FREIGHT TRANSPORT VISIBILITY PROVIDED BY RFID

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ABSTRACT

Automated identification is a basic element for implementing efficient positioning, identification and status & authenticity systems in the supply chains. RFID allows to identify objects automatically without visual contact at several meters reading range. By improving the visibility in the supply chain, the different actors involved can improve the efficiency of their processes and lower operational costs. RFID is an enabling actor for visibility, but requires the involvement of all participants in the supply chain. This paper will discuss how visibility throughout the supply chain can be achieved: how to agree on common processes and the information exchanged. Practical examples are given.

KEYWORDS
RFID, supply chain, automatic identification

INTRODUCTION

Automated identification is a basic element for implementing efficient positioning, identification and status & authenticity systems in the supply chains. The most important identification techniques for goods are barcode and RFID (Radio Frequency Identification). Barcode is currently the most widely used method, but RFID is better suitable for automated identification since it allows to handle larger reading distances, has the possibility to identify multiple items in a single reading, and can identify the target in motion. RFID has also the possibility to change the information stored on the parcel or handling unit, does not require visual contact and is less susceptible to environmental conditions than other identification technologies. There is a wide range of RFID techniques: from small inductive tags for animal identification with a few centimetres reading range to active microwave or UHF active transponders with 100 meter reading range. Lack of widely industrially accepted standards and business models has delayed wide deployment of RFID techniques in supply chains between different actors.

The target for the identification in a supply chain can be the product, transport unit or item, freight container or vehicle. Different tracking levels (vehicle, container, pallet, package) can be linked hierarchically to each other so that by reading the "highest level" all other items should identified.

The paper starts with an analysis of why visibility in the supply chain is important, and how RFID can assist in achieving this aim. A short overview of current applications of RFID in supply chains will be given. The paper ends with recommendations on how to achieve RFID enabled visibility in supply chains. Visibility is defined here as the ability to access or view pertinent data or information as it relates to logistics and the supply chain, regardless of the point in the chain where the data exists [1].

Why is supply chain visibility needed? RFID enables the controlled collecting of real-time information about the location of identified shipments, goods items, parcels and transport vehicles. When the collected information is combined with planning information, the actors are able to make decisions about the transport, usually in cases where there are exceptions to plans. ID information also opens access to content information. Is it profitable for companies to improve visibility with automated RFID identification? By collecting, processing and distributing information efficiently organizations should be able to improve the efficiency of their goods transport logistics processes, lower their operational costs and improve their portfolio of logistics services. [6]

RFID is an enabling technology for supply chain visibility. RFID should be integrated in the supply chain processes and phases. The most important question is how to obtain Return On Investment (ROI) in RFID implementation. The benefits do not come only from the automated identification. RFID is an enabler for other features such as real time information of goods flows and inventories. This helps companies to improve their supply chain processes.

Another issue in achieving supply chain visibility is related to the strategic importance of information. A major dilemma for companies is to decide to share information or not to share [5].

DRIVERS

Such logistics drivers as globalization, concentration on core business and outsoursing of secondary activities create demand for supply chain visibility. Fawcett & Magnan [4] found in 2002 that only few companies are actually engaged in extensive supply chain integration. The following advantages should be found:

- Efficiency of processes should be improved. This demands for new operating processes, opening bottlenecks, efficiency goals (must be set higher than simply upgrade the technology), agreed information content and the sharing of technological compatibility between the different actors in the supply chain.
- Cost-effectiveness and profit; how will RFID technology bring cost-effectiveness and also a new kind of value to customers? Supply chain visibility should increase the predictability and reliability of supplies. Manual work should be reduced. RFID's deployment should allow more accurate and faster information.
- How does RFID technology bring benefits to the entire supply chain or network? Visibility which means information sharing can also theoretically be justified. Lee et al. [8] claim that demand distortion may arise as a result of optimising behaviours by players in the supply chain. The combination of sell through data, exchange of inventory status information, order coordination and simplified pricing schemes can help mitigate the bullwhip effect [8].

