Using RFID in Rugged Supply Chain Conditions

Indisputable Key

Ville Puntanen & Antti Sirkka

TietoEnator
Indisputable Key

• The objective of the project is to develop a methodology and advanced technologies that can improve the use of wood and optimize the forest production, minimizing environmental impacts.
• Budget: 12,7 M€ financed to 50 % by EU
• 29 partners in 5 countries: Estonia, Finland, France, Norway and Sweden. The partners represent research institutes, universities, industrial developers, forestry and sawmill companies.
  • RFID development by VTT, Confidex
  • Software modules for integration by TietoEnator
  • Environmental performance management by IVL
The Indisputable key Partners (29)

RTD Organisations (11)
- Information Technology
  VTT(WP4), SP(WP1, WP8)
- Mechatronics
  TallUnit (WP5), KTH
- Material science
  TampUnit
- Wood Technology
  FCBA (WP9), NTI, LappUnit
- Forestry science
  NFLI, Skogforsk
- Environmental science
  IVL(WP3)

Industrial Developers (9)
- RFID-transponders
  Confidex, Idesco
- Forest machines
  Rottne
- Wood industry equipment
  CIRIS, Hekotek, MAUCHAMP
- Mobile communication
  Oskando
- Business management
  TietoEnator (WP6, WP7), Skog-Data (WP2)

Industrial Users (8)
- Forestry logistics
  Sveaskog (SE), Scanpole (NO)
- Primary wood production
  Ducerf(FR), Raunion(FI), ESAS(NO), SETRA(SE), Rolpin(FR)
- Secondary wood production
  Norsjöfönster (SE)
Pain

- Equivalent of €5 billion of wood raw material is going to waste in Europe. The major reason is that information regarding the raw material is not available throughout the system.
- The forestry wood supply chain consists of many production steps. Accurate data is collected during every production step but most of it is lost later in the supply chain.
Solution

- Tracing the complete supply chain
- Harvester automatically applies RFID tags on to logs
- Sensor and process data is associated with log identification
- Accurate real-time data is used to improve yield, logistics, and to reduce waste and environmental impacts
- Software modules integrate the different steps of the supply chain and enables the analysis and usage of the traceability data
Benefits of Tracing

• Improved utilization of forest and energy resources → reduced waste and emissions (25 million m3 - €5 billion waste annually)
  • Improved sawmill production efficiency
  • Reduced loss of timber, higher value

• Improved management of the whole wood supply chain (logistics of stakeholders, transportation)
  • Secured origin of wood to reduce illegal logging and log theft
  • Environmentally certified timber
  • Control of overly long storage periods to reduce the quality loss
  • The origin of wood (on a board level) can be traced

• Make active use of the variability of wood material instead of only accommodating to it
Tag development

• **Challenges**
  - Harsh all-weather, four-season environment
  - Durable and robust tag for surviving in the logs
  - Efficient and straight-forward marking & identification of logs
  - Compatibility with the pulping process

• **Solutions**
  - Water-resistant transponder material
    • Pulping compatible tag material
  - Transponder optimised for automatic application to logs
    • Rapid ~1 s application → minimal loss in the harvester efficiency
    • Long read range at UHF for straightforward and efficient identification of logs
Tag Inside a Log – Effects of Moisture

- Near field effects
  - Detuning (Impedance mismatch)
  - Losses (Antenna radiation efficiency)
  - Tag design important

- Far field effects
  - Attenuation (40-50 dB/m)
  - Reflections
  - Changed radiation pattern
  - Operating mode important
Reader development

- **Challenges**
  - Harsh all-weather four-season outdoor environment
    - Temperatures down to -40C, rain, snow, mud etc.
  - Operation in the harvester head
    - Vibration and shocks
    - Impacts and spatter
  - Difficult environment for RFID tag reading
    - Large metallic bodies cause reflections

- **Solutions**
  - Water-proof impact resistant electronics casings
  - Robust mechanical design and shock isolation
  - Adaptive RF-front end (patent pending)
Applicator development

