RFID AND INFORMATION SYSTEMS IN COMMERCE

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Abstract: The paper analysis the possibilities of using, a relative new technology, RFID, in commerce. The main features of this technology, the components of the system, the way the system functions and the stages of the implementing process are also presented. Another part of the paper is devoted to the identification of the advantages of RFID technology and of the hurdels faced by companies in adopting it. The interest for this technology, used as solution for the management of information systems, is in a continuous increase, despite all the problems related to the high cost of the implementation and the wrong legislation, which stops the spread of this technology on a larger scale. The technology is now presented in a relatively small number of companies, but, certainly, it will be adopted, by more and more information systems in the future and it will extend in other activities too.

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1. INTRODUCTION

As the competition level in commerce raises, many players on the market try to find new methods, in the technological field but also in the processes they undertake to obtain a competitive advantage. No matter the perspective offered by the sales department, by the supply, by the finances or by the information technology, the accent in this activity is set on an improvement of the performances and on achieving profit.

Today, considering the competition on the market, even the most performant companies must improve their strategy. The managers in commerce must always find new methods and approaches to lead their businesses more easily, in a more intelligent manner and with lower costs, and all these under the conditions of an increased satisfaction of the consumer.

The Radio Frequency Identification RFID is a last generation technology which can contribute to achieving these goals. But without a uniform infrastructure, which

helps the development of intelligent solutions for businesses, achieving considerable profits by using this technology is impossible.

To protect the initial investment and to accomplish maximal profits on long term, the commerce companies must design the strategy to implement RFID, which must have as a basis a last generation informatics architecture, an architecture flexible to the technology, standards and legislation changes.

2. RFID – GENERAL PRESENTATION

RFID is a method to identify individually the objects helped by the radio waves. The primary RFID systems are made of two large parts: readers and labels. The reader sends and receives the radio signals that contain data to and from the label with the help of some antennas. A reader can have more antennas which attends the sending and the receiving of the radio waves. The label is made of a microchip which gathers information, an antenna and a host object on which the chip and the antenna are assembled.

RFID is a technology used in many fields, from commerce to transport, from security to aeronautical industry. It is a technology that suits to the business environment to collecting data about the objects (products, materials, merchandise, etc.) in order to identify and underline them online.

This technology is a flexible one, easy to use, and useful fro the commerce operations because it brings advantages that don't exist in other technologies, such as the bar codes. The RFID chips can be conceived to be read and written or only read, they don't need contact with the scanner line, and they can work in a variety of conditions. Additionally, because this technology is hard to falsify, it offers an increased security of the data.

RFID is a concept similar to the bar codes. The bar code system uses a reader and coded labels which are attached on different objects, while the RFID uses a reader and special devices which are attached to the object. The bar code uses optical signals to transfer information from the label to the reader, and the RFID uses the radio waves to transfer the information from the RFID device to the reader.

The RFID labels can be attached on almost anything – from vehicles to pallets in warehouses and they can contain different data referring to an object, such as the nature of the object, what time the object passed through a certain area, the place's temperature, etc..

3. COMPONENTS OF THE RFID SYSTEM

The main component elements of the RFID system are:

- labels,
- reader
- RFID label printers ,
- antenna.

Label. To use the RFID system, the objects must have labels attached. They are made in a variety of formats used at different applications. The assembly process of the labels begins with the accomplishment of the PVC, pet or paper layer, on which an antenna is attached, antenna made from more types of material: aluminum, cupper or silver ink. The next step is the attachment of the chip on the antenna. Finally, a protective layer is applied on the label, protective layer made from laminated PVC or stickers, to protect the chip from abrasions, impact or corrosion.

These labels are presented in a variety of formats:

- adhesive bands applied on a card
- labels of large sizes used to number the pallets in a warehouse,
- paper labels,
- labels in a bracelet's form.

The type of material used and the way to assemble the labels have a direct impact on the final costs, in certain limits, on the communication performances. One of the biggest challenges of introducing the RFID system in mass is represented by the label cost, with a much discussed target of 5 cents per label. But the way this objective can be achieved represents one of the biggest challenges of this moment.

