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C O N T E N T

Foreword

Business logistics in Europe as well as worldwide is developing extensively both in practical and in scientific area. Increasing global trade and declining percentage of logistics costs in GDP indicates that logistics business is performing more efficiently than ever before. Logistics practice is again reflected on 15th international scientific conference Business Logistics in Modern Management 2015 which was held at the Faculty of Economics of Josip Juraj Strossmayer University of Osijek. Inspired by ever changing market and contemporary logistics and supply chain management problems, Conference continues with tradition of scientific and professional papers that contribute to business logistics theory and practice in all main logistics research areas. This year's publication presents 21 papers and 44 authors from 9 countries (Germany, Austria, Russia, Poland, Slovenia, Nigeria, Bosnia and Herzegovina, Serbia and Croatia).

Traditionally, retailing logistics plays primary role in considerations of this Conference. First section starts with analysis of contemporary retail trade as a driver of supply chains, and continues with significance of retail internationalization development in multichannel environment. Authors are also emphasizing interesting topic of emerging RFID technology in retail studied from younger consumers' point of view. This thematic section ends with discussion about scope and significance of concentration in retail trade.

Second thematic block is raising challenges in procurement and distribution channels. First article is considering procurement from business conduct approach, while second suggests appropriate procurement algorithms using harmonization method. Next article in this section gives an overview of Eco-food production, distribution channels and market perspectives in Croatia. A European experience in innovative solutions for a «last mile» delivery, with special emphasize on necessity to introduce innovative types of delivery vehicles is next topic, and this section ends with review of distribution channels of major construction materials.

Transport and warehouse as main logistics components are topic of third thematic section. First paper examines the conditionality of logistics performances of transport corridor with cost and non-cost factors related to transport corridor where the port is located. Next article is evaluating methods to optimize the handling of reusable containers for parts supply at the manufacturer, and provides a determination for safety stocks of these containers. Two articles regarding warehouse issues provide review of evaluation problem and assessment method of warehouse process efficiency, and present the introduction of variable pay schemes in warehouse logistics leading to productivity improvement. Next article discuss about significance of the intermodal transport route through the port of Rijeka for sustainable transport by highlighting the significance of the introduction of new seaborne truck traffic services from the Southeast Europe countries to the North Adriatic Italian port terminals for the reduction of vehicles gas emissions and sustainable development. Transportation is in focus of last article in this section as well – implication of food standard and food safety supply chain for the final products transportation are considered through case study of Croatian chocolate producer.

Last section presents development perspectives of supply chain and logistics. First article is talking about dimensions for supply chain integration - by applying process modelling and simulation methods, authors managed to represent characteristic features of supply chain operation at each integration level for all identified factors in article. Croatian competitiveness in the European logistics space is presented in second article of this section where authors argues that improving Logistics Performance Indicator to acceptable levels would significantly improve trade expansion, ability to attract foreign direct investments, and economic growth of Croatia. One more interesting idea comes with an article about "smart-box", a business concept towards the physical internet that will enable private persons to ship their private parcels or luggage through designed intelligent containers (so-called "smart boxes") and technologies for the branch-wide transport-related information flow. Next article provides policy framework for business concepts and models of urban/city logistics of developing economy in which author analyses the effect of traffic congestion, noise pollution and other negative externalities on city/urban logistics. A contemporary development of information technology infrastructure for optimizing logistics operations in segment of cold chain is next article's topic. Finally, last paper presents goals and benefits of university/industry partnership projects in the field of logistics.

Once again, Business Logistics in Modern Management 2015 is organized by Faculty of Economics in Osijek, and supported by Ministry of Science, Education and Sports of the Republic of Croatia - we are especially grateful to both for overall contribution. This publication as a Conference's Proceedings emerged from double blind international review process that was conducted by international review committee and editorial board of the Conference, and according to which all papers are categorised as scientific or professional papers. We would like to express our sincere gratitude to international review committee, editorial board and to all authors who have contributed.

In Osijek, 15 October, 2015.

Zdenko Segetlija
Davor Dujak

I. LOGISTICS IN RETAILING

LARGE RETAIL CHAINS, RETAIL DENSITY AND SUPPLY CHAINS

Zdenko Segetlija
Josip Juraj Strossmayer University of Osijek, Faculty of Economics in Osijek
Trg Lj.Gaja 7, 31 000 Osijek, Croatia
Phone: +382 031 224 400; Fax: +382 031 211 604
E-mail: seget@efos.hr

Scientific paper

Abstract

This paper was induced by the fact that in present-day conditions mutual competition is provided by entire supply chains and not merely by particular companies/groups. Therefore the importance of retail should be considered not only according to its shares in the number of companies, in the number of employees, in creating additional value, and the like, but also in respect of its role in supply chains. Namely, successful supply chains are created, primarily, by large retail companies with their large stores. Based on available literature, the author first analyses the retail as part of distributive trade, in concentration processes in the economy, in vertical marketing systems and in supply. Available secondary sources are used for the analysis of selected European countries: greatest retailers and their importance, role of wholesale distribution, and density and development level of retail sale. Data collected from Eurostat and Deloitte are analysed and graphically presented by means of usual statistical methods (relative numbers, indexes and shares, tables and graphs).

The results of the conducted research should confirm the thesis about the importance of the density and development of retail, relations between wholesale and retail companies, and shares of large retail companies / groups in the creation of modern supply chains as prerequisite for successful expansion into new markets. Therefore, regarding the possibilities for the development of supply chains, retail sale is not of the same importance in some of the observed countries.

Key words: retail trade, retail concentration, supply chain, economic development, European countries

1. INTRODUCTION

The paper opens with the analysis of the concepts of distributive trade, wholesale and retail, and then also analyses the concepts of retail and wholesale companies/trade associations, companies, retail chains and stores. Upon that follows the analysis of supply chain and point of retail trade within the supply chain. Finally, there is the analysis of the development of retail trade in concentration processes and retail trade within the vertical marketing system and supply chain.