DATA

Most RFID implementations up to day are closed company cases and they are not covering complete supply chain. In this paper we give examples from RFID in supply chains, where different actors are involved:

- Vehicle and unit cases railway wagon (Searail) and container (DoD, SMART-CM)

- Pallet identification cases industrial plant (ABB), bakery (Moilanen) and retail (Metro)

RESULTS ON VEHICLES AND TRANSPORT UNITS

In the TRACKIDEF project eight different active RFID systems were tested in laboratory conditions, with a container as item to be identified. In the pilot, two active RFID systems were tested and evaluated in harbour conditions. The item to be identified in the pilot was a railway wagon. The interfaces to the transport planning systems, control systems and client service systems (data content, form, transfer technique) were defined at a general level. Both piloted systems functioned well. One of the main findings was that a system integrator is needed in order to make the identification data available to the transport planning and management. The customers' needs for the automatic identification of transport units were studied by interviewing about 10 companies of the logistics pipeline. The benefits from implementing the technology are gained from the viewpoint of the whole supply chain. When the handling of units and goods is automated, automatic identification is also needed. Before further shifting to automatic identification the information exchange between the different parties in the supply chain must be more fluent. Furthermore, it has to be understood how exact the information, which is really needed, has to be [10].

The US Department of Defense (DoD) had great difficulties in container supply chain management during the first Gulf War called Desert Storm. The deployment of supplies during Desert Storm highlighted the consequences of not having complete visibility of the supply chain and what was in the pipeline. More than 25 000 of 40 000 containers shipped to Saudi Arabia were opened to determine the contents. The DoD requires to provide in the box, nodal, and on demand visibility of materiel moving through the DoD supply chain from point of origin to destination. To meet these requirements, the DoD mandates that all container, air pallets, and large airframe and vehicle component containers be equipped with active RFID tags by the shipper. To facilitate this mandate, the DoD installs Savi products to create, read, update, and delete data from the active RFID tags, at all points of origin that ship containers, air pallets, and component containers. At the points of origin, the shipper writes the format to the active RFID tag and sends the write record to the ITV network of servers. The DoD installed the readers to collect the RFID tag identification (ID) number as the shipment departs the point of origin location. The DoD has also installed active tag RFID readers at all aerial and sea ports used to move DoD cargo to ultimate consignees. As these tagged shipments arrive and depart these nodes, the tag ID is automatically collected and sent to the appropriate ITV server. When the shipment arrives at the consignee, the tag ID is again automatically collected and recorded in the ITV server. The DoD logisticians use the collected tag ID date to manage, monitor, and redistribute DoD assets to fulfill the warfighter's requirements. The DoD RFID Network is implemented at over 800 locations in 45 countries with over 1 300 worldwide locations including rapidly developed contingency sites [12].

The German retailing Group METRO has also piloted with Savi the real-time RFID-based tracking of containers originating in Asia and bound for METRO's European distribution centers. The containers were tracked across a global RFID reader network stretching from Asia to Europe. The tracking path begins at a consolidation center in Hong Kong, passing through the Port of Hong Kong, arriving in Europe at the Port of Rotterdam in the

Netherlands, and finally arriving at the inland Port of Duisburg in Germany. From there the tagged goods are delivered to METRO's distribution center in Unna. The reasoning of METRO was associated with RFID-enabled supply chain visibility, including improved management, locationing, and security of goods as they are shipped, as well as reduced lead times and inventory. The other significant topic is to expand visibility "up" the supply chain [9].

Different electronic seal designs have been developed over the last decade and include devices that communicate by using Radio Frequency Identification (RFID), infrared, direct contact, long-range cellular, or satellite transmissions. The RFID E-seal is the most common type in use today because of its reliability and ease of integration with current infrastructure. RFID E-seals are typically either active or passive. E-Seals can accurately and automatically report on container status at choke points, and the records can be accessed online to verify seal location, status (tampered or un-tampered), date, and time. However, a number of institutional barriers are likely to delay or even forestall the adoption of E-seals [2].

