

Stock Management With RFID Technology: An Emprical Study In Bed Production Sector

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ABSTRACT : *RFID (Radio Frequency Identification Data) system is one of the methods developed in recent years to facilitate supply chain management technology. RFID technology enhances efficiency, accuracy, security, and their level of visibility in supply chain process. RFID system designs without human influence the creation of knowledge. The aim of this system is the collection of information, and the use of it has become increasingly common. RFID is the technology with radio frequency that identifies materials and people. This technology follows objects by radio frequency tags. RF tag is an identification tag which is attached to a product and is capable of storing electronic data. Such data can be communicated to the system within a certain periphery. The aim of this study is to increase the level of observation in supply chain through RFID with real-time information processes and achieve a more accurate, less full-time secured stock customers, as a result, it will reduce costs and provide quality services which, in turn, enhances the usefulness of RFID. Part of the study examines the applicability of RFID in one of the leading companies in the Bed Production sector.*

KEYWORDS: *RFID, Supply Chain, Radio Frequency, Operation Management, Stock Management*

I. INTRODUCTION

Generally, data collection and reporting method is currently used for obtaining data in the production area. Error and falsity ratio is high because the data is received manually and displaying it on the computer screen takes additional time. Human resource is used in the production area in order to provide data flow. Moreover, some special data are provided by the personnel called as checkers and trained for this work. Because the reporting is of secondary importance according to the technical personnel working at the production area, data flow could not be carried out carefully and continuously and, therefore uncompleted, wrong and delayed data is faced[1]. For the reason that the reliability of the data collected in this period is connected with the data flow and reporting qualification carried out by the personnel, responsible for data flow, the reliability of the provided data vary with the personal skills of the personnel providing data flow [2]. Uncompleted, bad or lately transferred data require the exchange of data exchange again and this situation leads to spending extra time and establishing unproductive working environment. In some cases, instead of completing the missing or correcting the mistakes in the data, current insufficient and incomplete data are used[3]. In addition to this, storing the data, which are related to the field works and using them in similar projects that are likely to be carried out in future could not be done efficiently and in detail. In consequence, this leads to making wrong decisions in regard to the problems occurred during the data flow, losing valuable time, employing more personnel and using additional sources. Accordingly, this results in increase in the costs and taking prospective and strategic decisions becomes difficult because of the unreliable data.

Together with the continuous improvement in technology, the importance of technologies that speed up the periods and facilitate their controls is gradually increased and the area of their use becomes widespread. Radio Frequency Identification (RFID) was invented for the first time in 1945 by Léon Theremin in order to be used by the intelligent agencies in the Soviet Union. This technology has been developed by adopting the form of a resonator after liberating the wave sound with a diaphragm reflecting to the module. This study is accepted as the initial step of RFID technology. The RFID is a system that provides the identification of all kind of living and non-living objects by using the radio waves. It can be used in numerous sectors due to this characteristics and its usage has gradually becomes widespread. The RFID technology, being a method in facilitating the supply-chain management, definitely provides the process productivity in the supply-chain and also enhances the accuracy and reliability of data. The RFID technology is created by producing RF labels, which can be placed in all kind of living and non-living objects. Each label has an unconvertible code given by the manufacturing company and it belongs to only one object in order to provide the accuracy and reliability of data. Owing to the technology that providing traces the movement of any object carrying this label, process cycles of all objects can be identified and traced.

II. RADIO FREQUENCY IDENTIFICATION SYSTEM

Due to the fact that as the one of the automatic identification systems, the RFID (Radio Frequency Identification System) is a technology that gives importance to the on permanent use of data flow, its demand in the production sector area is gradually increasing. This system, which consists of a microchip wrapped with antenna and a reader, provides the data flow from each object by using radio waves. This data flow is made via RF labels. These labels are able to collect a considerable amount of information; all labels are able to bring together data flow at the same time in order to have it read quickly, without error and in full; and irrespective of the environmental conditions, these readers enable storing of various different pieces of information from the serial number of a product to its history, as well as the various databases present within a network, because of its remote storage capability by which it is able to store large amounts of data. The RFID technology is a kind of data identification, data source creating and regional data storage technology. The advantage of the RFID among the other identification technologies is that the read-storage data distance, which reaches up to 100 meters at normal weather conditions, is high. This read-storage is not required to have a certain angle and direct view and therefore it enables to collecting data regularly and rapidly in the irregular areas that have a manual structure. The RFID technology has a memory that can be updated and its memory capacity can be used up to 32 kilobytes. When compared to other implementations (barcode etc.), having a high memory is another feature that keeps this technology ahead of other similar technologies. The RFID labels attached on the object can locally provide the information belonging to the object and are also adaptable is resistant to harsh conditions of the sectors such as furniture, construction, and machinery sectors. The RFID technology consists of two main components; label and reader. In order to provide the communication between these two components, an antenna tied on the reader is used. The RFID label is attached to the object, from which the data is obtained and followed and the chip in it provides the data flow related to the object. The communication of data in the attached label is provided wirelessly by radio waves through the RFID reader. A reader operating with an antenna kept externally is used for data exchange from the labels. The RFID labels can be stable and mobile according to the usage [4].

