SVETLANA NIKOLIČIĆ, Ph.D.
E-mail: cecan@uns.ac.rs
University of Novi Sad, Faculty of Technical Sciences
Trg Dositeja Obradovića 6, 21000 Novi Sad, Serbia
MILORAD KILIBARDA, Ph.D.
E-mail: m.kilibarda@sf.bg.ac.rs
University of Belgrade,
Faculty of Transport and Traffic Engineering
Vojvode Stepe 305, 11000 Belgrade, Serbia
PREDRAG ATANASKOVIĆ, Ph.D.
E-mail: pedja.atanaskovic@yahoo.com
LJUBICA DUĐAK, Ph.D.
E-mail: ljuba@uns.ac.rs
ANDREA IVANIŠEVIĆ, Ph.D.
E-mail: andreai@uns.ac.rs
University of Novi Sad, Faculty of Technical Sciences
Trg Dositeja Obradovića 6, 21000 Novi Sad, Serbia

Transport Logistics
Preliminary Communication
Submitted: May 4, 2014
Approved: Mar. 24, 2015

IMPACT OF RFID TECHNOLOGY ON LOGISTIC PROCESS EFFICIENCY IN RETAIL SUPPLY CHAINS

ABSTRACT

The challenges that logistics faces in the retail industry must be investigated in the context of the specific retail sector as well as the degree of development of the retail market. The research focus in this paper is on logistic processes in supermarket supply. The aim is to deepen the understanding of logistic processes and then to investigate the possibilities of their enhancement by applying radio frequency identification (RFID) as a higher level of information technology for product identification in retail supply chains. The research was conducted in one of the top ten trade companies in the emerging Serbian market. Simulation modelling was performed for one supply chain category, followed by quantification of time and cost performance of the current logistic processes (AS-IS model). Then, in accordance with the capabilities of RFID system, improvements are proposed and integrated into a new simulation model (TO-BE model). The obtained results can be utilised as part of a broader research when deciding on the implementation of modern information technologies in supply chains.

KEY WORDS

logistic processes; logistic performance; retail supply chain; RFID;

1. INTRODUCTION

There are many factors, both external (decrease in population growth in the developed regions, inflation and demographic changes) and internal (market saturation, limited market growth and competition) that affect the retail sector [1]. In such conditions, as response to market and operational challenges, the retail companies focus on consumer requirements and at the same time try to reduce operating expenses in order to remain competitive.

In the retail sector logistics is considered as a physical realization of the company's business policy. Many retailers have come to realize that their individual ability to compete often relies on the collective performance of their overall supply chain [2]. To succeed in the modern global economy, it is critical to build a logistic network that is information-rich, highly flexible, cost-effective, and defined by both customer needs and internal corporate strategy [3]. The application of modern information technologies (IT) is often the first step in establishing efficient supply chains and a precondition for information exchange between partners. In addition, higher operating efficiency and better synchronization of the logistic processes result in a reduction of total expenses in the supply chain.

The utilisation of radio frequency identification (RFID) as a high-level IT product identification in the retail supply chains has attracted a lot of attention of both researchers and logistics professionals. Publications on the application of RFID in the supply chain, especially the estimated and achieved results of large retail chains have prompted us to investigate the im-

pact of this technology on logistics performance in a smaller, regional retail chains operating in an emerging market. The implementation of new strategies and technologies in logistics of retail supply chains, gives various results in different markets, due to differences in the level of economic development of the region and the logistics market, in logistic culture, in retail sector, in the size of retail chains, their power and in the covered geographical area.

In many developing countries, the supply and distribution networks are not developed to assure a steady flow of uniform quality goods. In addition, due to the poor organization of the supply chain, high inventories of goods are held over extended periods of time [4]. All this adversely affects the logistics performance. The aim of this paper is to research the logistics processes in real retail supply and determine the costs of key logistic processes in the supply chain as well as the effects that the introduction of RFID can achieve at the process level. Modelling of logistic processes and evaluation of logistic performance, both in the existing conditions and the conditions of application of RFID, is done by simulation.

The remainder of this paper is organised as follows: Section 2 indicates the basic characteristics of the retail sector as an environment for the realisation of logistic processes and gives a literature review on the application of RFID technology in the retail supply chain. In Section 3 the key logistic processes and their performance are shown. Section 4 describes the methodological approach and Section 5 presents the results obtained in a real retail supply chain in the developing market. Finally, the concluding remarks are given in Section 6.

2. BACKGROUND AND LITERATURE REVIEW

The key trends in market development, which make the retail business complex and challenging, have started in the 1990s and are still present. These are: pressure of high costs, shorter innovation cycles, increased customers' expectations and globalization. On the other hand, retail system characteristics, such as: trading structure, trading objects, degree of organizational integration of product supply participants, degree of IT development and geographical dispersion of retail stores, have an impact on both the structure of logistic processes and the strategies of logistic management.

The degree of economic development, demographic characteristics, purchasing habits, are just a few of the many factors that influence modelling and development of the retail market. On the basis of the degree of retail market development there are three subcategories of the retail markets: (1) developed markets (Western Europe and North America), (2) developing markets (Asia, Central and South America, Eastern Europe) (3) less developed markets (Africa, some parts of Asia and South America) [5]. This paper studies the logistic processes in Serbia and South Eastern Europe, which is an upper-middle income economy, with a GDP at $6,203 per capita for 2011 [6].