Traditionally, the main concern of the researchers was the size of the chip, and the producing companies obtained a 0.3 mm for the high frequency labels, with a cost of one – two cents per chip (according to the process used). This means that for the rest of the label a three cents cost is wanted. This seems to be the main challenge. There are also solutions suggested by the companies, such as Alien Technology and Philips Conductors, in which, at a volume of billions of labels, the cost can be reduced to a value of five cents per label.

Concerning the power to calculate, the RFID labels contain only primary mechanisms, which are capable to decode only basis instructions. But this doesn't mean that they are easy to manufacture, existing numerous challenges related to a low consumption accomplishment, reducing the noise produced by the radio waves and keeping it in the limit of the legal regulations.

The information quantity retained by the chip depends on its characteristics, and can vary from the simple identification of some numbers inscriptions on 96 bits to the gathering of some information on the product on 36 Kb. Nevertheless, a larger quantity of information leads to the accomplishment of large sizes chips and this way to high costs. In 1999 the AUTO-ID centre with the head office at Massachusetts Institute of Technology, USA, along with some very famous companies (Gillette; Proctel&Gamble etc.) set the basis of a project that had as main goal the development of RFID applications. They suggested the introduction of an electronic code of the EPC (Electronic Product Code). It has only 256 bits, which leads to the accomplishment of small sizes chips with low costs, which solves the main challenge of the RFID system adoption in the supply system. The labels contain only these numbers which are often named registration labels.

In a usual system, the labels are attached to some objects. Each label has a certain memory, in which information about the product is retained, such as the unique identification code, or, in some cases, the manufacturing data and the product's composition. When these labels go through a field generated by a reader, they transmit information back to it, this way identifying the object. Until recently in the centre of the RFID technology there were the labels and the readers used in systems with a relatively reduced quantity of information. This suffers modification because it is expected that the RFID, in the supply chain, provides a high volume of data, which will have to be sent to the end of the chain and namely to the IT department which maintains the informatics system integrated in the company. To solve this problem, the companies have developed packages of data called scientists, which act as a buffer between the RFID system's beginning (products, pallets, etc) and its ending, the informatical applications used in the company.

The communication process between the reader and the label is controlled by more protocols, such as ISO 15693 and ISO 18000-3 for high frequency or ISO 18000-6 for very high frequency. When it is started, the reader starts to emit signals on the established frequency. Any label in the vicinity will detect the signal and it will use the energy from the reader to open and supply the own circuits. Once the label recognized the signal as valid, the reader answers, and indicates the presence through its affiliation to the reader's field.

If more labels are presented, then they will respond at the same time, this being perceived by the reader as a collision sign. The reader solves this problem by using an anti-collision system which allows the individual filtration and selection of the labels. The number of labels which can be detected depend on the frequency and the protocol used.

Immediately after the label was selected the reader can accomplish a series of operations such as reading the identification number on the label, or in case of the reading / writing ones, the information writing.

One of the labels' classification methods is according to their capacity to read and to write information. This criteria leads to the following classes:

- *Class 0* is the simplest type of label, in which the information, usually represented by the identification number, is written one time in the production process. This class of labels is used to define the category named EAS (Electronically supervision of the products) or for anti-theft mechanisms, which don't use an identification number, their only goal being to announce the presence of the article when it goes through a certain field.
- *Class 1* is defined by the labels on which, during the manufacturing, nothing is written, and the information can be written later, by the label manufacturer or by the beneficiary, only one time. The labels of this type usually act as simple identification codes.
- *Class 2* represents the most flexible labels, which allow the writing and the reading of the data on the label by the users. They are usually used to gather and transmit information about the product and contain more memory than that necessary for a simple identification code.
- *Class 3* allows the writing and the reading of the information and it has one sensor board which helps the registration of the parameters such as temperature, pressure and movement, which can be registered by means of label memory. These labels can be semi-passive or active.
- *Class 4* contains labels that can be used for writing as well as for reading with an integrated transmitter. They can appear under the form of mini-radios that can communicate with other labels and devices, without the need of a reader. The labels from this class are independent having their own batteries, meaning that they are completely active.

In choosing a type of label, the first thing is selecting between a passive, semi-passive and active labels. The passive labels can be read from a distance of four to five meters when the high frequency waves are used, while other types of labels (semi-passive and active) can be read from larger distances: up to 100 meters for the semi-passive ones and a few kilometers for the active ones.

