THE IMPORTANCE OF RFID TECHNOLOGY IN LOGISTICS 4.0 IN THE AUTOMOTIVE COMPANY

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Abstract: The article provides the reader with information on the role of automatic radio frequency identification technology – RFID in improving work in an automotive company's warehouse. The evolution of the RFID method is described and the system construction is characterized. Moreover, the areas in which RFID is applied are expounded upon. The benefits of the RFID technology in the automotive company's warehouse are also pointed out. as well as its importance for improvement of warehouse operations.

Keywords: RFID Technology, Logistics 4.0, Automotive Industry.

1. Introduction

The complexity of the tasks facing modern logistics resulting from the growing competition on the market and the constantly expanding customer requirements, as well as the internationalization of business are just some of the challenges that almost all enterprises face today. However, no company can stay in business if it does not overcome potential and actual logistics problems.

The condition for success in modern logistics is the implementation of modern technologies. There is, therefore, a need to advance the introduction of comprehensive and innovative solutions ahead of time, not as a remedial action. Sometimes such changes are revolutionary and not evolutionary. One of such solutions is applying the technology of automatic radio identification – RFID. The implementation of RFID in the automotive industry has brought a number of benefits and greatly facilitated warehouse work through the speed of reading data, thereby saving time and eliminating human error.

The aim of the article is inform the reader of the characteristics and background of RFID technology.

2. The evolution of RFID system

The idea of automatic identification of goods was brought to life in the 1930s, but it was necessary to wait around 40 years for its dissemination, when the growing need for improving trade have accelerated standardization work. Indeed, the first goods marked with an individual code appeared in American supermarkets in 1974.

Although the history of RFID began in 1948 with the development of the concept of passive RFID systems, in the 1980s, the technology developed to the point of being extensively used in the areas of personal access, animal identification, regulation of tolls and identification of luggage at airports. The 90s of the twentieth century was the period in which RFID became part of everyday life and a business commonality. Standardization activities, ensuring wider use of RFID, were, however, taken only in 2000. Well-known global companies that now implement RFID technology for electronic product labeling include: Wal-Mart, Target, Albertsons, Metro, Tesco, Max & Spencer, Procter & Gamble and Gilette (Niemojewski, 2007). Currently, RFID finds wider and wider applications in logistics, public transport and security systems, as well as in the electronic payments market. RFID technology will replace in the near future the bar code system for marking goods, which will increase the efficiency of transport, storage and the process of selling goods. The huge potential that this technique can give is quickly noticed.

Modern radio frequency identification (*Radio Frequency IDentification*) technology is used to automate numerous processes in various areas of the economy – in public administration, in industry, commerce, science and medicine, for example (Gotfryd, Jankowski-Mihułowicz, Kalita, 2011). Accordingly, this technology will redefine the entire existing supply chain by including 'intelligence'. If products are equipped with RFID tags and there are readers at every stage of the supply chain, the paths of these products through this can be mapped out and bottlenecks removed.

Radio frequency identification technology is a cross-cutting technology that is considered the next wave of IT revolution. RFID supports innovation, economic growth and global trade in the same way as IT. However, RFID technology is still in the initial implementation phase. Researchers agree that the adoption and dissemination of RFID is not yet fully understood and understood.

3. RFID construction

The central element in RFID technology that accelerates its further rapid development and use is the electronic product code EPC (Electronic Product Code). The Electronic Product Code is a kind of serial number, unique on a global scale, which can be described as the successor of

the standard bar code. It is used in conjunction with an RFID system and it is a coding scheme that allows unique identification of individual objects, such as individual goods, pallets, packages and boxes. By marking the product with a number (which usually takes place in the form of a sticky label, the so-called 'tag'), it is possible to identify the location of each product within the supply chain. RFID tags are microchips that store and send data. Such a tag consists of three parts: a chip, an antenna and a packaging (a paper label, a glass capsule or a piece of plastic) that connects the other elements. The information is read in a wireless way, at a distance of several centimeters, to even meters from the reader (Bucharski, 2005).

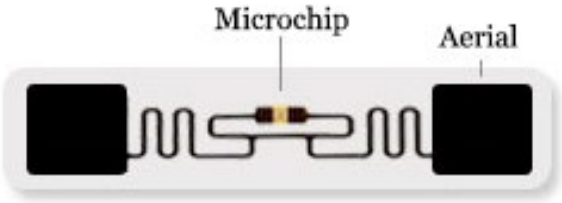

Figure 1. Construction of RFID chip. Adapted from: http://rfid.zone/.