- **Challenges**
  - Rapid operation of the harvester
  - All-weather, four season outdoor environment
  - Reliable, non-interrupted operation

- **Solutions**
  - Fast application of tags ~1 s
  - Robust mechanics
  - Tags suitable for fast application
  - Sufficient number of tags in a magazine with reasonable size and weight
IK Architecture

Publish-Subscribe Event Bus

IVL

TE

EPCIS

EPCIS

EPCIS

EPCIS

EPCIS

EPCIS

EPCIS

EPCIS

TietoEnator TE

RFID JOURNAL LIVE! Europe
Co-located EPC Europe Conference
IK Architecture

- Service Oriented Architecture
- papiNET, Stanford: messaging
- GS1: RFID, barcode
- Reference to the parent ID
- Assoc. physical ID code
Components of IK Architecture

• **IK Adapters ©**: Microsoft WCF is used to connect LOB applications to the Traceability Services ©. net.tcp is used as the primary transport for transferring process level data.

• **IK Collaborative Messaging System**: Microsoft Biztalk 2006 R2 is used. WCF Adapters are implemented with WS-RM, WS-Security and WS-Trust.

• **IK Traceability Services ©**: Microsoft Performance Point Server 2007 is used for reporting and KPI calculations. Microsoft Sharepoint Server 2007 Microsoft Infopath 2007 are used for creating the supply chain model.

• **Object Traceability Services ©**: To find web services related to the physical objects and their parents, WS-Discovery is applied on top of WCF
Messaging System

- Publish-subscribe is an asynchronous messaging pattern where publishers of events are not sending the events to predefined subscribers.

- Event providers publish events of an topic and subscribers can define content based subscriptions to one or more topics.
Traceability Services

- The purpose of the Traceability Services is to facilitate the analysis of the traceability data and provide services to use this information. It acts as a data warehouse for the entire supply chain.
  - Connects the steps of supply chain together.
  - Provides a common data model for the whole supply chain.
  - Enables statistical and logical analysis of large sets of transaction data which can be used in Enterprise Resource Planning.
  - Provides interfaces to the Object Traceability Service
  - Acts as a Data Repository
Assessment of SC Performance

• Develop models and metrics to realise the new possibilities offered by the collected data
• Work is mostly model-based:
  • Wood properties
  • Influence of storage and processing
  • Economical and environmental performance from a life cycle perspective
  • Integrate product quality, Supply chain profitability and environmental impact for holistic management
Key Performance Indicators

- KPIs are used to account for environmental and economic aspects in the wood supply chain. KPIs are quantifiable measurements that can be evaluated and tracked, with respect to the assigned objectives.

- KPIs reported from different producers and the included process steps that either can be summed up to an integrated performance (green figures) or utilised to compare the performance between different producers or production sites (grey figures).
Environmental KPIs

- Climate change
- Acidification
- Eutrophication
- Stratospheric ozone depletion
- ...
Environmental Certification

- When information is visible throughout the supply chain, the origin of products can be automatically authenticated.

- Environmental Product Declaration
  - An EPD is the environmental footprint of a product. It can cover cradle to gate systems or cradle to grave systems.
  - The goal is to provide information for a fair comparison between products by taking into account all environmental impacts including upstream impact (electricity production, raw material production)
  - An EPD is "quantified environmental data for a product with pre-set categories of parameters based on the ISO 14040 series of standards, but not excluding additional environmental information", ISO 14025
EPD

Global Warming Potential
kg of CO2 equivalent

Product A
Product B
Product C
Supply Chain Performance
Supply Chain Performance
Supply Chain Performance
Supply Chain Performance
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Contact Info

- TietoEnator
  - Ville Puntanen, ville.puntanen@tietoenator.com
- VTT
  - Kaj Nummila, kaj.nummila@vtt.fi
- IVL
  - Åsa Nilsson, asa.nilsson@ivl.se
Agenda

- TNT
- AutoID
- TNT’s autoID initiatives
- Comparison
- Moving forward within TNT
- Conclusion
- Q&A
Thank You