Europe is one of the largest retail markets, economically integrated but with clear regional differences. In the last two decades, changes at individual stores level occurred regarding the manner of customer service, the retail space and the specialization of the assortment. At the company level, the process of retail consolidation took place, followed by vertical integration of retail and wholesale [7].

The global retail market is dominated by global retail chains. The retail chains of the EU countries have expanded their business onto the Eastern Europe and they still integrate local sourcing and distribution in their processes. Such trends have expanded to Serbia in the last decade. The data on the market structure and the retail trade turnover in Serbia (1,473 EUR per capita in 2010) indicate a still underdeveloped market, but with a growth potential. The retail sales income is dominated by small shops with a 53% share, whereas supermarkets and hypermarkets achieved 24% and 6%, respectively [8]. The top ten retail chains in Serbia, hold around 38% of the market share, of which 47.7% are accounted for by international retail chains, 36.6% by regional and 15.7% by the domestic supermarket chains [9].

The retail market changes in the recent decades have caused the changes in logistics. Utilisation of new knowledge within the logistics itself as well as modern technical and technological achievements, particularly in information technology area, have developed new strategies for managing logistics processes in supply chains, such as Vendor Managed Inventory - VMI, Efficient Consumer Response – ECR, Continuous Replenishment - CR and others. Through various forms of partnerships among participants, all these strategies are aiming to meet the requirements of end-users for the specified products in the shortest possible time and with the lowest costs.

In the consumer goods sector, logistics is important for the following reasons: competition both between manufacturers and between retailers is extremely strong; a wide range of merchandise should be provided in the retail space; food products have a large share in the sales line; products are relatively cheap; customers often buy without longer comparisons between the quality and the price. The challenges that the logistics faces in the retail sector are numerous and are focused on the finding the balance between the demands for product availability in the sales area and the lowest possible logistics costs. The solutions are sought in different areas and extensive research on the application of Radio Frequency Identification

(RFID) in the retail supply chain, as a system that complements or replaces barcode systems and traditional manual tracking systems in order to identify, retrieve, track and store merchandise automatically [10] have begun at the turn of the century.

RFID supply chain is an application on the rise, attracting attention of researchers and experts in the U.S., Europe and Asia [11]. The research on the application of RFID in retail supply chains is intensive and oriented to different segments within the defined field: on technical problems related to implementation; methodological procedures of implementation; evaluation and determination of the usefulness of the technology for various participants in the supply chain. In the published papers, identified or estimated benefits of the RFID application in supply chains include: savings in labour time and labour force; increased number of fulfilled orders; higher stock turnover; greater guarantee of product quality; lower average and safety stock; shrinkage and out-of-stock reductions; reduced material handling; reduced staff errors, etc. The main barriers associated with the acceptance and introduction of this technology in the supply chain are: the lack of return on investment (ROI); technical risks; the popularity of bar codes; privacy concerns [12, 13]. The implication of these barriers clearly suggests that RFID and its predecessor, barcode technology, will most likely coexist in terms of usage until cost, platform standards and performance/cost barriers are better understood [14].

For the research presented in this paper, relevant publications are those that address the impact of RFID technology on logistics performance [10, 13, 15, 16, 17] as well as the results of the leading retailers (Metro, Tesco, Wal-Mart) achieved by adopting RFID system. In the implementation of RFID technology in logistics, the effects on the individual processes level and on the network level can be distinguished [18]. The main advantages of RFID in internal processes are improved accuracy, automation and greater efficiency. In RFID supply chain, the EPC data on products and pallets are exchanged throughout the supply chain and are available to all participants which results in an additional benefit of the information available in real time [15]. Data from Metro and Wal-Mart show that through the application of RFID on pallets and large packages, savings of 15% in trade and 5-10% at the manufacturer should be achieved. This assumes an increased business turnover of 0.6 to 1.2% for the manufacturer and 0.7 to 1.3% in trade [19]. The savings in labour costs achieved in Metro, when the RFID tags are on the pallets, range from 8 to 11% [20]. The application of RFID in Wal-Mart stores reduced out of stock by 26% while reducing inventory in the supply chain [21]. However, little is known on the impact of RFID technology on the logistics performance in developing countries; hence the motivation of this study is to at least partially fill the gaps in this area.

3. DISTRIBUTION PROCESSES AND PERFORMANCE IN SUPPLY CHAIN

The structure of logistic processes in retail supply chains is influenced by a plethora of factors that Fernie [22] categorizes in two groups:

- Factors defining the kind of relationship (power of retail merchant, trade brands in the market, degree of control in supply chains);
- Operation factors (form of trade, geographical dispersion of stores, associated logistic costs, degree of IT development and development of distribution industry).

Therefore, when studying logistic processes in the retail supply chain it is necessary to link them with the appropriate characteristics of the retail system. The research presented in this paper is limited to logistical processes realized for the sale of a wide range of consumer goods in supermarkets, more accurately, on the distribution processes. The limitation on this category of retail outlets (according to the size and the assortment) allows generalization to other retail outlets with similar product categories and distribution channels. Logistic processes are presented as a specific array of individual logistic activities and processes, which can be quantified. The established structure of logistic processes represents the basis for the separation of relevant logistic performances. Goals of measuring and controlling the activities and processes in logistics are to monitor the already-planned operational performance, to identify opportunities for improvement of effectiveness and process efficiency and, on the basis of this, devise a suitable management process.