The microchip is equipped with several hundred bits of memory potential and the data saved, includes above all, a unique number that refers to a specific user's database. To read this data from the RFID tag, an RFID reader is needed. When the antenna receives the signal (electromagnetic energy) from the reader's antenna, it sends a feedback signal in the form of radio waves containing information on the content of the microchip memory. The electronic reading and writing of data using radio technology is carried out by means of data exchange between the label and the tag (otherwise known as a 'transponder'). The reader then transfers the data obtained in this way to the device in which they will be stored. This device can be, for example, a system computer (Palonka, 2007). The structure of the RFID system consists of several basic elements. They are presented in the figure below.

Figure 2. Elements of RFID system. Adapted from: Milanowicz, 2012.

The crucial element of RFID is the tag, i.e. the transponder. It has a miniature form and is placed on individual products or packaging. The tag contains a reference to the manufacturer's database or the distributor of a specific product. The information about the product and its

routing can be supplement and edited. The transponder can transmit this information on coded demand. Each tag is built from memory (so-called memory tags) or from memory and processor (tag tags), and includes an antenna that allows data transmission and which is usually placed on the tag isolator layer (Juszka, Janosz, Tomasik, Lis, 2013).

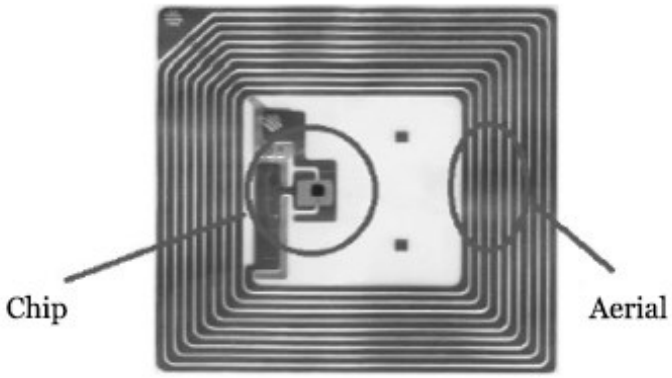

Figure 3. Construction of the tag identifier in the RFID system. Adapted from: Juszka, Janosz, Tomasik, Lis, 2013.

The data acquired through the transponder is transferred to the reader. In turn, the reader also performs a number of tasks, which include, first of all, issuing various commands related to the collection and storage of data to transponders. The principle of operation of the reader is that it receives data sent by the transponder, and then decodes it and transmits it to the system computer. It should be added that there are both fixed readers, for example, placed in the warehouse gate, mobile readers on forklifts, as well as those held by employees (Kanicki, 2012). The last element of the RFID system is a computer with software that contains the operating system necessary to run an application related to the functioning of the RFID system and the reception of data transferred by the tag via the reader. Such communication between individual RFID elements and the computer is possible thanks to special controllers.

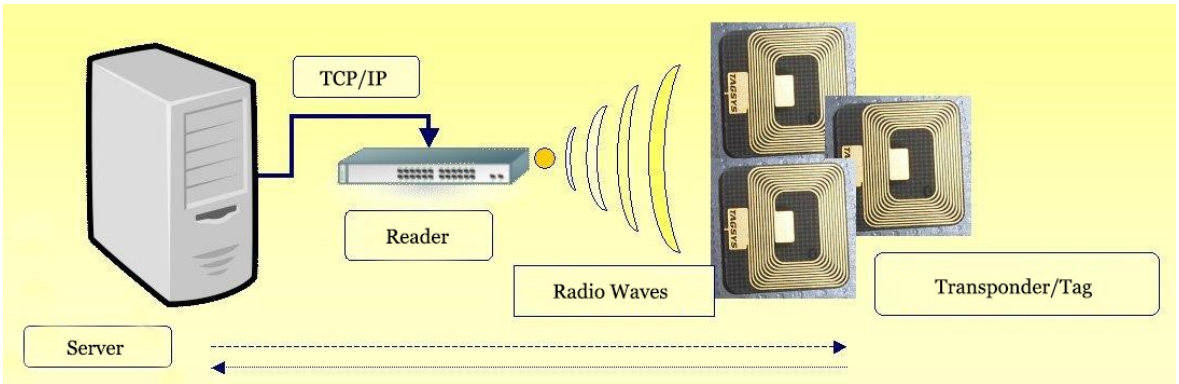

Figure 4. The method of data transfer in RFID technology. Adapted from: https://www.bankier.pl/wiadomosc/Historia-i-dzialanie-technologii-RFID-1985822.html.