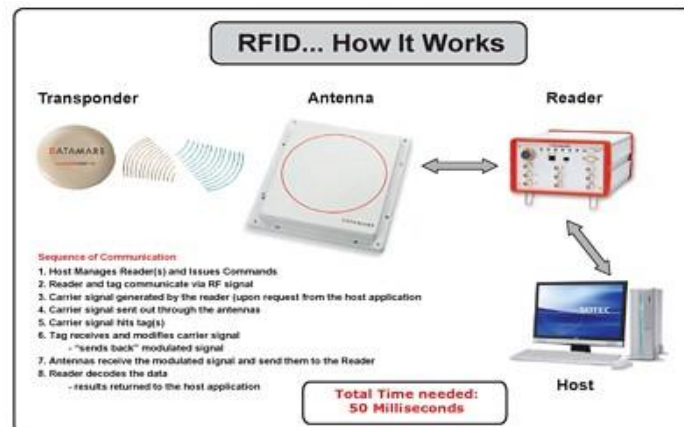


Table 1: RFID How it Works ? ([5])

The RFID technology is categorized according to the types and frequency ranges of the RF labels from which the data exchange is provided. Labels, used for providing the communications and data flow, split into two groups; active and passive. Active labels require internal power (battery etc.) in order to provide the communication with the reader to perform and the necessary functions for the flow of the recorded information. When the active labels are compared with the passive labels, they are bigger volumetrically and their cost is higher. Battery life of active labels is approximately 5 or 10 and there are two types of batteries; renewable and nonrenewable. Most of the active RFID labels have a memory that can be updated. Some of the labels have a large memory capacity and can communicate over wide distances (e.g.; 30-100 m) comparing to the passive label types [6]. The energy needed in the passive labels is provided by the reader. The data signaling rate is lower than the active labels because the passive labels get the energy from the outside and their memories has low capacity because the data transfer, being more in terms of memory at low speed, takes long time. Passive RFID tags were examined, but they did not have the necessary read range, and other commercially active RFID tags were too large to fit within the chosen tools. The memory of the active RFID tags was used to store operation and maintenance (O&M) data for the tagged tools[7]. Their cost is lower than the other active labels

and their sizes are also small and light because they don't need an external battery. These labels are classified in two main groups according to the memory types:

- 1- Read-only label over which information updating cannot be done,
- 2- Read/write labels which we can update their memories with new information

Read-only labels carry the identification information (identification number) only and all other information concerning the relevant object is kept in another database under the identification number. This type of labels are programmed only once during the time of operation, either during manufacturing or by the user. The programmed data is not changed in read-only labels. The memories of these labels, being the simplest form of RFID technology, can collect data approximately up to 8-128 bytes [8]. Read-write labels are generally the active labels. Information recorded in their memories can be updated. These labels, having a high memory capacity, are used for the purposes such as follow-up of devices, persons, vehicles, goods and for current information concerning them and equipment maintenance [4].

The RFID technologies are separated into four types according to the frequency values they use; Low Frequency, High Frequency, Ultra High Frequency (UHF) and Microwave. High frequency provides higher data signaling rate and application to read from a more distance. However, the RFID signals are impressed majorly by the environments containing metal and liquid at high frequency and the decrease in performance of the technology used is in question due to this impression. As the frequency decreases, the data reading and signaling rates also decrease, in contrast with the high frequencies. However, the RFID technology at low frequency is impressed less by the environments containing metal and liquid and its performance is higher than the high frequencies in the environments containing harsh conditions.

