A Simulation Tool for Radio Frequency Identification (RFID) in Construction Supply Chains

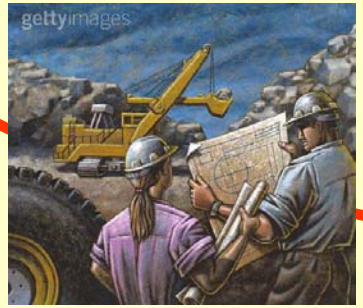
Frans van Gassel

Technische Universiteit
Eindhoven
University of Technology

Outline

- Supply chain
- Problems in the supply chain
- Radio Frequency IDentification (RFID)
- Research question and methods
- Case study and simulation
- Results and conclusions

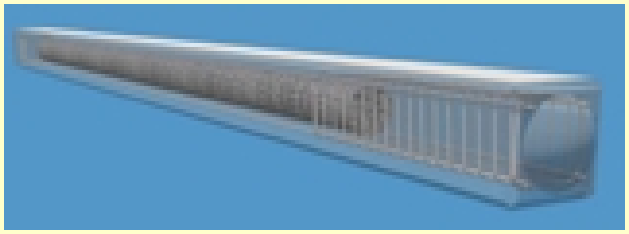
The Supply Chain



Not only material flow but also:

- data & information
- experiences & decisions
- inspection and registration

The Supply Chain Piles



The Management of the Supply Chain

The management of the material and information flows in the supply chain is:

> *"a process of planning inventory control, receiving and storing. Material handling, physical distributions and related information from point of origin tot point of consumption for the purpose of conforming to customer requirements"*

(Ren et al)

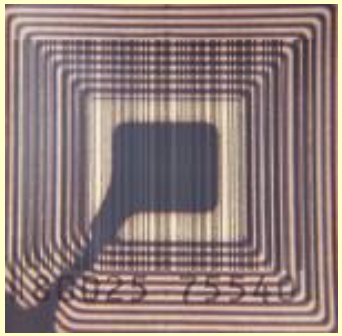
Problems in the Supply Chain

In the supply chain, unnecessary costs are incurred because:

- building elements are produced using the wrong drawings,
- the wrong building elements are delivered or
- the products were wrongly identified during processing.

In the Netherlands, these unnecessary costs have been estimated at approximately 10% at a turnover of 50 billion Euros

RFID a Solution for the Problems?



RFID is a technology used to identify and monitor objects and people.

An RFID system consists of RFID tags, RFID tag readers, output devices and software.

The price of the RFID tags will fall considerably in the next few years, which continues to prompt a study of whether an RFID system in the supply chain can generate benefits and how the pros and cons should be assessed.

Research to answer this question

A master study conducted at Eindhoven University of Technology in the Netherlands compared a supply chain with and without an RFID system.

For contractors, it is difficult to estimate the costs and benefits of using RFID technology in their production processes.

This is why the study looked at how the supply chain with and without an RFID system is structured and how the technology can help reduce unnecessary costs.

The paper contains a brief summary of the study results.

The aim of the master study is to develop a simulation tool for using RFID technology in the supply chain by means of a case study and simulations

Research Question and Methods

- How can the work processes with and without RFID technology in the supply chain be compared?

The question will be answered by studying:

- a case and
- carrying out simulations.

Case Study

Studying the supply chains of piles between production and placement by:

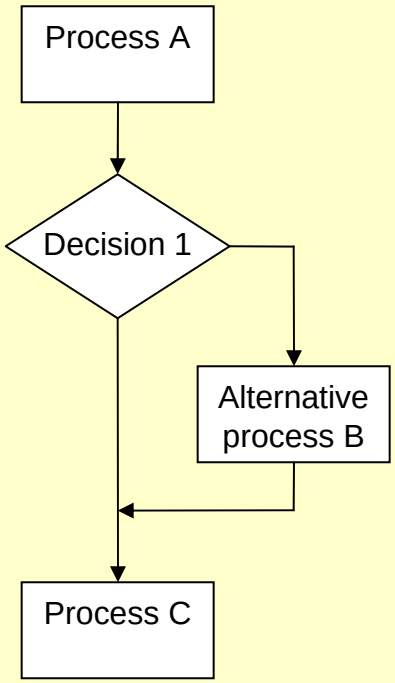
- Interviewing the work planner and site foreman.
- Looking at the administrative work processes, such as processing waybills, drawing up delivery reports, keeping track of building products in place, drawing up pouring releases, keeping a log, filling in hours worked by employees and subcontractors, etc

Simulation

To gain insight into the performance of the supply chain processes using an RFID system, these processes are simulated with the aid of ARENA software.

The simulation model not only consists of direct work processes, but also of indirect work processes such as inspection and registration. The model also comprises alternative work processes required to correct irregularities such as returning the wrong piles and performing extra inspections.

Simulation



Model

The model input is the number of orders and call-offs each day. The chance of an unnecessary process having to be performed has been entered in the model on the basis of interviews with experts.
The simulation consists of a scenario that takes up a production year in which 60,000 piles are driven.
The output is a percentage that shows the extent to which unnecessary processes are performed.
Three possible scenarios of a supply chain for piles are calculated:
1. Of the existing process as it occurred during the case study.
2. RFID used in the existing process.
3. RIFD pessimistic scenario.

Results Case Study

The case study produced the following results:

The site foreman is not always available to run the necessary processes in the case of irregularities. He may not be on the site, may be in a meeting or may be walking around somewhere on the site.

The collected information does not provide sufficient insight to draw a comparison between existing work processes and work processes that could be supported by RFID.

The work processes have been visualised in six models.

Results Simulation

The model used for the simulations consists of 79 execution and optional processes.

Use of an RFID system results in 1.18% fewer irregularities in the supply chain for the pile manufacturer and 10.58% for the contractor. In the pessimistic scenario, these figures are 2.64% and 6.76% more irregularities, respectively.

The simulations show that use of an RFID system can have a positive influence on the business process:

- The number of processes falls
- The number of errors falls.

Results Simulation

Simulation	**Manufacturer irregularities** [%]	**Contractor irregularities** [%]
Existing situation	3.80	13.46
RFID	2.62	2.88
Pessimistic RFID scenario	6.54	19.22

Cost Estimation Results

An RFID tag costs 2% of the average price of a pile and the RFID system infrastructure costs 1%, which amounts to a total of 3%.

The costs of the RFID tags look to be the biggest expenditure at approximately 76%.

Conclusions

The resulting simulation model gives stakeholders a decision tool with which to study whether the introduction of an RFID system creates benefits.

When using an RFID system for the supply chain:

- fewer errors may be made, leading to fewer irregular and incidental processes,
- the information becomes available faster and
- work is more efficient.

Stakeholders can use the model to decide for themselves whether the extra costs outweigh the unnecessary costs incurred if an RFID system is not used.