used in a diverse range of different industries with practical applications. In the past, the lack of widely accepted industry standards and resulting market fragmentation limited RFID use to a few applications such as ticketing. "E-Pass" highway toll booths are one example of RFID-enabled smart tickets.

RFID technology consists of three parts, which are an RFID tag, an RFID reader linked to a computer system and software for data processing (Nayak, 2007). RFID tag is a small object attached to or embedded into a product that collects real time data and then transmits it through radio waves. Information will be stored in a chip and transmitted and received through the antenna. Each product being tracked will be given a unique identifying number (electronic product code - EPC). Compared with bar codes, RFID tags support a larger set of EPC and

additional information such as manufacturer, manufacturing year, etc. All this information will be read by the RFID reader when a tag passes by it. The reader therefore can track the movement of the tag as well as the products which that tag is attached to. Readers function similarly to barcode sensors, emitting a radio signal through the antenna to communicate with the tag (Jin and Lu, 2006).

RFID is categorized by their radio frequency: LF (low frequency), HF (high frequency), UHF (ultra high frequency). Currently, two types of RFID tag are being used, which are active and passive. Active tags require their own power source like a battery, which is used to power the chip and transmit signal to the RFID reader while the passive tags require no internal energy supply. That is why the passive tags are more preferred in retail trade because they have an infinite operational life and need no maintenance.

2.3. Overview of application of RFID in logistics

In a logistics system, radio frequency identification, or RFID, is a widely utilized technology for tracking and tracing of assets, commodities, and flows (Hu L., Xiang C., and Qi C., 2020). According to a study by Giorgia C., Barbara B., and Eleonora B., (2022) the most common use of RFID technology in logistics is "tracking." In order to guarantee the visibility and traceability of goods in the logistics chain, particularly in the automobile industry, Stasa, P. (2016) created an RFID-based tracking and tracing system. Research has been proposed by Høyer, M.. (2019) to determine the different obstacles that the dairy business faces while utilizing tracking and tracing technologies.

Monitoring is another common use of RFID technology in the logistics industry. An analysis of a methodology that enables an RFID-based inventory management system to communicate with a suggested RFID-enabled automated storage and retrieval mechanism without the need for human interaction has been published by Alyahya, S. (2016). RFID technology has been used by Kang, Y. (2018) to enhance the just-in-sequence logistics process for incoming cars. Specifically, the authors are the first to develop an RFID-based visibility system for real-time control of part delivery from supplier production lines to an automobile manufacturer's assembly line. Secondly, an RFID-based sequence-error proofing system has been created to prevent unintentional line stops resulting from improper part sequencing.

3. Analysis of the application of RFID in logistics of textile industry

3.1. Overview of textile industry

The textile industry is one of the oldest industries which engages in the creation, production, and distribution of clothing, accessories, and associated products. The textile industry affects some of the world’s most severe economic and environmental effects. The global textile market was valued at USD 1,695.13 billion in 2023 and is anticipated to grow at a compound annual growth rate (CAGR) of 7.6% in revenue from 2024 to 2030 (Grand View Research, 2024).

Textile industry has traditionally been labor intensive although technological advancements have stepped in. With a lot of materials and products moving through different

stages of production, it is possible that there is a shortage of raw materials and products due to theft or loss and discrepancy during transit. In this case, RFID can be used to track expensive items and materials so the textile industry can reduce labor and avoid theft as well as counterfeiting.

A short product life cycle, frequent style changes, a large variety of product designs and, consequently, input material options, variable manufacturing volumes, intense competition, and frequently high standards for product quality are characteristics of the textile industry. Therefore, this industry can be cyclical due to dynamic economic conditions and consumer spending habits. The constant change in trend demand for new and innovative textile products to meet the market needs. RFID uses can be applied in retail monitor and control level of stock. It is especially useful when companies need to ensure accuracy but there is a shortage of staff. This also eliminates the need to count hangers, objects, and pallets and allows the amount to be regulated to the point of complete satisfaction.