The SMART Supply Chain management project (SMART-CM) is an urgent respond of key players along the logistic supply chain to make trade and transport more efficient, secure, visible and competitive not only in the EU but across the world in a global intermodal context, while respecting existing initiatives and pilot projects in the context of AEO and Green Lanes implementation. Two real-life demonstrators will validate all innovative organizational processes and technologies, using existing on board container technologies and dedicated management platforms in a door-to-door chain between Europe -Middle East and and Europe-Asia/Pacific. The project will test novel on board container technology which include both satellite and RFID technology on board. Main purpose of the RFID integration is to facilitate the operations of the handling companies. Trough the RFID handling companies can be provided with necessary data (Container nr, Weight, Type of container) when a container enters the platform. This will enhance the handling companies operations. The Container Security Devices (CSD) with satellite network are used to communicate the status information, the RFID integration has the purpose to feed data to parties who are demanding for other information than the security related data [13].

RESULTS ON PALLETS AND GENERAL CARGO

ABB Oy's drives factory in Helsinki implemented RFID solution in its order-supply chain, starting with a pilot project with selected suppliers. When moved to the shipment bay, empty standard material containers trigger an automatic materials order, which shows up on the supplier's extranet. Correspondingly, the supplier executing the order inputs an electronic shipping document into the RFID tag of full pallets. At ABB's end the goods are automatically entered and registered in the Enterprise Resource Planning system, ERP, via a drive-through RFID portal, thus removing the need for paper shipping documents. The system increases productivity and efficiency at the very heart of industrial materials management. It increases the transparency of the supply chain by reducing the time it takes to initiate orders, receive goods and rectify errors. Additionally, the system will make it possible to access precise statistical data on goods traffic. This results in a more streamlined flow of materials and will free up capital from current assets throughout the supply chain. ABB's drives factory has approximately 150 suppliers, several tens of whom work with standard material containers [14].

The pilot at Moilanen bakery consisted of automatic identification of frozen bakery products pallet loads. Gate and hand-held readers were used. Portal readers were installed in cold storage to the entry and departure doorways. The aim was to test the functionality of technology in automated identification of pallets. Cold storage conditions did not affect the operation of tags, in spite of accumulated frost and ice. Each identification of pallets saved about 2.5 minutes working time. Pilot project used middleware solution allowing the accession to company's ERP system [7].

Metro has implemented the EPC Gen2 standard system in pallet identification in 2006, and has reported on good results, for example 99% reading reliability for liquid products. The EPC Gen 2 performed well with long distances both on pallet and box level. Metro started its RFID use in 2004, and after the first year it was estimated that the efficiency of processes had increased to 12-17%, losses declined 18%, the availability of stocks rose 11% and work in storage fell by 14%. Metro estimates that the use of RFID and EDI provides 8.5 million euros savings annually in Metro Cash & Carry, Real shops and distribution centres in Germany. The review consisted only 2 of the 11 process steps [15].

An example of general cargo visibility technology is a paper reel RFID. Paper industry has developed a globally operable, reliable RFID tag for paper industry applications. Tag bases on omnidirectional C-tag tag antenna, located on the core, that can be read through paper and board with standardized RFID equipment. When reels are identified with a clamp truck-integrated RFID reader unit, the reel is clamped from arbitrary direction, and despite of that fact the reel has to be identified reliably. In addition, reading from any direction is a requirement also when the reels are identified at any other location in the paper reel supply chain, for example on a conveyor belt. In practice omnidirectional reading means that there is no need to turn the reel for desired identification orientation. There are two options for using RFID tags and determining the memory content of the tag: either to choose the EPCglobal approach, which is mainly driven by the retail industry, or use the ISO approach. The basis of the paper reel identification system is the reel ID. At the moment, European mills are using CEPI code, news publishing industry IFRA code and US market NARI code. These codes have similarities but also differences.