Lower Frequency (LF) (<135 Mhz) Passive

- It just can be reading, read and written
- Longer and Expensive Copper Antenna
- Connected with metal and liquid performance lose is lower
- Short reading distance
- Oversized

High Frequency (HF) (13.56 Mhz) Passive

- It just can be reading, read and written, written just one time and read continuously
- Contactless using on smart cards
- Cheapest than lower frequency
- Connected with metal and liquid performance lose is lower
- Longest reading distance than lower Frequency
- Oversized
- It can be read many tags
- High communication speed

Ultra High Frequency (UHF) (13.56 Mhz) Passive and Active

- It just can be reading, read and written, written just one time and read continuously
- Contactless using on smart cards
- Cheapest than high frequency
- Connected with metal and liquid performance lose is lower
- Longest reading distance than High Frequency
- Oversized

Mikrowave (2.45 Ghz, 5.8Ghz) Passive and Active

- It just can be reading, read and written, written just one time and read continuously
 - Connected with metal and liquid performance lose is lower
 - Connected with liquids performance lose is lower
 - Longest reading distance than Ultra High Frequency
- [9]

As examined, the RFID technology has different types and in order to specify which types are suitable for the sector in which they will be used, primarily, it should be specified for what purpose it will be used and accordingly, the needs should be detected. RFID technology to be implemented should be decided according to these detected needs. As the radio waves can be influenced by the harsh environmental conditions, the test environment should, as far as possible, reflect those of the sector in which it will be implemented.

III. SUGGESTED RFID SYSTEMS

The main target of developing RFID systems indicated in the literature and suggested to be used in the sector to be implemented is to be automatically identified the materials or to be specified their places during the supply chain. Identification or place information obtained in these systems shall be stored in such a manner that they could be easily accessed by the project participants (such as owner, contractor etc.). For example; storing this information in a database to be accessed on internet is one of the alternatives. In addition to this, it is suggested that the necessary information related to the materials in the production or construction site should be stored in some systems on the material. In this manner, this information will be provided locally and will be ready for use by the personnel who need this information in the site[4]. There are two different studies in which the RFID tests are carried out in the production environments in order to determine whether developing the suggested systems is technically possible or not. First one is the study in which the RFID is used for the follow-up and the other is the study in which the RFID is used for the identification. In the first study, the materials are identified semi-automatically or automatically through the RFID readers placed in the specific locations. The identity information read is stored with the location information in the cases where the RFID reader is stable and by combining with the coordinated information obtained from the global positioning system in the cases where the reader is not stable. In the second study, the labels attached on the objects are identified manually by a personnel and the identification information belonging to the relevant object and kept in the RFID label is rapidly transferred to the reader from the label. This manual identification is more ponderous system than the automatic follow-up system because it requires each label to be read one by one by a person. However the automatic follow-up system is not suitable for every environment. Instead of the automatic follow-up system, the automatic identification system is used in the sectors having an active and dynamic structure (such as furniture, construction and machinery sectors).

IV. IMPLEMENTATION

Many companies carry out the pilot implementations related to the RFID technology and thus try to determine the benefits and costs of this technology. The project study of the RFID technology carried out in a company being active in the bed production sector of RFID technology is mentioned in this article. In this particular case, the supplier carries out the raw material production in the bed production sector. The logistics service provider provides the transportation and storage services. The producer is responsible for the production of the good that the customer buys. The dealer carries out the product and service procedures. Before the RFID was implemented, it was determined that the inventory costs were high, the distribution was slow because the mobility could not be controlled completely in the system and also because of the balance disorder in the production line and the faults and obstacles in the raw material control. Several problems in the job follow-up had also been determined. The management of the company called İstikbal, decided to use the RFID within the scope of the Supply Chain Management project in 2010 in order to follow the products' moves on the production line, the materials to be shipped from the suppliers, the product and raw material inventories. The studies, which included searching the supplier suitable for the installment and implementation of the RFID, supplying the necessary materials, preparing technological infrastructure and making it integrated into the current system were completed in about a year. This article aims at providing the accurate information about the RFID implementation carried out and the operational plans, and offering suggestions in regard to the improvements to be made the current operation system in order to make it more productive, to determine the areas to be improved, to provide the inventory control on the supply chain and accordingly to decrease the costs.

İstikbal is the biggest bed producer in Turkey and one of the world's leading bed producers with a capacity of producing 6000 beds per day. The productions are carried out in Kayseri and also in Adapazarı. They are established at about 200 meters from the factories of Boyçelik, Form-Sünger and Boyteks Kayseri, which are the main raw material suppliers of the fabric, foam and arc required for the bed production of bed. The company called Milkay produces felt; another raw materials necessary for bed production is located at about 600-700 meters from the company. Deployment of suppliers close to İstikbal enables it implement the Just in Time system. The most important raw material is the fabrics to be used in production of bed. The fabric necessary for the production are supplied by the different suppliers and the best part of the total fabric supply is provided by Boyteks located at about 200 meters from İstikbal. The first stage of the RFID project study was concern with the material of fabric and it is aimed to be implemented in case of other suppliers as well at the

following stages. Two trucks full of fabric are shipped daily from Boyteks. 20 palletes of fabrics come with each shipment. Each palette contains 20 rolls of fabric. 100 m of fabrics are available in each roll. The daily required quantity of fabrics is 80000 meters on average. Before the RFID implementation, the fabrics were transferred to the virtual warehouse for quality control and the fabrics approved for the production were transferred to the normal warehouse from the quality warehouse after the quality control system. The quality control could take a long time due to several tests and 100% control.