The analytical part brings for each of the selected countries (European and other, in which the world's largest retailers have their headquarters) the analysis of factors influencing the formation of distribution structures and supply chains. Namely, for the selected European countries, the analysis comprises relative indicators of the realised turnover of the largest retailers, indicators of development level and density of retail sale, as well as indicators of the importance of wholesale.

In view of the fact that modern retail trade is still developing in the sense of its concentration and that retail supply chains are spreading internationally, the objective of this paper is to point at the preconditions allowing for the creation of international retail supply chains, as well as to indicate new aspects of importance of the retail trade in individual national economies. This would complete the picture of importance of retailing for a national economy.

2. RETAILING AS PART OF DISTRIBUTIVE TRADE

Without elaborating on various definitions of trade provided by some authors (see: Segetlija, 2009, pp.81 - 82), we shall here point out the definition of trade from the Trade Act of the Republic of Croatia. In Article 3 of the Trade Act (Official Gazette, Nr. 87/08, 96/08, 116/08, 76/09, 114/11, 68/13, 30/14) trade is defined as follows:

"In the sense of this Act, trade is the economic activity of buying and selling of goods and/or providing of services in trade for the purpose of realising profit or other economic effect. Trade is performed either as wholesale trade or as retail trade".

In this paper, official statistics data will be used, so the definition of trade in the official statistics must be considered as well. Official statistics comprises the so-called distributive trade. In the Statistical Yearbook of the Republic of Croatia for the year 2014, which has been harmonised with Eurostat, distributive trade is defined in the following way (Statistical Yearbook of the Republic of Croatia 2014, p. 417):

„Distributive trade is a set of all types of trading activities, from supplying of goods from the producer to distributing them to the final consumer. It comprises the wholesale trade on one's own account, the wholesale on a fee or contract basis, the retail trade and the repair of motor vehicles and motorcycles".

In distinguishing between the wholesale and retail trade, it is essential to distinguish between the characteristics of their customers (NACE, Rev. 2, 2008, Statistical classification..., p. 217).

In the wholesale, buyers are those recipients who use the purchased goods for further economic activities, whereas the retail trade serves the final consumer or the end user as buyer (Cf. Lerchenmüller, 2003, p. 19; Rudolph, 2009, p. 4).

In modern conditions, the following, slightly broader, definition of retail trade may be adopted (Levy & Weitz, 2012, p. 6):

„Retailing is the set of business activities that adds value to the products and services sold to consumers for their personal or family use".

According to Statistical Classification of Economic Activities in the European Community (Eurostat, NACE, Rev. 2, 2008, pp. 73 - 75) the entire distributive trade

(Section G – Wholesale and retail trade; repair of motor vehicles and motorcycles), consists of:

- division 45 (wholesale and retail trade and repair of motor vehicles and motorcycles);
- division 46 (wholesale trade except of motor vehicles and motorcycles);
- division 47 (retail trade except of motor vehicles and motorcycles).

In this paper, selling goods directly to consumers will be referred to as "retail trade", and large scale sale will be referred to as "wholesale". Both trade activities are, of course, constituent parts of distribution channels, e.g. marketing channels.

Marketing channels are all those organisations through which a product must pass between its production and consumption (Kotler et al, 2006, p. 858). The system of the so-called consumers' marketing channels comprises: producers, wholesalers, resellers and retailers. Unlike them, in the so-called business marketing channels there are: manufacturers, manufacturers' sales representatives or sales branch offices, business distributors and business clients (Kotler et al, 2006, p. 861).

The object of analysis in this paper is a company (trade association) in distributive trade business, as well as its business units (primarily stores).

Retail trade analysis frequently uses also the term "retail chain". In this paper, we shall adopt the following definition of retail chain (Levy & Weitz, 2012, p. 52):

„A retail chain is a company that operates multiple retail units under common ownership and usually has centralized decision making for defining and implementing its strategy. Retail chains can range in size from a drugstore with two stores to retailers with thousands of stores, such as Safeway, Wal Mart, Target, and JC Penney. Some retail chains are divisions of larger corporations or holding companies".

However, in general sense, we shall use the term "enterprise" as a goods or services producing organisation unit with a certain degree of autonomy in decision making, in particular in the investment of liquid assets (Statistics Explained, Glossary, Eurostat, 2015). In that sense, in this paper we shall also use the terms "retailer" and "wholesaler" for companies in the sphere of activity of wholesale and retailing.

Stores are defined as fixed sales premises which the customers enter to make their purchases (Concepts and Definitions, Eurostat's Concepts and Definitions Database, Eurostat, 2015).

Unlike the retailing in a store, Internet retailing (which can also be called "online retailing", "electronic retailing" or "e-tailing") is a retailing channel in which the goods and services are offered for sale, and all communication with the consumers is done through the Internet (Cf. Levy & Weitz, 2012, p. 58).

Namely, Eurostat gives the following definition of retailing (NACE Rev. 2- Statistical classification of economic activities in the European Community, Structure and explanatory notes, p. 217): "Retailing is the resale (sale without transformation) of new and used goods mainly to the general public for personal or household consumption or utilisation, in shops, department stores, stalls, mail-order houses, door-to-door sales persons, hawkers, consumer cooperatives, auction houses etc. "

Retailing that does not take place in stores, on benches, on markets or fairs would be the kind of retailing that that is performed through mail order or through the Internet. According to Eurostat NACE Rev. 2 – Statistical classification of economic activities … (p. 234) it is emphasized that: "This class includes retail sale activities

via mail order houses or via Internet, i.e. retail sale activities where the buyer makes his choice on the basis of advertisements, catalogues, information provided on a website, models or any other means of advertising, and places his order by mail, phone or over the Internet (usually through special means provided by a website). The purchased products can be either directly downloaded from the Internet or physically delivered to the customer."