DISCUSSION

Different parties in the supply chain may have very different interests in identification. Here we have monitored the consignor/consignee point of view which is the management and control of the shipment along the supply chain. Logistics service providers have different aims, e.g. optimisation of vehicle fleet.

Both transport unit and pallet cases shows clearly that RFID tehnology is a solution for supply chain visibility. Our three own cases (Trackidef, ABB, Moilanen) confirm the good results. Metro and DoD cases base on public material from these organisations and certain degree of criticalness must be in the interpretation of the results.

The main global focus during the previous years in logistics has been the application to retail sector. Other sectors are interested in the possible benefits from RFID, such as metal and building industry.

DATA CONTENT

In the retail sector, the EPC set of standards has received wide acceptance. The EPC approach is to store only a single unique identifier in the tag and to keep all other related data in databases. This approach cannot always be applied to other industry sectors, such as paper industry or metal processing sector. Also, the codes are not completely free. ISO has defined an alternative approach, based on Unique Item Identifiers. The first step is however that the industry sector should agree on a common numbering method, which all the actors in the supply chain can use.

NEW WORK PROCESSES

Most enterprises desire to implement RFID without making many changes to existing processes.. Changes in processes are often justified through improvement of operation efficiency, improved cooperation with the partner network, added value for the customer, improvement of the position on the market or with cost savings. In order to achieve real-time visibility and automation, process development is often needed, both in-factory and in the interaction between actors in the supply chain.

The current processes should be analysed, so that the effect of the introduction of RFID technology can be evaluated. The problems and bottlenecks in current processes must be identified, in order to assess to which processes RFID can bring a solution. Sufficient know-how on RFID is a precondition: the possibilities and the limitations of the technology must be taken into account to find a suitable solution.

The efficiency of processes can be improved by streamlining processes. The implementation of RFID requires all items or handling units to be uniquely numbered. Due to the current price of readers, processes should be designed so, that the number of reading points is minimal. Through tagging of items at the starting point of the supply chain and automatic reading at critical points, manual work can be decreased and process efficiency improved. At this moment automation is feasible for the pallet/parcel level and for returnable transport items. Automation allows reducing manual work at different processes, such as receipt and shipment of goods.

NEED FOR IT ARCHITECTURE AND MIDDLEWARE

Solution for IT-architecture is needed when implementing RFID. There are several reference architectures like MOSES, FREIGHTWISE, RoSETTANET and TARKKI which can be applied.

The identification system should provide ERP systems with information on processes, such as receipt and shipment of goods. ERPs are very powerful tools, but tailoring the ERP towards the specific needs of tracking and tracing can be very difficult. Problematic are exception cases (e.g. only parts of the goods are delivered) and internal transfers (e.g. between receipt of goods and the storage place). Middleware software, which processes the information from the RFID readers and passes the results to the ERP system, offers the flexibility demanded by the companies.

COSTS AND BENEFITS

Distribution of costs and benefits in a network has a big impact on RFID investment decisions. The first investor has to get the other parties of the supply chain also to invest in the technology in order to share in the benefits. The parties have to have a good co-operation. In the specifications phase the needs of the different supply chain partners should be taken into account. By showing the benefits from RFID technology to other parties the resistance will be smaller and the implementation phase goes faster. Different retail chains, like Metro, have for this purpose opened RFID centres, in which providers of goods can get acquainted to the benefits of RFID systems.

There are simple tools in Internet for the cost-benefit analysis, which calculate e.g. the pay back time for the investment. As all RFID cases are different, the calculation models can not be detailed. These tools may also be used as a checklist: the user enters the amount of equipment needed, and is requested to enter the different benefits, such as time reduction, stock reduction, decrease of errors. One example can be found at the website of RFID Lab Finland [11].

Experiences from different pilots and implementations give good basis for start-up: Start the planning early, understand the scale, choose the right partners, do not perform IT integration if you are not the expert, make pilots and test different types of exception situations. Take the risks into account.

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