To survive the fast-changing fashion trend, the textile industry has to build a complex supply chain system in order to be able to provide sufficient and timely supply for customer needs. The complexity of the supply chain can lead to various challenges in logistics, sourcing and coordination. RFID is used in these various stages to help control inventory, manufacturing process and customer relationships. To be more specific, the location and movement of materials, semi finished goods, and finished goods can be detected. It boosts productivity and quality of products.

The textile industry also integrated with a lot of other industries as their end products are used in a wide range of products such as home textiles, technical textiles, and industrial application. This requires the movement of goods through many warehouses in each region, even each country. RFID largely reduces lag times during distribution by swiftly resolving the problem of product sorting and tracking.

3.2. Application of RFID in logistics in textile industry

3.2.1. Application of RFID warehouse and inventory management in textile industry

Inventory management stands out as the primary application of RFID. The implementation of RFID in inventory management revolutionizes the traditional approach by providing real-time visibility into the movement and status of products throughout the supply chain. With RFID tags attached to each item, businesses can effortlessly track the inventory's journey from manufacturing to distribution, warehousing, and retail. This granular level of tracking facilitates accurate and instantaneous updates on stock levels, reducing instances of stockouts or overstocking. The efficiency gains are substantial, as RFID automates data capture, minimizing manual errors, and streamlining processes such as order fulfillment, restocking, and cycle counting. Ultimately, RFID empowers organizations with the tools needed to achieve optimal inventory control, ensuring that products are in the right place at the right time, fostering operational agility and enhancing overall supply chain performance.

Specifically, RFID technology is utilized for below specific applications of inventory management:

Firstly, RFID optimizes the level of raw materials. RFID tags are attached to raw materials, such as yarns and fabrics, enabling real-time tracking throughout the warehouse. This ensures precise monitoring of the location and quantity of raw materials, reducing the risk of shortages and optimizing procurement processes.

Secondly, RFID ensures efficient warehouse operations. RFID tags are utilized on finished goods and semi-finished products stored in warehouses. Warehouse personnel can quickly locate items, reducing search times and minimizing errors associated with manual handling. For instance, American Apparel implemented an RFID system across eight of their stores, leading to a weekly labor time savings of approximately 60–80 hours and a decrease in instances of out-of-stock products due to lack of awareness. (Wu et al., 2009). Another case of successful application of managing warehouses has been conducted by Kaufhaulf departmental stores in Europe to apply the cross docking model (Loebbecke and Huyskens, 2008). They found that RFID technology can be effectively utilized in warehouses to monitor goods and facilitate cross-docking operations. Unlike traditional methods, where received goods are separated in the warehouse, Kaufhaulf stores store them as they arrive from the manufacturer. In the receiving area of the distribution center, RFID readers are used to track incoming goods. The received items, whether in pallets or as individual fashion items on hangers, are registered, and the data stored on RFID transponders can be easily accessed. This approach eliminates the need for manually counting hangers, items, and pallets, ensuring accurate control of quantities with a satisfaction level of up to 100% (Nayak et al., 2015).

Thirdly, RFID helps to avoid Shrinkage and Loss. RFID assists in minimizing shrinkage and loss of inventory by providing accurate, real-time data on the movement of textiles. Unauthorized movements or discrepancies can be quickly identified, enabling prompt action to prevent theft or losses.

Fourthly, RFID enhances order fulfillment. RFID helps in fulfilling customer orders more efficiently by providing accurate information on the availability and location of specific textiles. This leads to quicker order processing, reduced lead times, and improved customer satisfaction.

Lastly, RFID ensures visibility across the supply chain. RFID enables seamless visibility across the entire textile supply chain, from manufacturing to distribution. Supply chain partners can access real-time information, facilitating collaborative decision-making and ensuring a smooth flow of goods. The Italian textile manufacturer, Griva, has implemented RFID tags in a new system to oversee production units and stockrooms. These tags are affixed to the external parts of rolls containing fabric (Barburski, M., Czekalski, B. and Snycerski, M., 2008).