Generally, all participants in the realization of logistic processes in supermarket supply chains can be divided in three groups: producers, distributors, and retail system. Considering the structure of the products sold in supermarkets and the fact that supermarkets mainly belong to trading companies, connecting the participants gives four categories of distribution process (*Figure 1*). Daily consumption products are sold, with around 2/3 of assortment are food and 1/3 are non-food items. Sales area is at least 400m^2. Each of the retail companies applies more than one delivery mode to bridge the gap between supplier and store.

3.1 Logistic processes in distribution

Logistics must be managed as a process or rather a series of individual actions if the goal is to achieve a superior performance for the customer [23]. The process is a specific order of business activities through time and space, with a beginning and an end, and

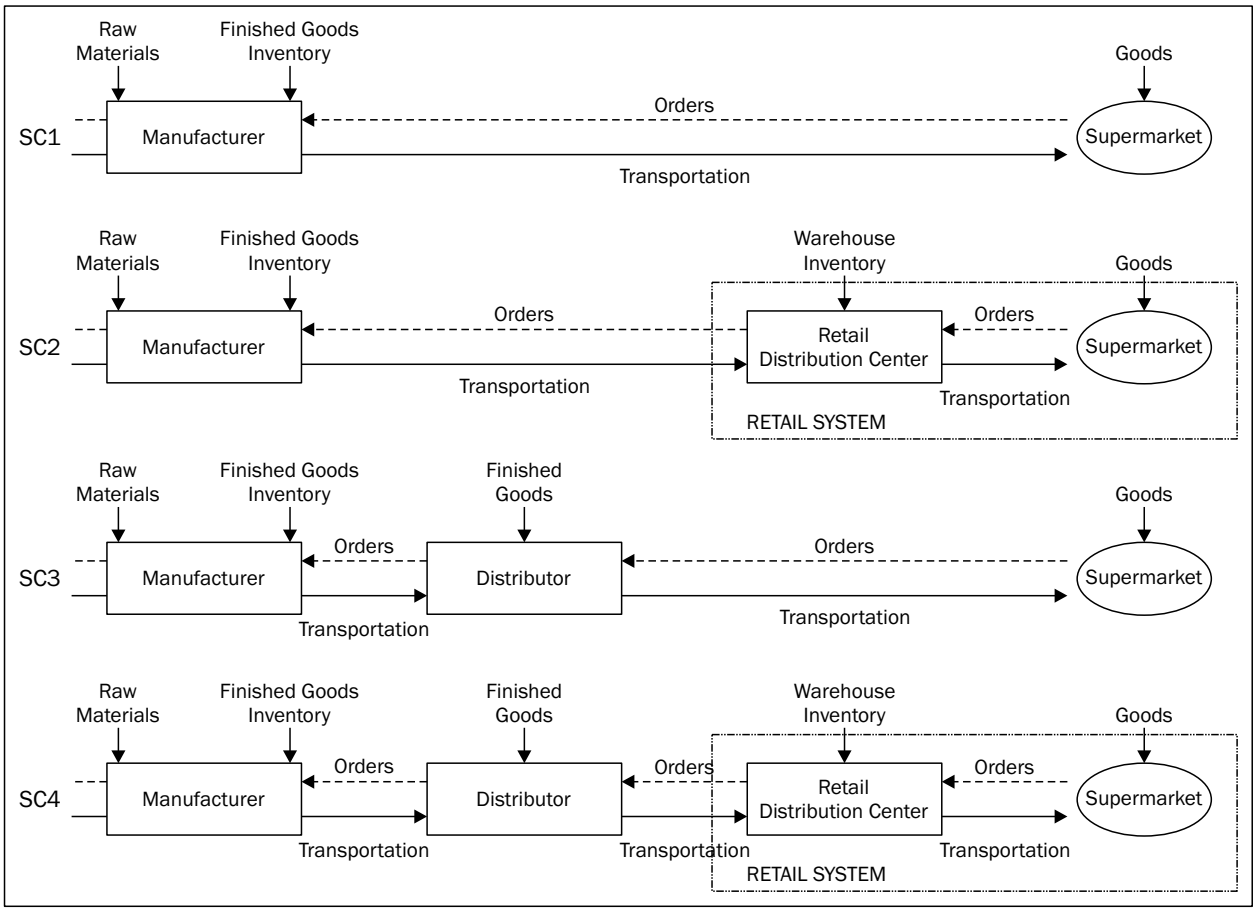

Figure 1 - Distribution process in supply chain of a supermarket

with a clear identification of inputs and outputs. It is a structured and measurable set of activities, aimed to produce a specific output (product, information, money, knowledge, ideas) either for a particular customer or for the market [24]. The process is an array of activities to be undertaken in certain sequences and that are supported using information technology.

The key logistic processes between immediate participants in a supply chain necessary for coordination and completing logistic tasks can be identified as [25]:

- issuing purchase order to a supplier– processing of purchase order by a consumer,
- preparation (commissioning) merchandise for dispatch,
- transport – delivery / dispatch of merchandise,
- reception of the merchandise,
- update of the stock.

Management of physical logistic processes involves the utilisation of modern information technology (IT). The effects of the application of IT in logistic processes in supply chains depend on the degree of integration of both the participants and their information systems so that they can be measured in internal processes in non-integrated scenarios and on the level of the entire supply chain in integrated scenarios.

