

# The possibilities with RFID within the construction industry

## – Key points for an implementation in a material handling process

Lukas Nowikowski & Helena Kranjcec  
Department of Industrial Management & Logistics, Lund University

---

### Abstract

The purpose of this master thesis is to explore the possibility of implementing an RFID-based technology in the goods reception stage in the construction industry. The aim is also to make observations in relation to time studies to determine if an RFID implementation is sufficient within the goods reception stage, or whether an implementation is required in an entire supply chain.

The objective of this master thesis is to extract the key points that are important for an implementation, of an RFID-based technology, to be profitable and viable in the construction material handling process.

For an implementation of an RFID-based technology to be profitable and viable it is necessary to implement RFID across an entire supply chain. We have chosen to call it an RFID-based supply chain, *Rsc*.

To achieve success with the technology and an *Rsc* the project should begin with a creation of a management team that is responsible for setting up an *Rsc*. We believe that it is the construction contractor who should be the leading and driving force behind the introduction of an *Rsc*. The construction contractor should also initiate and be responsible for the creation of a management team and for defining the relations between players within an *Rsc*.

The key points to achieve an RFID-based supply chain are:

- Create a management team that is responsible for establishing an *Rsc*.
- Define and structure the relations and responsibilities between all actors.
- Establish and implement an RFID-system.

---

### 1. Introduction

In the construction industry of today, RFID technology is not a topic often talked about, or a technology used extensively. There are not many documented studies performed in Sweden on RFID in construction except for some isolated reports and theses. A thesis from 2006 has investigated the potential of RFID, how players relate to RFID

technology and what is required by the construction industry to make greater use possible. In 2009 a report was published in which the possibilities of RFID technology were identified as well as three key areas in which the technology has the potential to grow within the Swedish construction industry. The report contains interviews, field visits and a mailing survey. The results from the report were that RFID-technology is profitable when used in several areas

simultaneously. Those areas being personal identification, monitoring tools and machines and control of goods in the reception stage on a construction site.

In the Swedish construction industry RFID-technology had its breakthrough in the personal identification area in order to above all make it difficult for undeclared work and to strengthen the healthy competition. At construction sites where personal identification has been introduced, all individuals who wish to gain access and on-site users are required to wear so-called *ID-06 tags*. By introducing these tags the construction site will add elements of control over all the individuals accessing the construction site, which will help to keep unauthorized people away from the construction site. Furthermore, the technology has evolved and increased in level when the RFID-tagged tools and containers were introduced, a process in which a personal identification is needed to gain access to the container and its content.

To raise the RFID-technology in construction yet an additional level a development project was introduced to investigate the possibilities of RFID in the control of material deliveries at the goods reception stage.

### **1.1 Problem statements**

We intend to answer questions following the below mentioned topics.

*Goods reception stage:*

- How can it improve?
- Is it profitable with an implementation of RFID?
- Is there a temporal difference with and without RFID?

*Who or which players need to be involved to make RFID work successfully?*

*What improvement opportunities can an RFID-based technology introduce to the goods reception stage and in a*

*construction related supply chain?*

*How can a construction-related RFID-implemented supply chain look like?*

*Are there differences in the material procurement process with and without RFID?*

## **2. RFID**

In order for RFID (Radio Frequency Identification) to function it requires three basic components. These components create a communication system called an RFID-system. An RFID-system consists of a tag, a scanner and a control unit. (1)

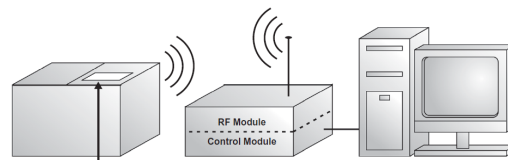


Figure 1. RFID-system (1)

The system functions in the following way; When an object with a tag is in the vicinity of a scanner, they communicate with each other by the use of radio waves. (1) The scanner sends a radio signal to the tag which in turn generates a response, (2) for example with a unique identification number, (3) which is sent back to the reader. The reader sends this information on to the control unit, which normally consists of a computer with some kind of database management software, where it is processed. (2)

## **3. Analysis & Conclusion**

The goods reception stage has the possibility to improve if an APD-plan is used and continuously revised. An APD-plan gives a good overview of the construction site with clear unloading zones that clearly simplify goods reception process, both for the construction site and for the unloading party. We believe that the use of visual on-site markings for unloading zones along the construction site is another way to further simplify and enhance the unloading process.