Figure 2. Roll of fabric with RFID tag attached

Source: Barburski, M., Czekalski, B. and Snycerski, M., 2008.

3.2.2. Application of RFID in transportation in textile industry

An effective logistics system requires a freight transportation system that operates efficiently. The textile industry requires the coordination of different stages from sourcing for materials like cotton or fiber to delivering products to customers. Transportation is required from process to process in order to move materials, semi-finished goods, and final goods to various locations. For example, Vietnam is the third largest textile exporter in the world, however, the domestic cotton supply only satisfies one or two percent of the total demand, Vietnam still has to import more than fifty percent of cotton from China and nearly eleven percent from Korea (Duc, M., 2021). After that, Vietnam textile products will be exported to different markets in the world such as the United States market (11 billion USD), Japan market (3 billion USD), EU (2.9 billion USD) and Korea (2.4 billion USD) (Trang, T., 2023). The above example illustrates that the textile industry involves different flows of goods and materials throughout the world, and depends heavily on transportation to operate.

One actual feature of the textile industry is the import of raw materials then export finished products to another market. Delay or loss of one container or vehicle can cost great losses to companies because of the high and continuous demand of customers. Therefore, firms are invested heavily on technologies to reduce the risks and accelerate the process of transporting textile products from one point to another.

The continuous decrease in the costs of emerging technologies, along with a growing recognition among freight operators of the potential advantages of such technology, will motivate the freight industry to expand its utilization of RFID technology. RFID will exert diverse impacts on different transportation modes. Carriers across all modes are expected to increasingly depend on real-time updates about the location and status of vehicles and containers within their systems. The expansion of the intermodal freight market necessitates a rise in the exchange of information among companies.

RFID can be used in transportation in textile industry in the following aspects:

Firstly, RFID can be used in vehicle management. RFID technology has the capability to automate yard management by streamlining workflows and processes. It facilitates the collection of data on monitored assets at various locations, aiding in the identification of shipping bottlenecks for prompt adjustments to delivery schedules within the supply chain. Additionally, it grants access to historical data concerning the location and status of assets. With this application, companies can actively coordinate suitable transportation to fulfill duties and meet service commitments. This application also enables to reduce the number of employees used for vehicle processing and on-site time, dramatically increasing productivity and responsiveness to customer demand.

Secondly, another application is using RFID for vehicle tracking and identification. A fundamental application of RFID in transportation involves the Electronic License Plate—a digitally tagged number plate read by a computer system through RFID readers (O'Connor, C., 2009). Every e-plate that is read by an RFID reader has information about the vehicle that is sent back to a server or backend system that is connected to the internet. Many things can be done after the system is connected to the internet because the vehicle's information is already stored in a database and is available for use in a variety of contexts. This RFID car monitoring system makes it possible to automatically gather data for safe and effective vehicle management. Automated vehicle identification improves security and can hence stop vehicles from being lost, making sure the products will be delivered safely.

Lastly, RFID brings visibility to the logistics activities. With the feature of providing real-time data, it can bring valuable insights for textile companies into its logistics performance. Companies can utilize this to optimize transportation routes and make more effective decisions. Also, in case of disruptions such as natural disasters, companies can actively change route shipments. In addition, by having real-time data, suppliers, manufacturers, distributors and retailers can cooperate more efficiently, leading to improvement in response to changes and a smooth flow of goods. Furthermore, RFID helps firms to provide better customer service through active communication with customers by accurate information of delivery time, shipment status.