3.2 Logistic performances

The measurement of logistic performances presents a basis for management of complex logistic processes in retail objects supply and for overview of the possibilities of their improvement. The objective of performance measurement and activity control in logistics is to monitor the logistic performances versus operational plan and to identify the possibilities for improvement of effectiveness and efficiency [26]. For the evaluation and monitoring of logistics processes, the following performance classification is often used [27]:

- Financial performance,
- Productivity performance,
- Qualitative performance,
- Time performance.

Logistic performances of the supply chain are global performances that depend on the performance of individual phases, thus differentiating: supply chain performances, individual participant performances, and individual business process performances [24]. The above classification is very convenient in terms of structuring, measurement and monitoring of logistic processes and in this paper represent the base in the analysis of logistic performance wherein is the focus

on the cost and time performances of logistic processes.

4. DESCRIPTION OF THE MODELLING APPROACH

In this paper, for logistic processes modelling, the utilised simulation approach allows supporting the dynamics of logistic processes, investigating the influence of random variables on processes and determining the logistic performances in different functional scenarios. The model incorporates the logistic processes realized during supermarket supply and was formed using *iGrafx*, a software package for mapping and simulation of a business process. Quantitative parameters were determined for two scenarios of logistic process functioning: for existing processes (AS-IS) as well as processes found in conditions of higher automation level, during identification of logistic objects (TO-BE). The aim is to evaluate the process-level effects of RFID application, on the basis of performances of actual logistic processes [28].

The discrete event supply-chain model consists of elements interconnected by links that describe the process flow. The main structural elements of the model diagram are the activities that take place and allow the process to take place. Each activity can set or determine the following information:

- Inputs: an activity can have one or more inputs that arrive by way of incoming connection lines.
- Resources: a resource is a person, machine, or other asset that can perform the activity. An activity can use several resources or more than one kind of resource simultaneously.
- Task: the task information covers the duration that the activity takes, its associated costs, activity base and schedule.
- Outputs: the outgoing connection lines from an activity attach to other activities for further processing [29].

A simulation model for representing the existing logistic processes (AS-IS) was formed on the basis of data accumulated in the real system for a supply chain: manufacturer - supermarket (SC1) and for one kind of product. Two different questionnaires were elaborated for data gathering: one for the manufacturer, and the other for the supermarket, which were complemented with the data obtained by direct process monitoring. Questionnaires were organized so as to collect general data (such as: product type, packaging type, product value, employees, technical means, working costs, number of shipped/received boxes per day, week days when shipment/receiving takes place, etc.), as well as specific information related to the research processes. The latter group of data included time features of the process (process beginning/ending, process duration, waiting time) and engaged resources, and these data were mostly obtained by direct process monitoring. The questionnaires included data for the period of one year, while monitoring was performed in the period of two months. The model on the existing situation was developed in such a manner as to imitate the real system processes, while the output model results were validated by the managers of the participating companies.

The published results on the application of the RFID technology in the supply chains (Chapter 2) are related to the research on the developed markets where there is a better logistic process organization and where larger amounts of goods are being manipulated. We believed it to be useful to research and quantify the effects for logistic processes related to less organized logistic systems and fewer amounts of goods. The effects obtained due to that depend on the specifics of individual companies (process structure, working costs, activity duration, number of packages), which was performed in this paper for the observed case.

For the modified (TO-BE) processes it is assumed that the informational connectivity of participants in the supply chain is realized through RFID (application of passive RFID tags on the package level is analysed) and an appropriate level of IT. The estimation of RFID technology effects on logistic processes, hence also on logistic performances, is performed on the basis of quantitative analysis of specific logistic processes within the observed supply chain. Besides the data collected from the real system, published results about application of RFID technology in logistic processes were also used in this step. These resulted from laboratory examination [20], implementation of this technology into real processes (Metro; Wal-Mart) or as result of numerous scientific papers [10, 15, 30].

The relevant outputs from the model are:

1. Lead time (activity duration time and waiting time per process), is calculated as:

$$L = \sum_{k=1}^{n} t_k + t_w \,, \tag{1}$$

where:

t_k – process k duration time (h),

k – process ($i = 1, \ldots, n$),

n – number of partial processes,

t_w – waiting time (h).

2. Costs of process realization (C_p) included: transport costs (C_t), manipulation costs (C_H), costs related to processing data (C_I), and costs of other activities that have been identified in the process (C_O). Processing costs are calculated for the average values of the processing quantity. The process costs are calculated as follows:

$$C_p = C_T + C_H + C_I + C_O \tag{2}$$

$$C_T = \frac{q_s}{K_l}\frac{D_t}{V_t}\cdot \xi_l \cdot (K_l), \quad (3)$$

where:

- q_s – quantity of shipment (e.g. package, pallet, ton),
- D_t – distance of transport (km),
- V_t – speed of transport (km/h),
- K_l – load capacity of the transportation means (e.g. pallet, ton),
- $\xi_l \cdot (K_l)$ – unit cost of transport means proper load capacity (EUR/h) [31].

$$C_H = q_s \cdot t_{Hu} \cdot c_{Hh}, \quad (4)$$

- t_{Hu} – handling time per load unit,
- c_{Hh} – handling cost per time unit (EUR/h).

C_l and C_O are calculated as the product of the activity duration time and operating costs per time unit (personnel costs + materials and equipment costs).

5. RESEARCH AND RESEARCH RESULTS

The case study considers a Serbian retail chain that is among the top 10 in the Serbian market. In the last decade, despite both the strong competition of regional and international retail chains and the economic crisis in the country, this retailer has managed to maintain a stable share of the domestic market.