It was detected from the examinations that the return rates of Boyteks arising from the quality were very low. Thereafter, 100% control method was abandoned and the quality controls were planned to be made through the use of sampling method. Carrying out the depot entry of each roll took 1 minute on average at the coming fabric shipments and averagely 400 minutes were necessary for the depot entry of the fabric material coming with a shipment. In consequence of this, the palletes of fabrics at the raw material warehouse were accumulated after each shipment. This caused failure in the production processes even before the production was started. Negotiations were carried out concerning how the implementation would be realized between the data processing departments of both companies because Boyteks didn't use the RFID implementation. In consequence of these negotiations, the RFID system was established in Boyteks. According to this, firstly, the personnel working at the fabric take up machines in Boyteks identifies empty RFID labels to the system, and then loads all of the information including the types, yardages and colors of the fabric that will be wound, to the labels. Afterwards, these labels are attached to the inner side of each empty roll on which the fabric is wound and the winding operation is carried out. The fabrics whose winding is made and RFID labels are attached are loaded into the palletes in which RFID labels, identified to the system RFID labels attached to the palletes show which roll is in the palette. After the shipment is made by Boyteks, the order number indicated in the delivery note is logged in the system by the goods acceptance department of İstikbal. Afterwards, palletes in the truck are unloaded via forklift and brought to the goods acceptance department. Upon entering into the warehouse, the labels on the palletes and in the palette are read by RFID antennas located in both sides of the entrance to warehouse and then the rolls login is made. Due to the fact that chaotic storage system is available in the warehouse, the SAP system determines the locations in the warehouse where the rolls are put after the labels are read. The persons responsible for the warehouse place the rolls to their rightful locations according to the labels printed out. The time used in making the entry of a truck fully loaded with the fabric to the warehouse has now decreased to 10 minutes from 400 minutes on average. Thus, the stock movements can be easily followed and efficient stock management and analysis is provided. The problem of backlogs the production line have been resolved, workforce costs have been decreased and the personnel used previously at warehouse entrance have been used in other processes where they could be more efficient.

V. CONCLUSION

Continuous existence of the establishments in the increasing competition environment cannot be ensured by the improvements made in their current internal business processes. They need to develop their business follow-up processes with the systems such as the RFID by complying with the technological advancements. The companies, which implement the RFID system ideally and manage the system well, gain important advantage for themselves in the intense competitive environment. Putting the RFID system into service efficiently leads to the optimization in terms of cost and the significant increases in the product quality and value by these developments. The RFID technology can provide many advantages to almost all sectors with its different implementations. The working and operational costs of the companies will decrease and their productivity and profitability will increase by this new technology. Its, rate of success is increasing every passing day.

Variations in the business processes can be planned and analyzed through the RFID technology and it can be managed efficiently by establishing systems with the most appropriate label arrangement. The most extensive implementations projected the detailed business processes such as inventory follow-up, production line capacity optimization, warehouse management, stock management and control, personnel and database follow-up and integrated with the database can be developed in numerous sectors such as production, logistics, wholesale, finance and public sectors via this technology. In future, those who want to make investment in the field of RFID, should conduct a proper research and analyze the gains from the RFID. It can be said that there is a discovery process experienced with regard to the RFID and that the application of an RFID based system is a science, to the same extent as it being an art at the same time.[10] RFID is a technology which is limited to not only product identification and follow-up but also to containing extensive implementations. The RFID can be used as an efficient and productive technology by the companies which carry out real time business in order to provide better service by shortening the product delivery and service periods, by the producers who don't want to lose their market shares in the intense competitive environment and who want to remain close to their customers, and by the institutions or companies which need the dynamic systems that can reliably control their

assets, data information. While the level of observation the stocks in the supply chain was increased on SAP via RFID project realized with Boyteks for the stock control concerning the raw material, fabric available in the raw material warehouse of İstikbal, the achieving more accurate and real-time information was possible. Full-time and quality service was provided to the customers with less safety stock and consequently the costs were decreased.

In the coming stages of this project, the same implementations will be realized at the products' exit part of the raw material warehouse and the automatic stock control will be provided. In addition to this, the stock control with the RFID will be carried out with the companies. Such as; Form-Sünger and Boyçelik after the Boyteks.

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