EFFICIENCY OF APPLICATION OF RFID IN SUPPLY CHAIN MANAGEMENT

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ABSTRACT: Development of contemporary logistics has seen tendencies to attach great importance to processes of flow of information in supply chain. It is necessary to look for new ways of efficient management of this flow, which is possible through development of new technologies, including RFID (Radio Frequency Identification).

Keywords: RFID, supply chain

JEL Codes:L1, L2

Supply chain management as a concept of business management

Nowadays, companies' operation show tendencies to integrate within supply chains. Market partners, i.e. suppliers, recipients, service providers focus their operation on such an organization of flow of goods and information so as to be able to compete in the market not as individual entities but as whole supply chain. It can be perceived that on the one hand the cooperating units need to maintain their identity and decision-making, on the other hand the coordination of partners' activity often means giving up many individual characteristics of the company.

Literature presents numerous definitions of supply chain. All of them seem to highlight several elements which decide on its specificity[1]. Supply chain can be defined as[2]:

- Integrating philosophy of management of the whole flow of goods from supplier to end customer (definition according to M.C. Cooper and L.M. Ellram).
- Strategic concept of management sequence of events – from supplier to customer – which adds value to the products flowing through the supply chain (definition according to A.J. Battaglia and G.Tyndall).
- Integrated management of flow of various elements of flow, processing and customer service – necessary to manufacture a product or to provide a service in an efficient and effective way (definition according to A.J. Stenger and J.J. Coyle)
- For investigations of logistics chains management a term of 'overorganizational management' is also present; it is understood as managing the group of cooperating companies as a 'superorganization'. Superorganization, according to R.K. Ballou, means a group of companies of vertical dependence which, however, are legally separated and which are interested in mutual decisions made by both such companies individually[3].

This means especially specific approach to the group of cooperating companies, which suppresses many of the barriers existing between them so far in order to manage and/or coordinate flow of goods, starting from raw materials to finished goods, acquired by consumers and other

[1] *Zintegrowany łańcuch dostaw. Doświadczenia światowe i polskie*. Pod red. K. Rutkowskiego, SGH, Warszawa 2000, s.12.
[2] Coyle J.J., Bardi E.J., Langley C.J.: *Zarządzanie logistyczne*, PWE, Warszawa 2002, s. 28.
[3] Kisperska-Moroń D.: *Zarządzanie konfliktem w łańcuchach logistycznych*. W: Logistics '98. Zarządzanie łańcuchem dostaw. Materiały konferencyjne. T.I. Katowice 21-22 maja 1998.

users[4]. Purpose of this cooperation is to achieve high efficiency of operation in individual companies an their networks as a whole due to the integration and coordination as well as optimization of the value added through all the links in the chain to the product expected by the customer. Successful management of supply chain depends on integration and coordination of three types of flow[5]:

- information
- goods
- cash

Each element is necessary for proper organization of flow processes so as to meet the most significant condition of efficiency of supply chain management or general logistics management.

Role RFID in supply chain management

The flow of each of the mentioned elements is optimized within logistics chain so that each link in the chain derives benefits from common management. It is necessary to look for new ways of efficient management of this flow, which is possible through development of new technologies, including RFID (Radio Frequency Identification). This system of identification of goods is based on technology enabling data transfer between a tag (electronic 'label', chip, transponder) and an RFID reader by means of radio waves. It operates similarly to technology of barcodes, however, giving more opportunities. It enables extended automation of work connected with reading the data and it is comfortable and easy to use. The features which distinguish this technologies from other previously used technologies of remote identification include[1]:

- relatively high resistance to external conditions, such as: dust, changes in temperature, rain/snowfalls, vibrations, shocks, solar radiation,
- lack of necessity of direct contact between a tag and a reader, which enables locating these components in an invisible places,
- opportunity to read information from more than one source at the same time while protecting it to be copied or lost,
- ensured low level of data transmission errors,
- increased amount of information on products; these data are of a dynamic type as the company can make changes within computer system,
- product information safety, standard barcodes contain information which might be read by anybody. RFID standard enables data storage within the system to which access may be possible for a particular group of authorized users.