Different analyses of the retail trade use indicators of the density of stores, i.e. of the density of the retail trade. In the marketing practice, there is a widespread understanding of distribution not only as an activity, but also as a condition, connected with the possibility to buy a certain product in particular points of sale in a certain area. Here, distribution is interpreted as the goal criterion. In that sense, there is a distinction between (Ahlert, 1985, p.10): (a) distribution level, and (b) distribution density. Distribution level shows the ratio between the realised and the potential points of sale that manufacturers want and consumers expect. Distribution density shows the ratio between the places of offer (usually stores) and the number of population or the size of a certain sales area. In that context, H. Meffert (Meffert, 1980, p. 389) emphasized that the distribution level indicates the presence of a certain product in stores, and W. Oehme points out the distribution density for brand articles (Oehme, 1983, p. 151).

If the entire retail trade is observed, the following criteria are usually used as indicators of its density (Cf., for example, Retailing in the European Economic Area 1993, 1994, 1997):

(a) number of inhabitants per store

(b) number of stores per 1 km^2 of a country's total land area

(c) number of retail companies per 10, 000 inhabitants.

The above indicators can also be used as indicators of the development and importance of retail trade in a particular country (Segetlija, 2012, pp. 56 ff). However, if one product or a group of products are selected for which the distribution density is calculated, then the stores offering these products must also be included in the calculation.

3. RETAILING IN CONCENTRATION PROCESSES

Concentration is the opposite of equality. Advantages of concentration in economy have been analysed in economic theory for quite a long time. Here, we must point out Marx' "Capital" (v. Marx, I, II, III) and analyses which have later shown that large companies possess the necessary strength for the development of new products and innovation of processes, and that they are in fact the ones propelling economic progress (see e.g., Schumpeter, 1943, pp. 81 ff).

In economic theory, the concept of concentration refers to the dominant position of several providers dominating the market (Baumgarten, 2012, p. 51). Concentration in economy is considered as a specific socio-economic pattern which was in the trade business in Germany especially analysed by B. Tietz (Tietz, 1993b, pp. 258 ff).

As a process, concentration in retailing relates to an over proportional growth of large companies in comparison to the small ones, so that the total number of retail trade companies is declining (Ahlert, 1985, 116.), and the progression of the

concentration process is reflected in the growth of market shares of a smaller number of companies (Nieschlag, 1972, p. 326, Konzentration im Einzelhandel, 2015).

It is important for retailing that concentration can be observed not only according to the number of retailing economic subjects (enterprises, companies) and their market shares, but also according to the number of large or small stores. As a result of the competitive relations in developed market economy, the number of large surface stores is growing, and at the same time the total number of stores is declining due to the decline in the number of small stores. This process is especially visible in the retail trade in the extended sector of food products, i.e. groceries (German: "Lebensmittel").

The concentration process in retail trade in the market-developed countries has been gaining momentum and speeding up since the mid 1960's (Beckermann & Rau, 1977, 39).

Through the concentration processes retailing also develops its "demand capacity" (in relation to its suppliers), so that in these processes retail brands are developing as well. Under the thus altered circumstances the relations with manufacturers are developing in the range from confronting interaction all the way to close and comprehensive cooperation (Magnus, 2007, p. 27).

Furthermore, as part of the modern concentration processes in retailing and further internationalisation of retail trade, there is also concentration and internalisation in supply, which has all together resulted in greater negotiating power of a retailing company as opposed to a manufacturing company. Of course, development of trademarks also depends on the behaviour of the consumers who accept such integration model when they are shopping (Pavel et al., 2010, pp. 70, 71).

However, apart from concentration, a retail trade company's "power of demand" is also influenced by other factors, such as: the possibility to close the market for a manufacturer (in some cases even a smaller retail chain may close the market for a potential supplier in a particular region), internationalisation, trademarks, regulation of retailing, consumers' behaviour, special investments, etc. (Pavel et al, 2010).

Of course, the importance of concentration in retailing can be observed primarily in the fact that only large retail trade companies and cooperative formations can utilise the attainments of the present-day technical-technological progress and achieve development. Concentration in retail trade is therefore not only the result of its development so far, but also a prerequisite for its development in the future.

Today, concentration in retail trade is much stronger expressed in European market-developed countries than in the so-called transition countries. In Germany, for example, in the extended retailing sector of groceries, the top five companies/groups have in 2011 reached the market share of 71.7% (Haucap et al, 2013, p. 6), and in the same sector in Austria in 2010 the top three companies/groups have reached the market share of 82.1%, whereas the Czech Republic, Italy and Poland had a significantly lower level of concentration (Triebl & Salhofer, 2013, p. 16). In the retailing sector of groceries in Croatia, in the year 2013 the top five companies/groups had a share of 53.2% (Segetlija, 2014, p. 44).

4. RETAIL TRADE IN THE VERTICAL MARKETING SYSTEM AND SUPPLY CHAIN

Concentration has contributed to vertical integration in the marketing channel by a process where the functions of one participant in the channel have been taken over by another participant in the marketing channel. This is how under specific competition circumstances vertical marketing systems, which coexist along with the conventional ones, are developing as well (Koppers & Klumpp, 2010, p. 10). Hence, some business systems have expanded by taking over the functions of other participants in the channel. Here we can speak about expansion of activities within individual corporations or groups and about the development of cooperation forms. In that context, it is important to mention the basic division of vertical marketing systems into (Kotler, 2001, pp. 549 – 552): corporative, directed, (managerial) and contractual systems.

In the analysis of retailing, it is important to point out that, in the concentration processes, large retailing companies could also assume wholesale functions, and their market power allowed them to dictate the prices upon manufacturing companies.

We may therefore conclude that in the concentration of the retail trade market shares of large economic subjects, their groups and large surface stores are not the only things that count, important is also the concentration of functions, i.e. assuming the wholesale and production functions by the retailing companies or groups (Segetlija, 2011). It is in such concentration processes in the retail trade that retail brands are developed as well. In fact, concentration of the supply function allows for the already mentioned "power of demand" of retailing (in relation to the suppliers).

In present-day conditions, the development of retail trade distribution channels must be observed not only in the framework of vertical marketing systems, but also within horizontal and multi-channel marketing systems.