4. Areas of RFID Applications

RFID technology can be used to identify and to track movements, as well as to enable detection and the counting and sorting of various products and objects. RFID tags are placed in contactless entry cards, e.g. to the premises of some company, in all kinds of access cards to specific rooms, e.g. in hospitals or in systems recording work time. In many hypermarkets (e.g. Empik), very small RFID tags are hidden in products so that when the product is illegally removed, hence, bypassing the cash register, they inform the control gate, and as a result act as security against theft.

Logistics is one of the most important applications of RFID technology. This results from many premises, which include, above all, the ever-growing information needs of logistics supply chains. This information is one of the most important elements of managing individual operations and logistics processes, because efficient flows of this information enable establishing connections between the company and suppliers, as well as integrating activities undertaken by the sphere of supply, production and distribution.

RFID systems are already widely used in security and access control in industrial logistics, in the identification of measuring samples or materials in research processes. Due to the multiplicity, diversity and complexity of factors affecting the operation of the RFID system, "the area of correctness of routing and activity are the most useful parameters that determines the possibility of widespread use of radio identification of objects in automated processes" (Gotfryd, Jankowski-Mihułowicz, Kalita, 2013).

The new technology also arouses great interest in trade. Indeed, retail chains use the technology on a large scale and are the main driver of its development. For example, one of the biggest American retail chains, Wal-Mart, has committed its suppliers to implement RFID codes in items supplied. For a company whose employees read codes per annum from over 5 billion packages, even the minimum reduction of time required for this operation means millions of dollars saved for the company (Ochab, 2004). This technology is also used to improve the flow of traffic. For example, in New York, there is an RFID based system that transmits data on vehicle speed to the Traffic Management Center and when it is too low, traffic lights are adjusted to eliminate congestion (Jakubski, Życiak, 2009).

The largest global carriers and logistic companies have also been working on projects using the discussed system. Delta Airlines has become interested in it, and in the Delta Airline system, travel luggage is marked and routed by electronic tags in order to completely eliminate the risk of loss or misplacement.

RFID is also recently been implemented in the aviation manufacturing industry. One aircraft manufacturer is working on an RFID system to identify components. These may include information on when and why it was repaired and how long it has been used. During routine reviews, these data will be read and updated by ground staff. This will improve the maintenance

process of components and reduce errors that occur when analogous information is registered manually.

While RFID technology has been known for several decades, its use on a larger scale began only when electronics were developed to the point of sufficient miniaturization and affordable cost (to the point of throw-away cheapness). Currently, RFID is the fastest growing technique in automatic identification. In addition, its wide application in everyday life makes it one of the most important trends in global IT (Bucharski, 2005).

Using it logistically primarily leads to improved deliveries. This is due to the fact that the automation of the process of obtaining data on products located in warehouses or on store shelves allows to eliminate any discrepancies in deliveries. In addition, it positively affects the reduction of mistakes when planning these deliveries, which in turn significantly translates into a reduction in financial losses, as well as the time needed to implement them. In the planning process, RFID contributes to ensuring the continuous availability of the assortment, which is achieved due to the constant control of the level of inventory in warehouses. As a result, it is much easier to find out which products are running out, and, therefore, which should be ordered, and which are in sufficient quantity to meet customer demand (Orłowski, Kaczan, Staszak, Tomaszuk, 2008).

5. Implementation of RFID technology in the motorization company

The company under study is a production company in the automotive industry. TI Poland is part of the TI Automotive group and specializes in the production of brake and fuel metal tubing, pumps and fuel pump modules and the assembly of plastic fuel tanks.

Due to the specifics of the performed activity, storage-type warehouses have become an indispensable part of the production system. The warehouse space of TI Poland amounts to a total of 10,300 sq m. It consists of two external warehouses with an area of 3,200 sq m, where molds for the production of tubing and castings, as well as parts needed for machine maintenance are held. Three internal warehouses hold component and raw materials, and finished assemblies. The warehouse structure is as follows: pipe warehouse, packaging warehouse, mold and parts warehouse, component warehouse, finished goods warehouse.

From the start materials warehouse, packaging and forms, as well as from the technical warehouse, materials are transferred for further production. The finished product warehouse fulfills the function of accepting, storing and dispatching final products to potential recipients. The logistics department oversees both warehouses. The staff consists of fifteen people involved in picking, unloading and loading pallets, securing products ready for shipment and moving packages. The warehouse manager is the direct warehouse management body.