The sales network of the analysed retail chain covers a part of the Serbian market and consists of over 30 stores of different formats (supermarkets, shops and minimarkets) as well as 2 warehouses in which product inventory of certain categories is centralized for their own retail stores and from where wholesale is performed. Sales assortment consists of over 15,000 products. According to its parameters (diversity of retail formats, product range, and local action), the studied retail chain also represents other domestic retail chains and hence can be considered as a good reference for the study of logistic processes in retail supply chain in a developing market. The research is focused on the logistic processes in a supply chain of one type of perishable food products, which includes a manufacturer and a supermarket (SC1). For this product category it is common to perform stockpile checks and re-stock the supermarket shelves daily. The supermarket assortment has around 50 products with the same mode of filling. The supply chain starts when a store makes a purchase order for goods towards the manufacturer, which realises the information flow whereas the flow of products is carried out in the opposite direction. The data necessary for the description and quantification of the existing processes was collected from the manufacturer and the supermarket chain.

The observed product is classified in the food category, short shelf-life products with expiry date up to 30 days. Every morning before 8:00 a.m., the stock in a supermarket is controlled and, if necessary, products are ordered from the manufacturer. The quantity of products ordered is mainly limited by the capacity of refrigerated displays in the store (by which a maximum level of stock is defined). The supermarket orders the packages of merchandise; in the observed case, one package includes 12 units of products and weighs

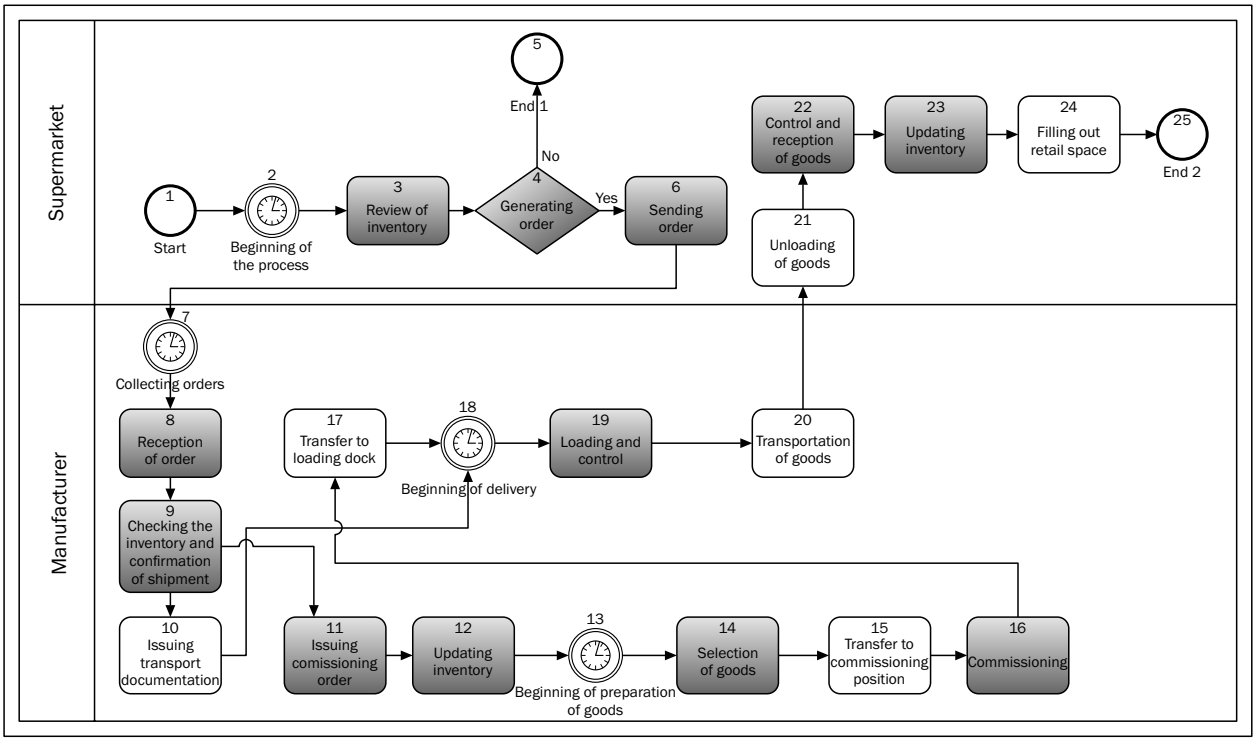

Figure 2 - AS-IS model of the supermarket supply

3.96kg. The product unit price in a supermarket is EUR 0.529, i.e., EUR 6.350 per package. At noon the manufacturer prepares the received purchase orders and confirms the delivery which is realized the next morning (within 24 hours). Although transport resources are often outsourced [32], the delivery to the retail stores is done by the manufacturer's own means of transport (refrigerated vehicles) and the vehicle supplies a number of retail stores in one cycle. The deviation from the delivery time depends on the routing plan; the truck leaves around 4:00 a.m. and the cycle ends in 6 or 7 hours. Upon the reception of goods in the supermarket, the products are directly carried and placed in the retail space.

Development of the existing (AS-IS) processes during supply of the supermarkets is shown in *Figure 2*. All activities in the process are related to the average processing quantity (in this case 6 packages) and described through the time needed for the realization, the resources and the operation costs. The marked activities are in modified (improved) state or modified from the aspect of time and resources needed for their realization, or transformed in new activities according to RFID requirements, or eliminated as excess.