Multi-channel systems come into existence when a certain product is sold to buyers who don't have equal status, or to buyers on different markets (possibly in different countries). Today, however, growing importance is gained by the so-called hybrid forms of integration. i.e., by hybrid marketing channels and multi-channel retailing, because the use of a single channel may often be insufficiently effective. This means that different channels are formed for different size clients (Kotler & Keller, 2008, p. 490). In this way, the so-called multi-channel management is developed (Multi-Channel-Management, 2011, p. 1). This concept refers to the use of more put options in sales, i.e. to parallel use of several sales channels.

Forms of Internet retailing and their connection with retailers' stores in physical sense are, of course, of great importance for multi-channel retailing as well.

Analyses of the distribution channels – marketing channels are nowadays usually extended to analyses of entire supply (providing, logistic) chains. Namely, in modern concentration processes completely different concepts of cooperation and integration of economic subjects have developed; these conceptions relate to entire economic flows, from the provider of the initial raw materials, over all stages of production and distribution, to final consumption.

Therefore, a company depends upon the entire supply chain consisting both of "upstream", as well as of "downstream" partners. The chain also includes suppliers

and agents, and even agents' clients, so that the so-called value supply networks are created (Cf. Kotler et al, 2006, p. 857, p. 859).

Such approach is important because market success can only be assured through creation of entire value networks and not only through their "downstream" sections – distribution channels. Therefore, large companies or groups today manage their own value creation chains and in that sense, the supply chain management (SCM) has developed.

The supply chain consists of a number of activities and organisations piloting materials on their voyage from the initial supplier to the final buyer (Waters, 2003, p. 7).

Today, value creation chain is considered as supply chain, that is, value chain management can be observed as supply chain management *(SCM)*. Essential for such management is the use of modern information technology, renewal (so-called re-engineering) of processes and a new way of thinking in the company. The supply chain is observed as a "transparent" value creation chain (Reindl & Oberniedermaier, 2002, p. 166).

In fact, *SCM* means active management of activities and relations in the supply chain in order to maximise the value for the buyer and win sustainable competitive advantage. It represents a purposeful effort of a company or a group of companies to develop and launch supply chains in the most effective ways (Bozarth&Handfield, 2006, p. 8).

It should also be noted that *SCM* represents a qualitatively new development stage in the life cycle of business logistics. This is a conception for networks and for discovering potentials for success by crossing companies' borders through development, formatting, management and realisation of efficient and successful flows of goods, information, money and funds (Göpfert, 2006, p. 65).

According to Chopra and Meindl (2016, p. 4) "effective supply chain management involves the management of supply chain assets and product, information, and fund flows to grow the total supply chain surplus. A growth in supply chain surplus increases the size of the total pie, allowing contributing members of the supply chain to benefit".

Koppers & Klumpp (2010) have pointed out that the escalation of competitive struggle in distribution and creation of large retail chains made it necessary to develop various cooperation conceptions, such as: *SCM*, "efficient consumer response" (*ECR*) and vertical marketing.

Most broadly viewed, *ECR* is a method for efficient forming of a value chain focused on the benefits for the consumers (Corsten & Pötzl, 2002, p. 7). Furthermore, *ECR* is, in fact, a widely accepted initiative in the industry by which borders of companies are crossed and which, through enhanced cooperation, aims at optimisation of the flows of goods and information and consequently at global optimisation of the supply chain (Riemer, 2015).

In practice, the *ECR* concept concentrates predominantly on retailing and wholesale, and almost exclusively on consumables. As opposed to *SCM*, it follows the relation with the final customers (*B2C)*. However, *ECR* can also be observed as an expression of the *SCM* in the consumables branch. In the *SCM*, too, cooperation between companies extends both over the supply (offer) and the demand (sale) side,

so that there is coordination between marketing, product and logistics. Of special importance for the introduction of *ECR* are data warehouses and product category management (*CM*), and thus also the observing of the supply chain from the marketing point of view (Zschom, 2001).

Large retail companies are becoming more important today because they increasingly take over the leading role in the supply chains management. This means that the retailers have gained their leading position through concentration. In the USA, for example, large retailers stand out as holders of supply chains. In the times when retailers were mostly small or family businesses, larger manufacturers and distributors dictated when, where and how the goods were going to be delivered. Now, however, larger national retail chains play an active role in coordinating activities of supply chain management (Lewy & Weitz, 2012, p. 248).

In present day supply chains, especially in the grocery sector, most power belongs to retail chains (Dujak, 2012, pp. 41 – 44). When a large retailer (retail chain) dominates the supply chain, then the term "retail supply chain" can be used.

Retailing has an important role in the supply chain. By sharing sales information with their suppliers, stores would, namely, allow the manufacturers and other chain members upstream in the chain to make more accurate plans, cut operative costs and offer the customers lower product prices, which would enable them to gain competitive advantage in comparison with another supply chain (Prester, 2012, p. 34).

Hence, retailing is also important for the supply chain thanks to its position in the distribution channel in which it is in direct contact with the consumers. Thus the information in possession of the retailers are essential also for their suppliers, so that they may plan the production, product promotions, delivery, assortment and stock level. Successful *SCM* is, of course, is also important for the retailer himself who can thus achieve strategic advantages, because he improves the availability of products and stock turnover, which creates a higher return rate on assets (Lewy & Weitz, 2012, p. 248).

A typical supply chain in the retail trade can be marked with a multitude of partners participating in the creation of value. Retailing is the penultimate link in the supply chain, the one in direct contact with the consumers, and the one representing the efforts of all participants in the entire supply chain. Other links in the supply chain are the manufacturers in stages before trade, providers of pre-products, and logistical service companies. They can, in the form of outsourcing, take up logistic activities for the manufacturers and for the retail trade (Welbrock & Traumann, 2012, p. 5).

The importance of large international chains is evident in their entrance into particular countries (outside of their country of origin) where they appear as brands and build logistic-distributive centres, and where they (usually) bypass local production because of the large quantities of goods they procure at low prices (Bormann & Siegel, 2007, p. 29). This means that smaller bidders cannot participate in their supply chains and that concentration processes further amplify concentration in the production. However, spreading of international retail chains from highly developed countries into less developed ones creates dangerous competition that has the capacity to push domicile manufacturers and retailers from the market, because they are unable to adapt to the new competition in a very short time.