Development of RFID technology is progressing at a fast pace; thus, it is worth to highlight features which distinguish the transponders between each other. One of the most modern solutions are long-range passive tags without internal power source and the active ones – with their own power source. Market demand is covered by both active battery-powered tags with read range of 30m, USD 10-150 per unit, as well as passive short-range units (0,3-0,6) m at the price of 1 USD per piece. Decisive factors which determine quality of their operation include the following parameters:

- tag sensitivity; the parameter which determines possibility to power an integrated circuit and the power of the signal emitted towards the reader, which equals the range of the unit,

[4] Hricová R., Warehousing System – Key Element of Company Processes. In: *Zborník referátov zo 2nd Conference with international participation Management of Manufacturing Systems focused on Manufacturing Logistics and Supply Chain Management*. FVT TU Košice so sídlom v Prešove, Prešov, 2006

[5] *Zintegrowany łańcuch dostaw. Doświadczenia światowe i polskie*. Op. cit., s.12.

- tag size; the bigger size, the longer range,
- tag shape; shape of the antenna affects range scale,
- number of antennas connected to the integrated circuit. Two dipole antennas connected to one integrated circuit ensure lower sensitivity to direction of operation. This is of big importance when reading occurs from various directions,
- speed connected with efficiency of the reader reading tag identifier. Higher speeds enable more precise readings and they reduce load,
- density of tags; tags located in close distance might be a source of noise to each other,
- carrier material; using materials containing water and metals might cause disturbances in reading. This can be minimized through application of separators between a tag and the marked product, e.g. cardboard, plastic etc.

Considering the abovementioned factors it is possible to apply efficient elements of RFID system. RFID solutions can be used both by the manufacturers as well as distributors or retailers. The pioneers of using this technology include such large-scale retail chains as Wal-Mart, Best Buy and Target in USA, Metro, Tesco in Europe. Wal-Mart, an American hypermarket network obliged one hundred of their biggest suppliers to get involved in this technology as soon as several years ago. Nowadays other supplier implement RFID systems for the products which get into Wal-Mart network. RFID systems operate also in US Army, e.g. they were used to supervise logistics operations during war on Iraq. In everyday's life similar solutions are used .e.g for the system of satellite navigation which enables searching for optimal route from A to B, viewing a location in the world using bird's eye view at Google Earth. In reverse logistics chains, thanks to RFID, each product is possible to be identified. Warehouse halls might be scanned in order to localize the products which are outdated, which should be get rid of, or withdrawn from sale and returned to the manufacturer or send to the agent. However, in case of returning product by the customer, a history of delivery might be tracked, e.g. where, when and how the product was bought and a deception might be found and eliminated which reduces the costs of service [4]. Thus, when defective products are returned on the basis of a guarantee, the history of their flow is presented in the form of a comparison. Both agent and the manufactures obtain immediate information on percentage of returns and they can diagnose reasons for defectiveness of goods as well as prepare the plan of action e.g. make a decision on withdrawing a batch of products. Cost reduction becomes then possible through reduction in inventory level and through ensuring cyclical deliveries[6]; the lead times can be determined more precisely through reduction in costs of transport. Better communication within the chain gives opportunities to obtain more updated and more precise analyses of demand and to adapt an appropriate inventory policies and production planning to them. Higher efficiency is obtained for relationships with supplier through improved delivery schedules, improved time of response to sudden changes in demand and supply. Businesses can also improve their asset management e.g. through minimizing the costs of downtime and maintenance for the machines and devices[1]. RFID technology opens large opportunities of innovation within large organizations with complex logistics processes. Profitability of use of this technology is particularly enhanced when a company:

- owns a wide range of products,
- owns plants with large floor area and scattered locations,
- encompasses various locations of storage,
- is a place of frequent warehouse goods exchange activities – increased circulation of materials, products, packages,

[6] Štefko R., *Akademické marketingové inštrumentárium v marketingu vysokej školy*, Bratislava, R.S. Royal Service 2003

- has additional requirements and needs for information resulting from a branch specificity e.g. 'best before' dates, identification of a batch of raw materials etc.