Several scenarios of reengineered models were studied, but they cannot all be described in this paper. After the detailed analysis of the processes and activities, the paper presented only the most important modification of the process that influenced the outcome of this paper. As an example, the modified process of supplying supermarkets with RFID tags on packages, mobile readers with the manufacturer (in the warehouse and on the shipping dock) and the supermarket (receiving dock), with real-time availability data through the EPC global Network were analyzed.

Changes that have been made in the TO-BE process model (*Figure 3*) caused by the following characteristics of RFID systems:

- time reading of RFID tags is measured in milliseconds; hence the RFID is 10 to 20 times faster and more precise than bar codes [33];
- reading packages data are possible outside the visual range;
- not necessary manual operation with packages to perform a reading;
- saves labour hours.

The simulation procedure involved a period of one month, which was sufficient to determine the average times and associated costs of both AS-IS and TO-BE processes. The total delivery time was divided into the waiting time and activity duration time; the latter being subdivided into activities related to processing and transfer of information (I), manipulative activities (M), and transport activities (T). The obtained results relevant for this paper are presented in *Table 1*.

The alterations causing the greatest reduction in time are related to the activities of verifying the compliance of orders and goods in shipment and receiving. There, the elimination of the manual verification activity occurred (total time for the process and transfer of information was reduced by 49% per process). In the observed case, the effects of applying the RFID system for the transport process were not detected; furthermore, due to the transport organization mode, even

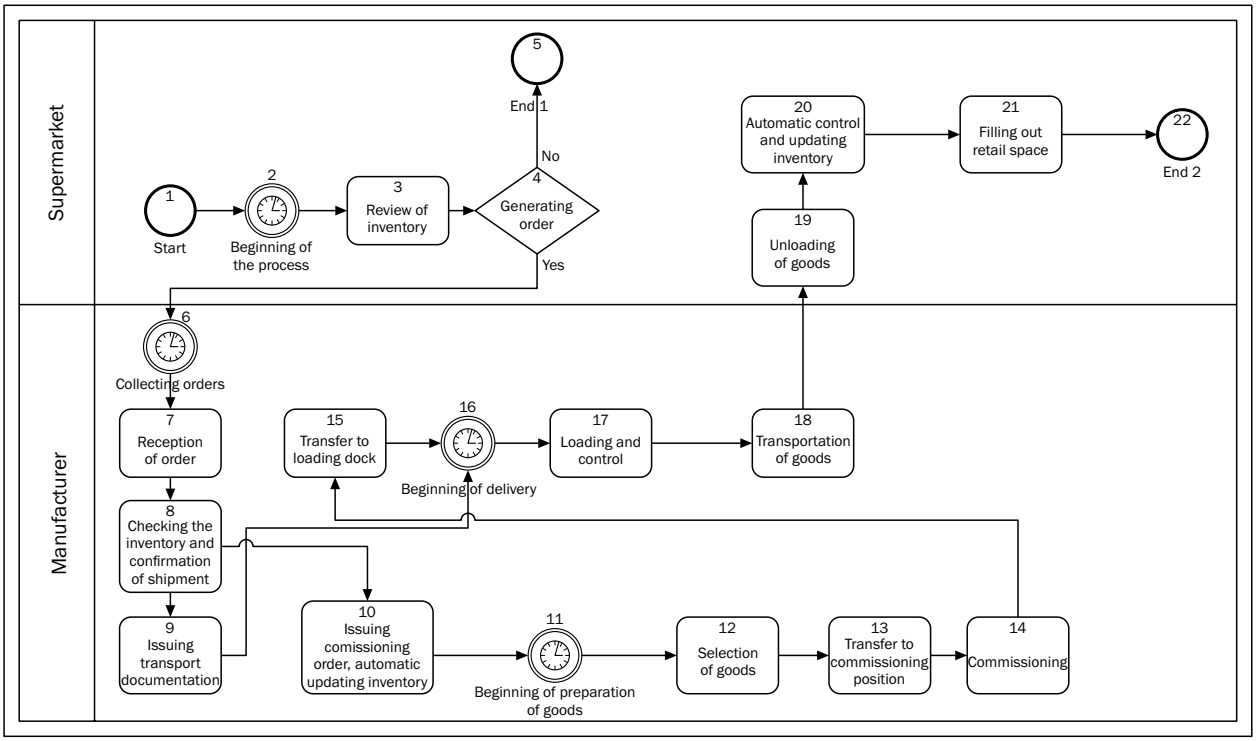

Figure 3 - TO-BE model of the supermarket supply

Table 1 - Output results of the process model

Participant	AS-IS processes							TO-BE processes						
	Lead time (h)						Costs (EUR)	Lead time (h)						Costs (EUR)
	Activity duration time				Waiting time	Total		Activity duration time				Waiting time	Total	
	I	M	T	Total				I	M	T	Total			
Supermarket	0.15	0.36	-	0.51	1.70	2.21	2.06	0.09	0.32	-	0.41	1.72	2.13	1.42
Manufacturer	0.30	0.27	2.17	2.74	18.86	21.60	2.64	0.14	0.24	2.17	2.55	19.11	21.66	2.04
Total process	0.45	0.63	2.17	3.25	20.56	23.81	4.70	0.23	0.56	2.17	2.96	20.83	23.79	3.46

I Activities related to processing and transfer of information
M Manipulative activities
T Transport activities

the vehicle waiting time in loading/unloading was not reduced.