Special importance of large, internationally spreading retail chains is also reflected in the fact that they are able to also integrate all stages prior to them (manufacturers and market agents) and thus direct and develop the production itself. In addition to that, advantages of international retail chains lie in the fact that they have concentrated their functions so that they are, in fact, much larger than the domicile retail chains in particular countries in which they appear. Also, due to global expansion of international retail chains, retailing is especially important for the countries in which the headquarters of companies as owners of these chains are located, because principal strategic decisions are made in their head offices (Segetlija, 2010).

Since the concentration processes in the retail trade result in the creation of concerns and various cooperative groups with numerous stores and their various formats (types), retail brands are required so that they may be distinguished from one another. In that sense, company brands are especially developed because the object of marketing strategy in retailing is always the format of the store (in the marketing of a manufacturing company this object refers to products). Namely, to become distinctive in the market competition, a retail company must have its image that cannot be copied by its competitors (Haller, 2001, p. 29; Theis, 1999, p. 561).

Retailing is the integrator of various value creation chains, i.e., supply chains, because retail trade has an assortment consisting of various products and services, and also because, by using outsourcing, it can integrate various services (services of logistic companies, banking services, Internet services, etc.).

The importance of retailing supply chains for the analysed European countries can be observed in the fact that in the early 1990's retailing in most countries reached the stage of stagnation or reduced growth, and the following trends were observed (Magnus, 2007, pp. 12-13):

(a) retailing formats with the conception of low prices are booming (first of all discounters offering a modest assortment but with a high share of products with their own brands);

(b) the largest retailers continue raising their market shares (i.e. concentration is still developing);

(c) trends point towards globalisation.

Globalisation could be understood as a company's strategy by which state borders are crossed, and in which global competitive advantages must be developed by exploiting location advantages and achieving economics of scale (Gabler Wirtschaftslexikon, 2015). This is, of course, connected with the processes of concentration, i.e. internationalisation in particular economic activities.

Namely, the primary reason for internationalisation of, for example, German retailers was the competitive concentration on domicile markets (Hanf & Hanf, 2005, p. 88).

Levy and Weitz (2012, pp. 11 -12) gave their assessment of the impact of specific factors on the forming of supply chains in the USA, European Union, India and China. They have taken the following factors into consideration: (a) retail concentration (largest retailers), (b) retail density, (c) average store sizes, (d) the role of wholesale, (e) infrastructure supporting the supply chain, (f) restrictions of retail locations, of store size, and ownership.

Some of the above factors will be analysed in the following section.

5. ANALYSIS OF THE SELECTED INDICATORS

The following indicators were selected in this paper for the analysis of the factors of importance for the forming of supply chains:

(a) indicators of the world's largest retailers according to their countries of origin
(b) indicators of importance of wholesale in countries with the largest retailers
(c) indicators of density and development of retail trade in countries with the largest retailers.

5.1. Largest Retailers

The analysis sets out from the assumption that largest retailers can also develop the largest stores. The combination of large stores and large companies results, namely, in a highly successful supply chain (Levy & Weitz, 2009, p. 11), i.e., distribution system (Levy & Weitz, 2012, p. 11).

Table 1 presents the level of globalisation of the retail trade in world's regions in 2013.

Table 1. Level of Globalisation by Region in 2013

Region/Country	Number of companies	Share of Top 250 revenue	Share of retail revenue from foreign operations	Average of countries
Africa/Middle East	7	1.0%	25.1%	12.1
Asia/Pacific	55	14.0%	14,0%	5.4
Europe	90	38.9/%	38.6%	16.2
Latin America	10	1.8%	22.9%	2.3
North America	88	44.2%	14.7%	7.8
Top 250	250	100.0%	24.2%	10.2

Source: Global Powers of Retailing 2015, Deloitte, G 21.

Table 1 shows that Europe has the highest share in the income of the Top 250 global retailers (38.9%), as well as the highest share in the income made on foreign markets (38.6%). It is, namely, possible that in some (larger) countries there are some large retailers that only do business in their domicile country – as it is shown in Table 2.

Table 2. Countries with the Largest Retailers 2013

Ordinal	Country	Number of companies	Number of single country operators	Share of Top 250 revenue (%)
1.	United States	79	32	41.9
2.	Germany	17	1	10.6
3.	France	14	1	9.4
4.	Japan	31	14	7.0
5.	United Kingdom	14	3	6.2

6.	Australia	2	0	2.6
7.	Netherlands	4	1	2.2
8.	Canada	8	6	2.2
9.	Spain	5	1	1.9
10.	Switzerland	4	1	1.5
11.	Hong Kong SAR	5	0	1.3
12.	Belgium	4	0	1.3
13.	China	7	6	1.3
14.	Russia	6	5	1.2
15.	Sweden	5	3	1.1
16.	Italy	5	2	1.1
17.	S. Korea	4	1	1.0

Source: Global Powers of Retailing 2015, Deloitte, G11 – G16.

Today, the world's largest retailers should also be viewed with respect to the realised e-commerce retail sales. Table 3 shows the countries with the largest e-commerce retailers from the Top 50 group.

Table 3. Countries with the Largest e-Retailers in 2013

Country	Number of companies	E-commerce retail sales (US$ mil.)	Share (in %)
United States	25	122,470.9	64.7
United Kingdom	10	23,252.7	11.3
China	4	17,626.2	9.2
Germany	3	12,179.0	6.3
France	5	10,933.7	5.7
Brazil	1	2,838.1	1.5
Netherlands	1	1,442.5	0.8
Australia	1	1,102.0	0.6

Source: Global Powers of Retailing 2015, Deloitte, G33, G34.

E-commerce retailing is developed not only by pure e-commerce retailers but also by other large retailing companies. In 2013, in the group of Top 250 retailers, 145 retailers also had e-commerce retailing. The largest among these companies are: Amazon.com, Inc. (USA), JD.com, Inc. (China), Wal-Mart Stores, Inc. (USA), Apple, Inc. (USA), Otto, GmbH & Co. KG (Germany), Tesco PLC (United Kingdom) etc.

