Life Cycle Information of Buildings Supported by RFID Technologies

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Agenda

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1 Introduction

Radio Frequency Identification (RFID)

- RFID is an Auto-Identification technology that allows the unique identification of objects up to a distance of several feet.

In contrast to conventional Auto-ID Systems (e.g. Bar Code) RFID bears several advantages:

- Less contact, non line-of-sight identification of objects over long distances
- Bulk or mass identification
- Insensitivity of the transponders against moisture, dirt and abrasion
- Possibility to store information directly at the item
- Possibility to write new data onto the chip of the transponder
1 Introduction

RFID-Transponder

RFID-Reader-/Writer

Control unit

Backend system

standardised software application (ERP)

Microwaves

data
1 Introduction

Applications and research

- Mainly focus on the implementation of RFID in so called off-site production where it has already been proven to be successful
- E.g. automotive sector and electrical and electronics industry with anti-theft systems, department stores with theft-secure devices, tracking of products throughout the supply chain, auto-identification of goods,…

Complexity of production processes in construction

- Final assembly of the building takes place on-site
- Amount of materials and components as well as information arising over the life cycle of a building are significantly higher than in traditional manufacturing processes

→ Construction still lacks the application of automated identification systems over the life cycle of a building!
2. Prospectives on RFID Technology in Construction

Life Cycle of a Building

- Design
- Production
- Construction
- Use / Occupation
- End of life

Pre-Stages / Upstream
- Production (off-site)

Production (off-site)
- Operation
- Management / Administration
- Servicing / Maintenance / Refurbishment
- Partial deconstruction
- Ageing / Deterioration

Commissioning / Hand-over

Construction (on-site)

Transport

Pre-Stages

Project development

Design / Planning

Pre-Stages

Production (off-site)

Commissioning / Hand-over

Deconstruction

Reuse / Recovery / Waste

Reuse / Recovery / Waste / Downstream


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Life Cycle Information in Construction

Labour

• Personal data, e.g. name, date of birth, information on working status, skills

Material and components

• Master data, e.g. identity of the material or component in terms of a unique ID, characteristics of material, measures
• Manufacturer, e.g. name of the manufacturer, date and place of manufacturing
• Organisational data, e.g. date of delivery, maintenance intervals, maintenance, time and type of repair

Equipment

• Master, producer and organizational data in terms of a unique ID, operation limitations, name of manufacturer, date of delivery, ownership, or required skills
Production – Material Identification

- Identification of construction materials like solids, liquids, gaseous and metals as well as components
- Tracing of building materials and components from point of origin to point of final assembly

Benefits
- Time savings collecting necessary information
- Pallet-level tagging can lead to more efficient identification of products, reduces misdirected shipments and enables a more efficient consignment verification

Technical realisation
- Tag is attached to each of the components
- Information about building materials, e.g. the name of the supplier, the delivery date, the amount delivered as well as the way of the delivery are stored on the RFID tag
Tracking of building materials with RFID at the entrance of a construction site
Production – Tracking and Tracing of Material

- Identification of objects on the building site to which storage space is usually randomly assigned due to site congestion

Benefits
- Eased warehouse management and stock keeping (a large part of the materials is usually stored temporarily on the construction site)
- Support of tracing and locating certain building materials and components even over longer distances without line-of-sight once having lost track of them

Technical realisation
- Storage of identification data on transponder
- Handheld reader or via GPS from a certain place onside or outside the construction site
Construction – Access Control

• Access control and monitoring of on-site activities

Benefits

• Eased access control to construction site
• Enhancement of construction site security
  → Immediate traceability of worker already being evacuated in case of emergency
  → Skills check for the operation of machines and construction equipment

Technical realisation

• Personalized data stored on transponder, integrated e.g. in a plastic card (like access to parking lots) given to every worker
• Transponders may also contain information about skills, qualifications and authorisations of the construction worker
• Verification of skills, access permission and movements of workers with the backend system on site if a person or car moves into the reception area of the systems reading device
Construction – Anti-Theft Systems and Tool Tracking

• Site monitoring and extended information availability

Benefits
• Prevention of thievery of construction materials and equipment
• Reduction of paperwork for occurring for warranties and maintenance of equipment

Technical realisation
• Simple anti-theft applications:
  → 1-bit transponder
  → Activation of alarm when a tagged tool is moved into the reception area of a reading device at the entrance or exit of a construction site
• Advanced tool tracking system:
  → Transponders with higher memory capacity
    - Survey the procurement/leasing and maintenance or modification history of the equipment
    - Billing to specific construction projects
    - Information about the utilization of the tool, e.g. of the construction worker who used the tool
Use and Occupation – Servicing and Maintenance

• Maintenance and operation support during use and occupation phase

Benefits

• Reduction of maintenance effort of, for instance, sewer system by permanently available information on next necessary maintenance of the pipe or its manufacturer
• Automation of applications within households and during the utilization of houses
  → Refrigerator detects products beyond the date of expiry and automatically creates a shopping list
  → Ingredients, calories or nutritional values as well as manufacturers and delivery dates stored to trace product history
  → Automated setting of household appliances, e.g. ovens

Technical realisation

• RFID-tag is cast into the concrete of the pipes during the fabrication process
• Data can be read out by remote-controlled, navigable robots provided with a RFID reading device
• RFID-tag attached to every good, and reading device installed on household appliances initiating the related application to start
End of life/Deconstruction

- Support of deconstruction activities with respect to economic and ecological criteria

Benefits
- Easy access to information on composition of building
- Support of systematic and selective deconstruction of buildings to separate different kinds of building materials and their reutilization in superior utilizations options
- Precise cost estimation of deconstruction projects and prevention of unexpected incidents during the dismantling of the building

Technical realisation
- Integration or tagging of RFID-tags to the component
- Gathering of information on composition of building before deconstruction with reading device, e.g. handheld
3 Potentials of RFID in Construction

**Improvement of internal and external production as well as logistic processes**
- Improvement of communication and collaboration simultaneously decreasing communication effort
- Simplified assignment of construction materials, components and equipment to projects
- Traceable material flow even during occupation of building
- Improved information exchange between suppliers and contractors
- Direct assignment of products to projects, information stored on product

**Increase in construction quality**
- Unique identification and traceability of construction materials and components
- Tagging of deconstruction and recovery data to the product or component

**Improvement of jobsite security and healthcare**
- Emergency alerts or machines switch offs in emergency zones
- Check of completeness of safety working clothing
- Coupling of operation permission for machines in dependency on permissions stored on RFID-tags in ID cards for construction workers
3 Limitations of RFID in Construction

Critical success factors for the implementation of RFID

- Standardization of frequencies and sending power
- Standardization in the area of product identification
- Data protection (Personal data, …)
- Interferences caused by metal or liquids

Especially developed for RFID systems: (rfid)-onMetal-Label

- Guarantees a reliable identification without an exertion of the electromagnetic field
- Can be tagged directly to metallic surfaces

The further development of special components appropriate for the construction industry will be a question of how far there will be an adoption of RFID within the industry in the future!
4 Conclusion and Outlook

- Construction is still lagging behind applying and adapting RFID technologies already successfully implemented in other industrial sectors
- Several potential applications for RFID in construction
- RFID could unveil its benefits even under the harsh environmental influences in construction
- Positive sign towards the application of RFID in construction are the development of RFID technologies which work under conditions typically for construction, for instance metal interferences or other environmental influences

→ RFID in the construction sector is going to be an increasingly important topic!
Thank you for your attention!

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