By comparing the performances of AS-IS and TO-BE processes and projecting effects at the annual level (within a year, the supermarkets have sold 1,676 packages) the following conclusions are drawn:

- Total active time of the process is reduced by 9% or by 17.50 minutes per process, which on an annual level amounts to approximately 81 hours;
- The total process costs are reduced by EUR 1.24 per process (26%), which on an annual level amounts to approximately EUR 346;
- Compared with the product price, the determined cost reduction is 3.3%, which is particularly important in the developing markets where an average consumer is sensitive to product pricing.

6. CONCLUSION

The application of modern IT is often the first step in supply chain establishment and a prerequisite for the information exchange between the partners. In this context, the presented research that quantifies the process efficiency increase should be extended to the case when the supply chain partners have a higher level of information exchange, which would allow the determination of the additional effects of RFID technology and EPC system - primarily the impact on the average supply chain inventory and on product availabilities.

The goal of the paper is to quantify the effects on the developing market that can be achieved in logistics after applying the RFID technology. The results obtained in the research quantified the time reduction and related savings in logistic process costs due to the application of RFID technology. The process costs were calculated for the average order in the processes: goods verification in receiving/shipment, transport, manipulation, commissioning, and data processing. Quantification of these effects for the observed goods flow presents the main contribution of the research and it partially fills in the gaps in this research field.

For the analysis of the application of new methods to identify logistic processes, simulations are a valuable optimization tool. The application of RFID contributes to costs reduction and business efficiency increase through the automation of the entrance and exit of goods, commissioning and operation of personnel. In the case study investigated in this paper, the utilisation of RFID tags on packages can reduce processing costs by 26% and the total active time by 9%. The comparison of the effects of the RFID application in the retail markets suggests that significantly better improvements can be achieved in the emerging markets than in developed markets, which have a higher level of regulations, development and application of IT.

Future research should include the quantification of the influence of RFID technology on other components of logistic costs, primarily on storage costs, supply costs and out-of-stock costs as a manner to complete the logistic costs function (i.e. effects quantification for the listed areas). The effect quantification by the RFID system from the aspect of logistics on one side, and the necessary investments on the other side, represent the basis in making decisions on investing in these systems.

ACKNOWLEDGEMENT

The study was financially supported by the Serbian Ministry of Education and Science (Project No. TR36030).

Dr **SVETLANA NIKOLIČIĆ**
E-mail: cecan@uns.ac.rs
Univerzitet u Novom Sadu, Fakultet tehničkih nauka
Trg Dositeja Obradovića 6, 21000 Novi Sad, Srbija
Dr **MILORAD KILIBARDA**
E-mail: m.kilibarda@sf.bg.ac.rs
Univerzitet u Beogradu, Saobraćajni fakultet
Vojvode Stepe 305, 11000 Beograd, Srbija
Dr **PREDRAG ATANASKOVIĆ**
E-mail: pedja.atanaskovic@yahoo.com
Dr **LJUBICA DUĐAK**
E-mail: ljuba@uns.ac.rs
Dr **ANDREA IVANIŠEVIĆ**
E-mail: andreai@uns.ac.rs
Univerzitet u Novom Sadu, Fakultet tehničkih nauka
Trg Dositeja Obradovića 6, 21000 Novi Sad, Srbija

ABSTRAKT

UTICAJ RFID TEHNOLOGIJE NA EFIKASNOST LOGISTIČKIH PROCESA U LANCIMA SNABDEVANJA MALOPRODAJE

Izazovi sa kojima se suočava logistika u lancima snabdevanja maloprodaje moraju se istraživati u kontekstu određenog maloprodajnog sektora i stepena razvijenosti maloprodajnog tržišta. U ovom radu, fokus istraživanja je na logističkim procesima koji se realizuju pri snabdevanju supermarketa. Cilj je da se razumeju logistički procesi pri snabdevanju supermarketa, a nakon toga, da se ispita mogućnost za njihovo poboljšanje primenom sistema radio frekventne identifikacije (RFID), kao višeg nivoa informacionih tehnologija pri identifikaciji proizvoda u lancima snabdevanja maloprodaje.

Istraživanje je sprovedeno na tržištu u razvoju, u trgovinskoj kompaniji koja je među top deset na tržištu Srbije. Za jednu kategoriju lanca snabdevanja izvršeno je simulaciono modelovanje i kvantifikacija vremenskih i troškovnih performansi aktuelnih logističkih procesa (AS-IS model). Potom su, u skladu sa mogućnostima RFID sitema predložene izmene i integrisane u novi simulacioni model (TO-BE model). Rezultati dobijeni ovim istraživanjem se mogu iskoristiti kao deo širih istraživanja pri odlučivanju o impementaciji savremenih informacionih tehnologija u lance snabdevanja.

KLJUČNE REČI

logistički procesi; logističke performanse; lanci snabdevanja maloprodaje; RFID;

REFERENCES

[1] Kumar S. A study of the supermarket industry and its growing logistics capabilities. International Journal of Retail & Distribution Management. 2008;36(3):192-211.

[2] Brown JR, Dant RP, Ingene ChA, Kaufmann PJ. Supply Chain Management and the Evolution of the "Big Middle". Journal of Retailing. 2005;81(2):97-105.

[3] Maslarić M, Groznik A, Brnjac N. Distribution Channel Reengineering: A Case Study. Promet-Traffic&Transportation. 2012;24(1):35-43.