5.2. The Importance of Wholesale

Since wholesale is important in the distribution structure as well, this paper also includes the analysis of indicators of the number of retailing and wholesale companies per 10,000 inhabitants in selected countries. Only relatively small retailing companies are, namely, dependent on wholesale.

Graph 1 shows the number of retailing and wholesale companies per 10,000 inhabitants in 2012. The presented data lead to the conclusion that European countries in which retailers from the group of Top 250 global players have their headquarters have different distribution structures. In some countries, retail trade is not of major

importance according to the number of retailing companies per 10,000 inhabitants (e.g. Switzerland), but their large wholesale companies effectuate relatively high shares (in respect of the number of population) among the 250 largest companies (as presented in Graph 2). The ratio between the number of retailing and wholesale companies is most favourable in Denmark (3.24), France (2.95) and Portugal (2.36).

Graph 1. Number of retail trade and wholesale companies per 10,000 inhabitants in selected European countries 2012.

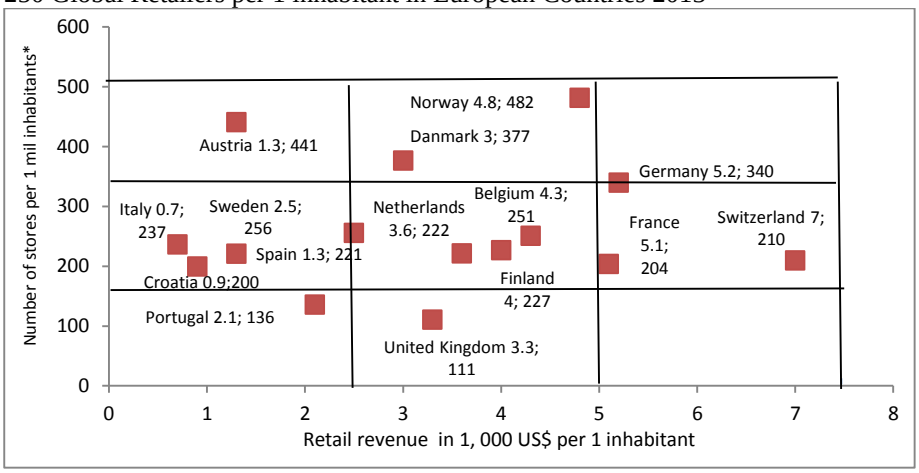
Source: (a) Annual detailed enterprise statistics for trade, Eurostat, 2015
(b) Population on 1 January by age and sex, Eurostat, 2015.

5.3. Density and Development of Retail Trade

As indicator of retail trade density for the analysis in this paper we have used the number of large-surface stores (with sales surface of 400 m^2 and more) in the extended grocery sector per 1 Million inhabitants. It is assumed that in the countries with a higher density of such stores this density is created by large retailers that can expand internationally, i.e., globally. Therefore, the given indicator of density of stores may be confronted with the retail trade income per 1 inhabitant realised by the retailers (from the group of Top 250 global retailers) with their head offices in the respective countries, as it is presented in Graph 2.

Graph 2 shows that Germany belongs to the countries with the highest density of large stores, but also that it is among the countries with large retailers (from the group of Top 250 global retailers) that realise the highest income per 1 inhabitant. Swiss retailers from this group do, indeed, realise an even greater turnover, but the density of large stores in Switzerland is lower. Highest density of stores is found in Norway which belongs to the group of countries with a relatively higher realisation of income per 1 inhabitant than that of the analysed largest retailers. Portugal has the lowest density of stores, and Italy has the lowest income per 1 inhabitant among the analysed largest global retailers from the Top 250 group. Other European countries (with the exception of Russia) did not have their representatives among the Top 250 largest global retailers in 2013.

Graph 2. Retail Density in the Grocery Sector and Retail Revenue in Group Top 250 Global Retailers per 1 inhabitant in European Countries 2013



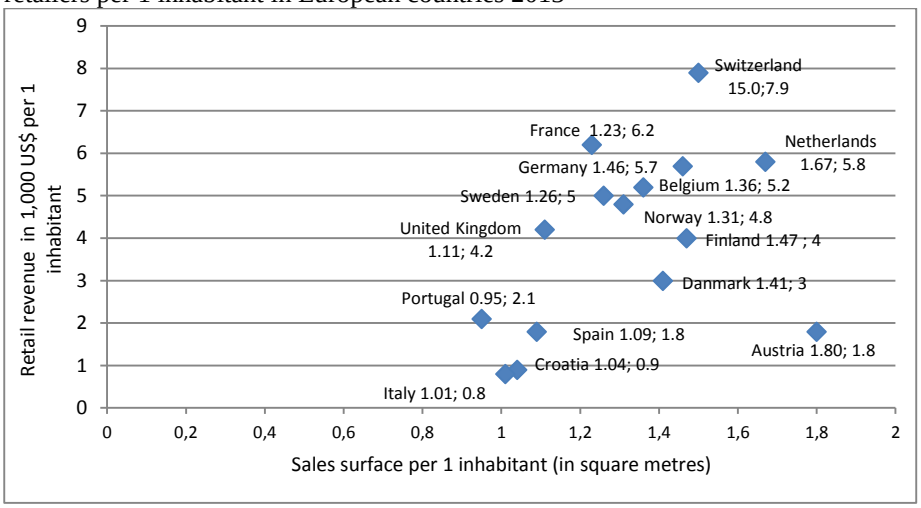
Annotation: * Stores with sales surface of 400 square metres and more;
** The number of stores in Croatia is the author's estimate

Sources: (a) Global Powers of Retailing 2015, Deloitte
(b) Population on 1 January by age and sex, Eurostat, 2015
(c) Number of stores in grocery sector retailing per 1 Million inhabitants in European countries in 2013 (Anzahl der Filialen im Lebensmitteleinzelhandel pro 1 Million Einwohner in Europa nach Ländern im Jahr 2013), Statista.