The reader or the interrogator is a key element of the RFID technology. Until recently, the RFID readers were used for RFID applications with a reduced

volume of data, which means that the problem of processing a large number of labels and with a large volume of data was not that serous. Now, everything has changed and many reader manufacturers try to create products that can solve the specific problems of the supply chain.

There are a series of criteria that are taken into consideration when acquiring such a reader:

- The frequency on which the operation is made (high or low),
- The regional regulations,
- The network that supports the reader (Wireless LAN, Ethernet LAN, TCP/IP),
- Ability to connect more readers together,
- Controlling more antennas (usually four antennas to one reader),
- Adapting to the antenna's conditions.

The readers can also be portable. This type of reader can be used in cases in which a label must be verified, updated or even thrown away.

Printers compatible to the RFID technology allow the printing of the labels. The printer has a high frequency radio waves reader and a very high frequency radio waves reader, able to accomplish a preliminary pre-testing of the labels, and, if this test is not passed, the writing of the labels is made with the sign REJECTED. The paper must have a certain texture to fit the RFID technology.

Antenna. In a RFID system the antenna are most of the times deceiving parts of the design. For the high frequency radio waves, the antenna is usually integrated in the reader. For a larger reading distance, the antennas are almost all the time external and connected to the reader helped by a cable.

The antenna's design greatly depends of the performances wanted. They can be bought under the form of finished products and they can be built according to the necessities of one application.

The antennas can be of more types: linear polarized, omni-directional, circular polarized, etc

4. IMPLEMENTATION OF THE RFID TECHNOLOGY

The implementation of a RFID system is not a very easy problem. Many organizations that tried and didn't succeed to implement this technology, suffered many image losses, and the subsequent analysis underlined the evidence of lack of necessary technology, budget constraints, unqualified partners and misunderstanding or not understanding at all the mechanisms of this technology and of the way it can integrate in their business.

The accomplishment of a new system, which needs the dedicated equipments and programs, as well as a specified infrastructure, represents a difficult mission. The experiences that were a success, the interviews with the clients and the case studies framed the efficient implementation methods of this five steps system. To understand the RFID technology, the organizations must first perceive the concepts and the components of the entire system. The implementation of the RFID needs a strong planning and execution.

The first phase marks the start of the activities to implement the system. Because they are complex, the organizations might need business partners. So, the first step in this stage is to choose the partners. They represent a good way to fill the technological wholes which the organization might have. Also, the company must

create an organizational frame that can accomplish all the future requirements and that can adapt easily to the changes. The last part of the first phase is the placing and the testing of the label. The place the label is set, the understanding of the material the product is made and the factors of jamming are critical points to implement a successful RFID system.

The next phase is the testing and the validation. The first step is the integration of the new system in the ERP system of the company (Enterprise Resource Planning: the informatical system which facilitates the integration of all the information of an organization in a unique platform). The reception of the new information, the way they were interpreted, the informational- decisional impact and the financial impact are very important factors that must be taken into consideration. Another step is the accomplishment of a map with the operation flux which takes place at the company's level

The third phase is the pilot implementation. From the past experiences we can say that the objective of this phase is to solve as many types of scenery as possible for the daily actions of the company. For this phase the production, the placement and the performance will have to be registered

The last phase is the implementation itself, in which the validation of the system is assured with real data, the network management is made and the old system is replaced with the new one of RFID type. Helped by the labels validation from the conceiving phase the increased efficiency will be assured, the system is now capable to verify if the data correspond to the one in the data base, without a manual intervention in the system being necessary. The ability to pursue the ordered products, the transit or stock one are very valuable, rendering a version of precise financial information, an educated request and offer and an efficient planning which leads to a performing strategy. Also, it is essential that the passing from the old system (with bar codes) to the new (RFID) is made as slowly as possible. One of the frequently met practices is the one to use both systems at the same time for a certain period. This way the testing can be made more easily for the new system and the problems can be eliminated, without producing any damage to the company.

These phases represent the basis of the new work method. After finalizing the first step, the new system can be exploited.