This will make the construction site easily oriented for external players when accessing the site.

A value-creating activity within the goods reception stage is to examine the delivered goods during the unloading process. This will make it possible to detect damaged goods directly and we believe this is a stage in the goods reception that is very important. The risk of future disruptions or delays in production is substantially reduced through the examination of goods. If the delivered goods are damaged or false the error is discovered in the earliest stage possible in the goods reception process and can therefore save precious time through reducing production delays that may occur if this type of examination is not used by the on-site supervisors.

Based on our observations we can conclude that there is little difference between an RFID-based and conventional goods reception stage. The only difference we could observe is that at the RFID-enabled goods reception the packages were scanned during the goods reception stage on the construction site, which is not a time-consuming action in itself and does not take longer than to accept the delivery note.

We also observed, during a conventional goods reception, that when the goods arrived and were unloaded there was usually a supervisor that gave directives as to where the parcels should be put after they are unloaded, for example on which floor or in which building. But no direct examination was made to check if the delivery note was consistent with the delivered goods or if the goods were damaged in any way.

With an RFID-based goods reception there is a larger chance to notice damaged goods because the supervisor has to scan each parcel to register that the delivery has occurred and to get information as to what the parcel contains, which will directly

eliminate the risk of errors in the received goods.

---

Our view is that if RFID-based technology is to be profitable and successful in the Swedish construction industry it has to be implemented across an entire supply chain, which we have chosen to call an RFID-based supply chain, an *Rsc*.

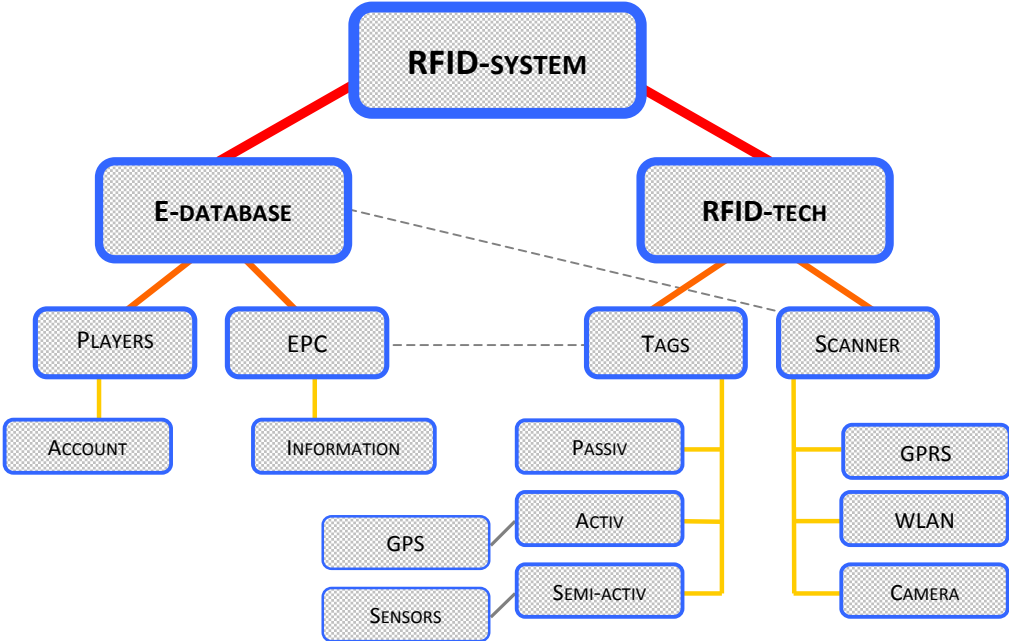
In order to achieve an *Rsc* there must be stricter requirements on all players involved in a construction project. The basis is that with the help of RFID create a supply chain where all players in the project are included. At the beginning of a project, the relations between all players have to improve and clarify in order to achieve clearer goals and conditions. All involved players must always strive for efficiency, beyond the limits and want to provide assistance to others, so that the core competencies that exist among the players are fully exploited in the *Rsc*.

We believe that the initiator to create an *Rsc* should be the building constructor because the final responsibility for the buildings completions lies with the contractor. We also believe that it is important that the supply chain creates a driving collaboration and commitment from all the involved players. This is the basis for developing a transparent, common, trustfulness and interdependence throughout the supply chain. When this is developed then conditions for common processes, material flows and information exchanges are created. By using RFID a condition is created to ensure the efficient use of resources through the joint material flows that are synchronized and coordinated in teamwork with all players.