As indicator of development of retail trade, in this paper we shall use the indicator of total sales surface (in m^2) per 1 inhabitant. This indicator is confronted with the indicator of total retail revenue (of the retailers from the group of Top 250 global retailers) per 1 inhabitant (Graph 3).

It is obvious from Graph 3 that in the countries with larger sales surfaces per capita greater revenue is realised from the retail units of large retailers from the group of Top 250 global retailers. Exceptions are Austria (with a relatively large sales surface) and Portugal (with a relatively small sales surface).

Graph 3 Retail trade development and retail revenue in the group of Top 250 global retailers per 1 inhabitant in European countries 2013



Source: (a) Global Powers of Retailing 2015, Deloitte
(b) Einzelhandel Europa 2014, GfK.

6. INSTEAD OF A CONCLUSION

This paper sets out from the analysis of the basic concepts in the field of retail trade, wholesale and distribution followed by the analysis of retail trade in the concentration process, and retail trade in the vertical marketing system and supply chain. Emphasis is put on the role of retail trade, i.e. of large retail chains, in vertical marketing systems and in the forming of supply chains. To understand the importance of large retail chains for particular countries, analysis of the Top 250 global retailers was performed according to world's regions, including the identification of the countries with head offices of the largest retailers in 2013. Additionally, the analysis has also comprised 50 largest e-commerce retailers in the world (according to their countries of origin).

Furthermore, based on the analysis of the importance of wholesale, as well as of the density and development of retail trade, attempts were made to determine the characteristics of distribution structures in particular European countries, from which the largest retailers are originating.

The analysis has led to the conclusion that retail density (in the grocery sector) does not have the same importance in the realisation of revenue for large retailers in particular countries, whereas the development of retail trade (measured in sales surface per 1 inhabitant) may be considered as a consequence of concentration and a result of economic development of a particular country.

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DEVELOPMENT OF RETAIL INTERNATIONALIZATION IN MULTICHANNEL ENVIRONMENT

Jelena Končar
University of Novi Sad, Faculty Economics in Subotica
Segedinski put 9-11, Subotica, Serbia
Phone/Fax: +381 24 628 015
E-mail: koncarj@ef.uns.ac.rs

Ljiljana Stanković
University of Novi Sad, Faculty Economics in Subotica
Segedinski put 9-11, Subotica, Serbia
Phone/Fax: +381 24 628 000
E-mail: lj.stankovic@ef.uns.ac.rs

Sonja Leković
University of Novi Sad, Faculty Economics in Subotica
Segedinski put 9-11, Subotica, Serbia
Phone/Fax: +381 24 628 000
E-mail: sonjalekovic@ef.uns.ac.rs

Scientific paper

Abstract

Global expansion requires studious approach to marketing channels which represent one of the areas where they build competitive advantage in the market. Internationalization of business in the retail causes changes in the competitive structure under the increasing influence of globalization and internationalization of markets. The growth of electronic marketing channels, together with conventional channels, is faced with growing challenges of the new multichannel environment. The problem of this paper is how the globalization affects on the internationalization of retailers in multichannel environment. Multichannel approach has the best possibility of meeting the needs and demands of customers worldwide. Strategies include multichannel retailing channel selection, which is based on its ability to increase sales and profits thanks to multichannel consumers. In the context of the multichannel strategy, synergies lead to use one channel in order to improve the efficiency and effectiveness of other channels in the mix. The purpose of the paper is to provide recommendation for creating a sustainable competitive advantage in the global multichannel environment. The most significant effects are reflected in the internalization process of modernized markets and retailers. The development of international retailers in multichannel environment leads to increased competition and affect changes in the relations in the existing marketing channels. In the paper we used induction and analysis method for making conclusions. The further research should contain detail analysis about the effects of multichannel approach in the global retailing.

Keywords: globalization, electronic marketing channels, internationalization strategy, multichannel retailer, Internet

1. INTRODUCTION

Global processes are encouraged by new technologies in the electronic marketing channels. The online strategy contributes to the functioning of the global market in terms of modernization and structural transformation of retailers. The internationalization is becoming an innovative strategy of development of modern retailing in emerging markets. In such a condition, there is development of new competitors on the market with completely new strategies of market positioning and differentiation compared to the competition. The internationalization of retailers is becoming an innovative strategy through the opening of large retail companies outside the national market, as well as through the integration of joint ventures with retailers in the global market. The strategy of international appearances by retailers in new global markets includes the use of modern multichannel strategy of segmentation, differentiation and positioning in the process of further growth and market development and trade. The internationalization of retailing is changing completely the structure of the market and trade and by that retailer is becoming a leading player in marketing channels, as a result of the globalization of the world economy. The expansion of new competition in terms of market globalization creates new relationships between participants in marketing channels. Building a global and integral trade raises many questions:

- How the globalization and integration affects on the internationalization of retailers?
- How the globalization of market affects the growing role of electronic marketing channel?
- What possibilities offer global multichannel strategies of international retailers?
- What is the new role of Internet retailers in the global market?

Answers to these questions should provide the ability to conduct effective internationalization of retailers in terms of global multichannel environment.

2. THE GLOBALIZATION OF RETAIL MARKET

The globalization and economic integration of markets leads to expansion of the internationalization of the multichannel retailers. Contemporary multinational trade organizations internationalize their views on the global market with material and human resources, as well as with the use of modern information technology (Končar, 2008, pp. 182-183.). Global processes bring a new role to retailers in marketing channels. Retailer, as the main link in marketing channels, takes an increasing number of functions of marketing and on that basis achieves competitiveness. The growing internationalization of retail activity causes changes in the competitive structure of the domestic market and the new markets in which foreign companies are coming

(Lovreta et al., 2013, p. 567). Retailers see benefits in the expansion of their business outside of the domestic market, and large retail companies assume an increasingly important role in marketing channels. The value of retail sales in the market is created under the influence of high internationalization of markets with intense competition between retailers. The globalization of the retail market by regions in the world is shown in the following Table 1.