4. Analysis of application of RFID in logistics of Vietnamese textile industry

4.1. Overview of Vietnam logistics in textile industry

In Vietnam, textile is one of the key industries with a large amount of imported and exported goods. According to the 2020 Vietnam Logistics report of the Ministry of Industry and Trade, this is the second industry in terms of import and export turnover. However, currently, Vietnam is facing a situation where the costs of logistics activities are still quite high. According to a report by the Vietnam Logistics Service Business Association (VLA), in 2023, logistics costs in Vietnam are estimated at 16.8% - 17% of GDP and are still quite high compared to the general average of the world (currently about 10.6%). Regarding the textile industry, according to the Vietnam Textile and Apparel Association (VITAS), Vietnam's logistics costs for the textile industry are higher than other countries in the region, namely Thailand, China, Malaysia, etc. because Vietnam's textile enterprises are mainly small and

medium-sized enterprises, but compared to other countries in the region, they have to bear many high costs such as bank interest rates, especially transportation fees. Along with that, businesses are also subject to pressure from foreign transport companies because the services of domestic logistics businesses are very limited. Furthermore, an additional obstacle facing logistics operations in the textile industry is the insufficient scale, location, and quality of Vietnam's warehouse system, which presents difficulties for companies in storing raw materials, finished goods, as well as importing and exporting goods. This makes the textile industry less competitive, significantly affects the production and business costs of domestic textile enterprises, and becomes an obstacle for businesses when entering new markets.

4.2. Application of RFID in logistics in Vietnamese textile industry

Implementing RFID technology in textile warehouse management is a recent development that boosts productivity and gives Vietnamese textile companies a competitive advantage. Previously, to manage product codes and product quantities, most Vietnamese textile enterprises used barcodes combined with management software. However, during the application process, this method increasingly reveals many disadvantages: for example, the risk of barcodes being easily torn or blurring information, making it difficult to search if a product is lying around the correct location in the warehouse, slow time to receive information from products, etc. (Khanh, P., 2015). Currently, in Vietnam, RFID technology has been applied in various stages during logistics activities.

4.2.1. Application of RFID warehouse and inventory management in Vietnamese textile industry

RFID technology is being utilized for inventory management and production control in the textile industry. With complex and diverse product lines, accurate inventory tracking can be difficult. RFID tags attached to fabrics, garments, and cartons enable real-time visibility, reducing stockouts and optimizing warehouse space. Previously, each time a physical inspection of inventory was performed, it took a lot of time, sometimes it took many hours, even days, and there was a risk of producing inaccurate results. Now, with RFID technology, with just one handheld RFID reader, this step has been thoroughly optimized for labor costs, improved inventory accuracy, thereby helping to improve the efficiency of logistics activities and related costs. RFID technology has also been applied to the operation of the INA Smart Conveying System to help improve product quality control, product control throughout the process of warehousing, exporting and searching for inventory and products' locations (VITAS, 2020).

4.2.2. Application of RFID in transportation in Vietnamese textile industry

Regarding freight transportation, RFID has been used by Vietnamese textile enterprises for real-time tracking and traceability throughout the transportation journey, from factory gate to store shelf by attaching RFID tags to shipping containers and pallets. Data-driven insights support the optimization of truck and container usage, leading to reduced empty space and helping the textile industry's logistics costs. This technology is also used for automatically recording and updating information about the location, schedule quantity and status of raw materials, semi finished goods and finished goods in real-time during transportation to help

reduce the risk of loss and discrepancy and improve delivery accuracy and ensure that the enterprises can have an overview of the entire logistics process and enhance the ability to offer reasonable transportation routes and smart delivery methods. In addition, Vietnamese textile enterprises also apply RFID technology in combination with other technologies in their logistics activities, especially IoT. For example, they combine RFID and IoT sensors such as temperature and humidity sensors, businesses can track and monitor the environmental conditions of textile products during transportation and storage to help ensure product quality and early detection of problems that may affect quality.