5. ADVANTAGES OF THE RFID TECHNOLOGY

The RFID technology promises, for the commerce activity, a series of tangible advantages:

- Reducing the stocks and a better management of the shelves. One of the main advantages of this technology is that it can collect in real time, the information concerning the mo0vement of the products. With the RFID help, the supply of the shelves is made much more efficiently, the placement errors on the shelves are much more easily detected, and the suppliers are informed faster about the situations of their products on the shelves of the stores, facilitating a re-provision with those respective products.
- Reducing fraud. Due to the pursue quality of the RFID, fraud (at the warehouse level as well as at the store level) is reduced very much. The scanners pursue from a certain distance the products in the warehouse and in the store, but also at their exit from the store

- Increasing productivity and development of operations in a faster way. Considering the ability of the RFID technology to scan entire batches of merchandise, full hand-carts at the exit and complete delivery at the receiving docks, there is huge opportunity to reduce the cost of the work factor. RFID also reduces the time and the resources necessary to accomplish cyclical inventories. The exact inventories can be made more frequently, with fewer resources and in a shorter time. All these economies at the personnel level, allow the employees from the store to focus on what really matters: increasing the sales.
- The intensification of the efficiency at the checkout *point*. With the ability to scan entire quantities of merchandise once the scanner passes, the time of verification at the exit of the unit is reduced a lot, and the levels of human errors is minimized. Also the RFID supplies exact information about the price and the product, eliminating the errors due to the improper labeling of the products.

6. DISADVANTAGES OF THE RFID TECHNOLOGY

While the benefits of the RFID technology are considerable, there are a series of difficulties which must need exceeded in order to obtain success, and this must be made in the shortest time possible, so that not to allow other technologies to fight the market.

The interesting fact is that more technologies promised similar benefits in the last years, but, due to the obstacle growth and the time necessary to overcome them, they resulted in failures in the end.

For the RFID technology, the obstacles are framed in one of the following categories:

- Technological obstacles
- Obstacles concerning the cost
- Obstacles of standardization nature
- Obstacles concerning the consumer intimacy

One of the technological obstacles is represented by the size of the labels and the capacity of stockade of the RFID devices. Presently the RFID devices are classified in two large classes: active and passive. The active ones have a battery incorporated and can be read at a larger distance than the passive ones. Unfortunately the increased functionality is accompanied by a larger size of the labels and an increased cost. The benefits of the passive labels are that they present a reduced cost and that they have a smaller size because of the reduced memory. In order that the RFID system is adopted by the traditional commerce operators, the development of a smaller label with a larger memory and a reduced cost is crucial.

One of the greatest problems concerning this technology is the multiple scanning. This problem must need solved to assure the beneficiaries that the scanning is a quality one.

Another obstacle of technological nature is represented by the infrastructure cost necessary to develop the RFID system. The reading equipments and other hardware and software support must be permanently improved to respond to the forms' requirements, use and characteristics of any type of label.

The actual cost to accomplish the less expensive labels, which require a smaller scanning distance, is approximately 0.5 dollars per unit, while in order to accomplish

smaller labels it is significantly greater. This obstacle must be exceeded because the beneficiary companies suggested a cost between 0.1-0.5 dollars to make this system as advantageous as possible. Without reaching this level of the cost between these limits, the mass adoption of the system will not be possible and the bar code will be the system used more frequently.

In order to standardize the identification codes of the product, a great step was made by the Auto-ID centre supported by the Massachusetts Institute of Technology and a series of global companies (Gillette, Metro etc.). It developed a code named Electronic Code of the Product (EPC) which helps at the individual identification of each product. Each product will have such a label with a 96 bits memory able to retain the first part information such as the name of the product, of the manufacturer, and on the last 40 bits the unique numeric code of the product.

Another obstacle raised by the standardization is that of the products made by different manufacturers which are not compatible. For example many readers of some companies can't read the labels made by all the producers.

The consumer intimacy is one of the most debated subjects concerning the RFID technology in this moment, and this fact increases the anxiety degree of the companies from the commerce field which are ready to implement the new technology. The consumers are restraint because pursue of a product they might have can put at the company's disposal information which affects their intimacy

7. CONCLUSIONS

Critical thinking is an active and purposeful thinking process that is required to perform contemporary accounting and auditing tasks. Several task characteristics (e.g., task novelty) were identified as those that require critical thinking. It was also noted that several action- oriented attributes such as meaning imposition are necessary to understand the tasks and to perform them effectively.

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