Proper planning and coordination of activities in the abovementioned areas help minimize loss both for the customers, who have not been ensured an appropriate level of services as well as for a business who wastes their resources delivering defective products. This is particularly visible in case of returns of goods returned to the manufacturer in order to be repaired or due to the mistakes in shipment. Application of solutions of radio identification enables minimizing possibility of failure during providing of services. This technology enables monitoring of products on the level of pallets and containers, which are transferred through RFID gates at the places of goods reception or dispatch and also in internal control points, which enables registration and supervision of any movements for the controlled assortment. Complex information results in facilitation of flow of products; they are delivered in right time to right place. The cases of losing or stealing of goods are also limited, the missing goods are reduced, customers are more loyal and, eventually, the incomes and profitability are enhanced. It is also worth to highlight the contribution of identification to the flow of such elements as[7]:

- *transport returnable packaging,* such as pallets, crates, containers. They are essential from the point of view of logistics processes (sometimes it happens that they are not returned in an original state) and can be reused for further transportation of other goods from the destination place,
- *retail returnable packaging,* such as e.g. bottles or cans. This products usually need to be washed and to be made usable and can be reused for many times,
- *recycling materials,* such as toners for copiers, cartridges for printers, television screens, paper and other materials. They include products which have lost their functionality. Their recovery is usually imposed on businesses through legal acts on environment protection. During recycling, the most frequently recovered materials include metals and the parts which can be reused. The recovered components are reused by the companies which amassed them or are used for industrial purposes in other branches,
- *returns,* concerning e.g. items not within specification, items delivered too late etc. The persons who order products through Internet often return products due to the fact that the goods on the computer screen might look different to the reality, which makes them unsatisfied. Sometimes the goods of high-tech application, such as computer screens might be damaged during transport, which causes that they are not fully usable and must be returned to the manufacturer,
- *spare parts,* recycled materials, rejected goods, not used materials and others.
- RFID solutions might be used by all participants of supply chain: manufacturers, distributors, retailers; increase in efficiency of cooperation within the whole supply chain becomes possible. Achievements of radio identification can be employed by the businesses with complex logistics processes who have wide variety of products and who own plants with large floor area and scattered locations.

While emphasizing numerous advantages of RFID technology, one should not forget about its imperfections. In case of old-generation tags, such limitation means costs, frequently too high in comparison to financial capacity of a particular business. Technical requirements imposed on EU member states by ETSI (European Telecommunication Standard Institute) are also remarkable: they differ from the standards accepted in USA and other countries worldwide, which limits opportunities to use solutions outside EU.

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[7] Grabara J., Kot S., *RFID- nowe możliwości usprawnienia przepływu dóbr*, [w:] Informacja i komunikacja w logistyce, Katowice 2005

To sum up the presented considerations, it is remarkable that RFID technology faces brilliant future. Considering the activities performed by the businesses who implement and use this technology, one can argue that it enables creation of a real global supply chain, although achieved not until the far future. The activities of supply chain management require new system solutions in terms of identification of goods withdrawn from use and forwarded to recycling or prepared to other use. Through employing RFID technology it becomes possible to collect the amount of information which enables precise tracking of reverse flow, which is very useful for building of proper reverse supply chains. EPCglobal is an organization who works towards formation of a global supply chain in the future. Their efforts focus on unification of technological standards through supporting RFID development in two directions. On the one hand their efforts are made towards unification of data so that they are readable everywhere worldwide, on the other the global standards of communication between tags and readers i.e. RFID protocols are suggested.

The electronic product code, which uniquely identifies objects and facilitates tracking throughout the product life cycle, was created to take advantage of widespread broadband capability, faster computing power, and cheaper data storage. The EPC was designed by the team at the MIT Auto-ID Center to be a simple and extensible code for efficient referencing to networked information: a worldwide license plate for every object ever made — an Internet of things was the vision. This went well beyond what the UPC could ever dream of doing with its limited data scheme and ability to be programmed with information only one time.

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