4.3. Evaluation of RFID applications in logistics of Vietnamese textile industry

4.3.1. Successes in applying RFID to the logistics of Vietnamese textile industry

Realizing the potential of RFID technology in the logistics of the textile industry, Vietnam has promoted the application of this technology, replacing the initial use of barcodes and management software, taking advantage of many benefits. First and foremost, RFID technology provides the capacity to revolutionize the management and tracking of textile products throughout the supply chain, leading to improved efficiency, visibility, and cost-effectiveness. One of the significant benefits of RFID application in Vietnam's textile logistics is enhanced inventory management. RFID tags enable real-time tracking of textile products, providing accurate and up-to-date inventory information. This allows companies to optimize inventory levels, reduce inventory holdings, and improve order fulfillment. Another advantage of RFID technology in textile logistics is streamlined warehousing operations. RFID facilitates automatic identification and classification of textile items, reducing manual labor and increasing operational efficiency. With RFID-enabled processes,Vietnamese textile companies can easily locate, track and manage textile products in their warehouses (VITAS, 2020). This enables faster and more accurate picking, packing and shipping processes, improving productivity and reducing errors. RFID also contributes to improving the visibility of logistics activities in the textile industry. Through RFID-enabled tracking, Vietnamese textile companies can gain end-to-end visibility into textile products, from production to distribution. This visibility helps identify bottlenecks, optimize transportation routes, and improve overall supply chain performance. With real-time data on product movement and location, companies can proactively address issues such as delays, inefficiencies and disruptions, leading to flexible logistics management and facilitating prompt responsiveness. Additionally, RFID technology can assist in preventing counterfeiting in the textile industry. By using RFID tags embedded with unique identification codes, Vietnamese textile companies can authenticate their products and ensure their legitimacy. This helps protect brand reputation, maintain customer trust and reduce the prevalence of counterfeit textile products on the market.

4.3.2. Limitations and in applying RFID to the logistics of Vietnamese textile industry

However, currently, the application of this technology is not extensively implemented in the Vietnamese textile industry due to several factors that limit its effectiveness. Firstly, although RFID has great potential for application in the textile industry, this technology has the disadvantage of being relatively higher in cost compared to conventional Barcode technology: in addition to the initial costs (tagging, readers, and infrastructure), there are costs

associated with employee training, maintenance costs, etc. (Ohkubo, M. et al., 2005). Additionally, RFID requires RFID readers and antennas to be installed at appropriate locations within the factory or warehouse and RFID needs to be integrated with a business's existing IT system, which means investment in new infrastructure may therefore be required in a complicated and time-consuming process. Another factor contributing to the limited application of RFID technology in the textile industry in Vietnam is the lack of trained and skilled personnel. The successful implementation of RFID requires individuals who are knowledgeable about the technology and possess the necessary skills to handle and manage RFID systems effectively. However, in Vietnam, the training and development of such skilled human resources specific to RFID technology in the logistics in textile industry are still in the early stages (Tien, N. H. and Dana, L. P., 2020). This causes a huge obstacle in popularizing the application of RFID in logistics of the Vietnamese textile industry. In addition, Vietnamese textile and garment enterprises also encounter a technical challenge in the process of implementing this technology of integrating systems, switching from an existing enterprise resource planning (ERP) system to an RFID-based system. Besides, card durability is also a challenge that businesses need to address. During the process, there may generate strong mechanical stress and increased temperature, especially during the processing stage, RFID tags applied to textile products may experience damage. Given the aforementioned challenges and limitations, Vietnamese textile enterprises have been hesitant to extensively adopt RFID technology in their logistics operations. However, despite the challenges faced, the adoption of RFID technology in textile logistics offers significant benefits that cannot be overlooked. Consequently, the Vietnamese textile industry must devise strategies to surmount these obstacles in order to effectively implement RFID technology in their logistics operations to enhance their competitiveness and establish sustainable advantages in today's market.