[4] European bank for Reconstruction and Development. Food and Agriculture Organization (FAO) of the United Nations. Agribusiness handbook; 2009.

[5] Reinartz W, Dellaert B, Krafft M, Kumar V, Varadarajan R. Retailing Innovations in a Globalizing Retail Market Environment. Journal of Retailing. 2011;87(Supp. 1):S53-S66.

[6] World Bank. [cited April 2012]. Available from: http://data.worldbank.org/country/serbia

[7] Wortmann M. Structural Change and Globalisation of the German Retail Industry [Internet]. Discussion Paper SP III 2003-202b, Berlin; 2003. Available from: http://www.wzb.eu/en/research/completed-research-programs/internationalization-and-organization/projects/retail-and-globalization-t

[8] Perspective of retail [in Serbian]. B&F. 2011;81:20-22, [cited May 2012]. Available from: www.danas.rs/upload/documents/2011/11/23/

[9] Bogetić Z, Veljković S, Stanković Lj. Importance of key account management concept and implementation in Serbian business practice [in Serbian, Internet]. Naučni skup novi metodi menadžmenta i marketinga u podizanju konkurentnosti srpske privrede, 2011 Oct 15; Palić, Serbia. Available from: http://nde.ekof.bg.ac.rs/vesti/palic.php

[10] Lee I, Lee BC. An investment evaluation of supply chain RFID technologies: A normative modeling approach. Int. J. Production Economics. 2010;125(2):313-323.

[11] Soon CB, Gutierrez JA. Effects of the RFID mandate on supply chain management. The Journal of Theoretical and Applied Electronic Commerce Research. 2008;3(1):81-91.

[12] Smith AD. Exploring radio frequency identification technology and its impact on business systems. Information Management & Computer Security. 2005;13(1):16-28.

[13] Tajima M. Strategic value of RFID in supply chain management. Journal of Purchasing & Supply Management. 2007;13(4):261-273.

[14] Ross AD, Twede D, Clark RH, Ryan M. A framework for developing implementation strategies for a radio frequency identification (RFID) system in a distribution center environment. Journal of Business Logistics. 2009;30(1):157-183.

[15] Bottani E, Rizzi A. Economical assessment of the impact of RFID technology and EPC system on the fast-moving consumer goods supply chain. Int. J. Production Economics. 2008;112(2):548-569.

[16] Ustundag A, Tanyas M. The impacts of Radio Frequency Identification (RFID) technology on supply chain costs. Transportation Research Part E. 2009;45(1):29-38.

[17] Becker J, Vilkov L, Weiß B, Winkelmann A. A model based approach for calculating the process driven business value of RFID investments. Int. J. Production Economics. 2010;127(2):358-371.

[18] VDI. Requirements to be met by transponder systems (RFID) for use in the supply chain Cost-benefit-analysis

of RFID systems in logistics. VDI 4472, Part 4. Berlin: Beuth Verlag; 2009.
[19] Behrenbeck K, Küpper J, Magnus KH, Thonemann V. Between euphoria and scepticism - RFID comes, the increase pressure: Which options have Consumer goods manufacturers and retailers? [in German]. Logistik Heute. 2004;12:54-55.
[20] Rothweiler S. Warm-up lap for RFID [in German]. Logistik Heute. 2004;12:58-59.
[21] Hardgrave BC, Waller M, Miller R, Walton SM. Does RFID reduce out of stocks? A preliminary analysis. Information technology research institute; 2005.
[22] Fernie J. Quick response: an international perspective. International journal of physical distribution and logistic management. 1994;24(6):38-46.
[23] Christopher M. Logistics and supply chain management-Strategies for reducing cost and improving service. 2nd ed. London: Pitman Publishing; 1998.
[24] Van der Vorst JGAJ. Effective Food Supply Chains: Generating, Modelling and Evaluating Supply Chain Scenarios [PhD thesis]. Wageningen University; 2000. Available from: http://www.wageningenur.nl/en/Publication-details.htm?publicationId=publication-way-3636353732
[25] Ballou RH. Business Logistics Management: Planning, Organizing, and Controlling the Supply Chain. 4th ed. Prentice Hall; 1999.
[26] Bowersox DJ, Closs D. Logistical Management: the integrated supply chain process. New York: McGraw Hill; 1996.
[27] Frazelle E. Supply Chain Strategy – The Logistics of Supply Chain Management. New York: McGraw-Hill; 2002.
[28] Nikoličić S. A contribution to the improvement in existing methods and models with a view to establishing the performance of the retail logistics system [in Serbian, PhD thesis]. University of Novi Sad, Serbia; 2011.
[29] Bosilj-Vukšić V, Štemberger IM, Jaklič J, Kovačič A. Assessment of E-Business transformation using simulation modelling. Simulation. 2002;78(12):731-744.
[30] Atanasković P, Nikoličić S, Cvijanović S. Analysis of required investment and benefits using RFID in supply chains. Industrija. 2012;40(2);69-79.
[31] Vidović M. Options for improving the performance of logistics systems by optimizing operational planning of some classes of reloading processes [in Serbian, PhD thesis]. University of Belgrade, Serbia. 1997.
[32] Stojanović Đ, Nikoličić S, Miličić M. Transport fleet sizing by using make and buy decision-making. Economic Annals. 2011;56(190):25-50.
[33] Mark R. How Much Time Is Required to Read an RFID Tag? RFID Journal [Internet]. 2013 September. Available from: http://www.rfidjournal.com/blogs/experts/entry?10736