The positive influence of RFID on the storage process is visible primarily in the way of loading and transporting containers and palleted goods to and from the warehouses, which are done through RFID gateways. Thanks to these gates, all tags that are on individual packages are read, which significantly shortens the time of the storage operations. Previously, it was necessary to introduce each item separately into the system. Interestingly, in the most advanced RFID technologies, it is possible to scan up to 400 transponders simultaneously, which can undoubtedly improve the work of the warehouse, because a few seconds are saved on scanning each pallet. It follows that RFID impact on a large scale of activity can reclaim up to several days within a year.

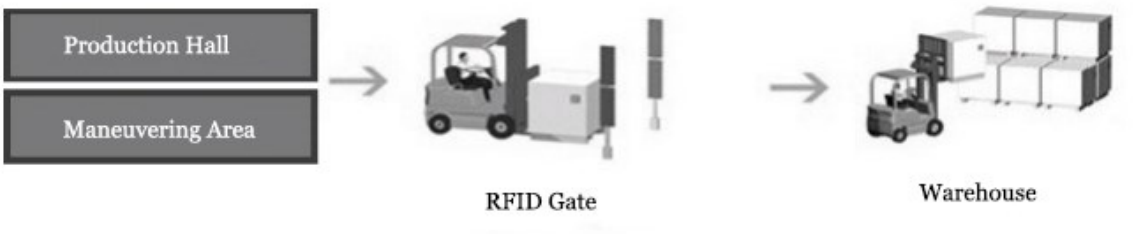

Figure 5. Application of RFID in the storage process. Adapted from: Milanowicz, 2012.

Companies commonly use a defective control system, or do not have it at all. What system is used is most often based on manual counting of all elements, using paper forms or Excel, input being manual, and date gained by scanning barcodes with a mobile reader (at best). The lack of automation of these processes leads to poor record-keeping and, as a consequence, to losses. This situation also took place in the discussed company (TI Poland). Before the implementation of the current technology, items were bar-coded and manually scanned. Often, discrepancies occurred, notably in the transfer of raw material - especially in that information was manually loaded into the computer. This also wasted time, and it is known that in order for the warehouse to work well, all documentation must be dealt with efficiently. The situation was similar when taking delivering of raw material. During unloading, the warehouseman was tasked with accurately counting containers, covers, pallets and palleted goods, filling-out shipping forms when doing so. The data was then cross-referenced with the shipper and the delivery documentation. Unfortunately, there were lots of discrepancies and delays in this area. It turned out that, to counter delay, with large deliveries, warehouse workers did not always count all packages or approximated. Containers were often returned not fully unloaded, and palleted boxed materials were unpacked and repacked. A frequent problem was delays on the warehouse dock, delays in the forwarding of items, and delays in return of pallets and shipping containers. This loss of control generated more and more costs for the company, hence the problem was researched and RFID technology implemented – firstly as a trial. Herein, only goods to be shipped to three selected customers were tagged, those with whom there was always the biggest problem when it comes to returning pallets and containers. In comparison with the process used with other clients and with previous activity, the trial proved successful.

The process is as follows. The tag (chip) mounted on a given item, in this case on the returnable packaging, is picked up by a reader located in the data collector or in the RFID gateway, and stored in the system. This process takes place remotely. There is no need to scan or manually input data. The readers can detect up to several hundred objects in their environment and immediately transfer data to a computer via Wi-Fi or LAN, hence palleted goods need not be broken open. A well-constructed database of a warehouse program and an RFID system coupled with it will indicate if there is anything missing or even the ownership of pallets or containers. By way of RFID systems, it is possible to control not only the inventory, but also the location and return dates of borrowed/returned returnable packaging. In the case of non-compliance with contracts, it is exactly known which of the contractors is responsible for losses. Thanks to such a solution in the system, it is clearly evident of what products are at which stage of transport, while admission and issue processes are accelerated, labor consumption is minimized, the number of mistakes is limited and data is verified at the initial stage of the supply chain. The identification process is therefore instant, which greatly affects the warehouse, as it speeds up its efficiency.

The replaced process did not perform well due to lack of detailed identification of entries and exits. The discussed program combined with the RFID system introduces to the company orderly transaction and a clear and detailed database of all material and container movements taking place in the company. Hence, bottlenecks or breakdowns can be quickly identified and remediated. Although the exact effects of full implementation of the new system in the organization will have to wait a bit longer due to the fact that the project is still in the experimental stage, great benefits are already noticeable.

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