5. Recommendations for Vietnamese enterprises in applying RFID in logistics of textile industry

5.1. Recommendations in reducing costs when applying RFID in Vietnamese textile companies

The foremost challenge encountered by Vietnamese enterprises in the integration of RFID technology is the considerable associated costs. Consequently, it is imperative for Vietnamese businesses to conduct a comprehensive analysis of anticipated profits and expenditures before embarking on the implementation of this technology. To manage the financial risk, businesses are advised to introduce RFID in a specific operational segment, whether it be a particular product line or warehouse, before contemplating a full-scale deployment. This phased strategy enables a thorough evaluation of the merits and challenges, allowing for informed decision-making prior to committing to a more extensive and substantial investment. Next, optimizing the use of RFID devices and maximizing their reuse can help reduce costs. This includes identifying and reusing RFID tags when they are no longer needed or when products are returned. Additionally, leveraging existing systems and infrastructure can also help reduce costs. Instead of investing in new infrastructure, businesses can take advantage of existing systems and equipment to integrate with RFID technology. This means that businesses can use

existing systems and simply change some software or equipment to be compatible with RFID if they are suitable.

5.2. Recommendations for training employees in the utilization of RFID

Besides, the limited understanding of RFID among personnel in the Vietnamese textile industry poses a noteworthy challenge for businesses. To alleviate resistance from employees, it is crucial to incorporate them into the project from its early stages. This proactive involvement ensures that employees acquire a thorough comprehension of the project, subsequently mitigating apprehensions about potential shifts in the business model. Moreover, training employees on using RFID technology and adapting to new processes is crucial. Therefore, Vietnamese textile enterprises need to establish a variety of comprehensive training programs to educate employees about the benefits and functions of RFID technology, while also addressing any concerns and problems related to the application of technology to logistics activities.

5.3. Recommendations for addressing the technical and mechanical issues when converting into RFID-based system

Additionally, a challenge encountered during the implementation processes was the integration of systems, transitioning from the existing enterprise resource planning (ERP) system to the RFID-based system. Several technical issues were identified, including the management of a substantial volume of real-time log files, ensuring the reliability of tag performance, and the extended search duration for RFID readers in the operational environment. To address these technical challenges, it was essential to establish a close collaboration with a software contractor. Maintaining a strong rapport with the contractor facilitated precise problem identification and effective solution finding. Furthermore, the material composition of products linked with RFID tags and their orientation were deemed crucial factors in enhancing the accuracy of readability.

Concerning the resistance of tags, challenges arise from intense mechanical stress and elevated temperatures, particularly during the processing phase, causing damage to RFID tags applied to textile products. Typically, these constraints are not attributed to RFID chips but rather to antennas and the welding connection between the antenna and the chip. To address this issue, passive tags are advised to be utilized because they are capable of withstanding high temperatures, even up to 250°C, and enduring low mechanical stress, allowing them to withstand processes such as painting and dyeing.

6. Conclusion

The textile industry, one of the oldest industries involved in the creation, production, and distribution of clothing, accessories, and related products, is renowned as a global giant recognized for its dynamic trends and intricate supply chains. However, it is currently facing increased pressure to streamline its logistics operations. Technology known as Radio Frequency Identification, or RFID, appears to be a viable remedy for this sector.

Our findings have revealed that RFID offers numerous benefits for the textile industry, not only in transportation and within warehouses but also in tracking the movement of products throughout the supply chain. In the context of Vietnam, RFID technology offers the country's textile industry a revolutionary chance to overcome its present logistical obstacles and get a competitive advantage in the global market. By optimizing inventory management, improving warehouse operations, and increasing supply chain visibility, RFID has the potential to revolutionize the way textile products are tracked and moved throughout the logistics chain.

Although its potential is undeniable, there are a number of obstacles standing in the way of the broad use of RFID in Vietnam's textile industry. These include the necessity to handle integration issues, the comparatively high initial costs, and the shortage of competent workers. It is suggested that Vietnamese businesses take a systematic strategy to get around these restrictions. This might entail working with software contractors to provide technical assistance, engaging staff, using existing infrastructure, reusing or employing passive tags, performing cost-benefit evaluations, and implementing RFID in phases.

Vietnamese textile firms may greatly increase the efficiency of their logistics, improve product traceability, and ultimately build a more sustainable and competitive industry by tackling these issues and utilizing RFID technology. The future of Vietnam's textile industry will surely lie in the adoption of cutting-edge technologies such as RFID and the proactive management of challenges by enterprises to unlock its significant advantages.

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