In order for an *Rsc* to function properly it needs a system. The purpose of this system is to link together all players in real time, resulting in effective communication and

coordination of resources as well as the risk of conflicts and delays are reduced.

We propose the creation of an RFID-system, *Figure 2*.



*Figure 2. RFID-system*

We propose that the RFID-system should be built according to *Figure 2*. It consists of two key components; an electronic database and RFID-technology. These two components are the core of the system and depend on each other in order to work.

E-database will contain the tags unique identification number, EPC, which is linked to information about the tagged goods as well as the accounts for all players. The tag can be of three different types and selected according to the necessary needs, depending on the type of material and delivery requirements.

Since all players are linked together in this system, information about the tagged articles is already printed in the e-database at the production site. It is also where the RFID tag is used for the first time. Each item or package in an *Rsc* will have an RFID tag. We believe that the biggest benefits of RFID and a system structure which is described here is for items such as doors, windows, kitchen, prefabricate concrete and glass sections of larger glass facades. We do not

believe that plasterboard, mineral wool and wood of various kinds are especially suited to an RFID tagging at the item level, but are most suitable for tagging on the package level.

When a tag is scanned the tags EPC is sent to the e-database and information related to that specific EPC is sent back to the scanner. On-site this can be done in two ways depending on the scanner built-in technology.

With a RFID system in an *Rsc* many of the processes in a standardized supply chain are automated, at the same time as the articles are being automatically identified. An electronic exchange of information is created which result in visible processes in a supply chain. This means that all the information is available in one place so that players in a time- and cost-effective way can get information about current events in the project. We strongly believe that this characteristic is very important to quickly react to various types of changes, which can both strengthen collaboration among

players and improve relations between them.

The flexibility in an *Rsc* increases in many moments. Since communication and coordination is in real time it improves because of that all changes are visible immediately, which simplify the synchronization of material flows. The result is an efficient use of resources leading to greater cost effectiveness and less restricted capital along the *Rsc*.

---

We have found differences in the material procurement process in a supply chain, compared with an *Rsc*.

The need of purchase is always present but the first difference appears in the procurement process. Usually the choice of supplier is driven to a large extent by the price of the commodity. The first change must take place in this stage where suppliers must use RFID-based technology in their production.

In an *Rsc* with exchange of computerized data and RFID-data information can be moved back in a supply chain, for example information regarding the current stage of construction. With this information, material flows can be synchronized between the supplier and the construction site, which will automatically require cooperation between them. If it is done correctly, Just-in-Time deliveries can take place to the construction site. This can cause a variety of uses for several of the players, including the production plant that can produce the right

amount of goods at the right time which eliminates waste in the production. Supply conditions are optimal when the goods arrive at the construction site in just the right time, that is to say just before it is time for them to be built in or simply when they are needed, which reduces lead-times in a *RSC*.

In a standard supply chain supply monitoring and delivery announcements are among the last phases of a material procurement process. In an *Rsc* these phases are being replaced with one phase that we have chosen to call a TN-delivery (Trace & Notify delivery). A TN-delivery of an *Rsc* will with the help of the Automatic Data Acquisition, track goods during the journey from factory to the construction site. Tracking goods can be done with active tags and GPS technology. It is not possible to realize it with passive tags, however it is possible to register the goods at each crossed point and thereby get a better insight on where the goods are located.

The last phase of a material procurement process is the delivery reception. When a delivery arrives at a construction site, in an *Rsc*, the on-site unloading should be monitored by a supervisor. Each package respective each article will have an RFID-tag attached to or embedded in the material which identifies the article. The supervisor should on arrival scan the packages, whereupon the scanner contacts the e-database and then gets back information about the package contents. On this occasion the package that has been delivered is also registered in the e-database.

## References

- (1) HUNT, DANIEL & PUGLIA, ALBERT & PUGLIA, MIKE (2007), *RFID A GUIDE TO RADIO FREQUENCY IDENTIFICATION*, JOHN WILEY & SONS, INC., ISBN 978-0-470-10764-5
- (2) GÜNTHER, OLIVER & KLETTI, WOLFHARD & KUBACH, UWE (2008), *RFID IN MANUFACTURING*, SPRINGER, ISBN 978-3-540-76453-3
- (3) BANKS, JERRY & PACHANO, MANUEL & THOMPSON, LES & HANNY, DAVID (2007), *RFID APPLIED*, JOHN WILEY & SONS, INC., ISBN 978-0-471-79365-6