Table 1. The globalization of the retail market by regions in the world in 2013

Region	% retail revenue from foreign operations	% single country operations
Africa and Middle East	25.10%	0.00%
Asia and Pacific	14.00%	43.60%
Japan	9.40%	45.20%
Other Asia and Pacific	18.90%	41.70%
Europe	38.60%	22.20%
France	43.60%	7.10%
Germany	45.40%	5.90%
United Kingdom	21.50%	21.40%
Latin America	22.90%	40%
North America	14.70%	44.30%
USA	15.40%	40.50%
Average of top 250 retailers in the world	24.20%	34.80%

Source: Deloitte, 2015, p. 21

The impact of globalization on the retail market is presented on the basis of following indicators: percentage of retail revenue that is carried out on the domestic market by retailers in the mentioned region, and the percentage of retailers who do not implement the strategy of internationalization on the market, but their operations are only on the domestic market. The first indicator shows that retailers for Europe have a highly international business with an above-average percentage of revenue out of the domestic market, with differences in the individual countries. For instance, German and French retailers have over 40% of revenue outside domestic markets, while retailers from United Kingdom have below average revenue outside domestic markets. On the other hand, markets of Japan and the USA are characterized by high consumer purchasing power, so the retailers in these countries focus on the domestic market and the achievement of their goals are directed only at the domestic market, so that the percentage of revenue that takes place outside of the domestic market are 9.4% and 15.4% respectively, which is significantly below the average.

The percentage of retailers which operate only in the domestic market indicates that the small part of retailers from France and Germany are oriented only to the domestic market (7.1% and 5.9%), which indicates a high integration of the market in the European Union, among other things, due to regulations in the retail sector which is uniformed in all state members and therefore facilitates the expansion of their retail network beyond the borders of the domestic market of each country.

The development of retail sales in the home country is a key factor in the internationalization of companies, because it is obvious that the countries with the most developed retail such as United Kingdom, Germany and France are experiencing

the highest number of initiators of entry to new, sometimes very distant markets (Lovreta et al., 2013, p. 575). The internationalization of the leading retailers in the European Union is the result of globalization and integration of world markets. International retailers have their own retail network in ten countries at least on average, which is noticeable with European retailers who mostly rely on their business in foreign countries. Another indicator of the impact of globalization on retailers is the fact that there are fewer retailers that have operations only in the domestic country. The characteristic of European retailers is focus on the internationalization and globalization of business and achieving competitive advantage using multiple marketing channels, due to competition which is expressed much more than in other parts of the world.

The impact of globalization on the retail market has a different effect and the intensity of the effect on the individual markets. Undoubtedly, globalization is strengthening retail competition and concentration, changing the relationship between participants in marketing channels, and strengthening the position of retailers.

3. THE DEVELOPMENT OF ELECTRONIC MARKETING CHANNELS IN THE GLOBAL MARKET

The global concentration of retail sector makes the basis without which markets cannot operate effectively under conditions of increasing internationalization of retailers. The internationalization of retail and total trade is a direct consequence of globalization and integration of world market (Lovreta et al., 2013, p. 568). The concentration of retail trade in the global market makes an important basis for the development of new multichannel strategies. Electronic marketing channels can be defined as the use of the Internet to make products and services available so that the target market with access to computers or other enabling devices can shop and complete the transaction for purchase via interactive electronic means (Rosenbloom, 2013, p. 420).

Global integration processes in retail sector is acquiring a new role of retailer in marketing channels and becoming a link that takes an increasing number of marketing functions (Končar & Leković, 2014, p. 144). The largest multichannel retailers that recorded a high rate of e-commerce in their businesses are Apple Inc./Apple Stores, Wal-Mart Stores, Inc., Otto (GmbH & Co KG), Tesco PLC, Liberty Interactive Corporation, Casino Guichard Perrachon S.A., Home Retail Group plc, Best Buy Co., Inc, Staples, Inc., and Lojas Americanas S.A. / B2W Digital (Deloitte, 2015., p. 11). Among mentioned retailers the biggest revenue of electronic commerce had Apple Inc. / Apple Stores, Wal-Mart Stores, Inc., and Otto (GmbH & Co KG) recorded in 2013. In business-to-consumer model (B2C) the largest percentage of the total retail revenues was realized by Otto (GmbH & Co KG), Liberty Interactive Corporation, and Lojas Americanas S.A. / B2W Digital.

Table 2. Presentation of leading B2C electronic retailers in total operating retail revenues in 2013

Top e-retailer sales rank	Name of Company	Country of origin	B2C e-commerce % of total retail revenue
2	Apple	U.S.	31.4%
3	Wal-Mart	U.S.	1.6%
4	Otto	Germany	57.1%
6	Tesco	U.K.	4.7%
7	Liberty Interactive Corporation	U.S.	43.9%
9	Casino Guichard Perrachon	France	6.4%
12	Home Retail Group	U.K.	31.5%
13	Best Buy Co.	U.S.	7.1%
14	Staples	U.S.	19.3%
15	Lojas Americanas	Brazil	42.5%

Source: Deloitte, 2014, p. 28

The internationalization of multichannel retailers depends on the process of modernization of markets and trade in a large extent. The leading place in the process of internationalization takes the retail chains from developed countries (Lovreta, et al., 2013, p. 583). Multichannel retailers choose different international strategy for entering new markets and become leading actors of global marketing channel.

4. THE GLOBALIZATION OF MULTICHANNEL STRATEGIES OF INTERNATIONAL RETAILERS

Intensive development of new technologies, globalization and international strategy, emphasizes building competitive advantages of retailers in the market. The development and creation of a global concentration in retail sector is the basis without which market cannot operate effectively in terms of increasing the degree of saturation of the market and globalization. The internationalization of retailer's business activity brings the issue of expansion and globalization of the multichannel strategy.

Multichannel retailing systems are becoming one of the most powerful applications in the business areas for international strategy. Getting closer to the customer and understanding their behavior is of crucial importance for the survival of retailers today. An attractive offer creates the ability to adapt to any range of sales premises, sales channel or customer. Retailers' interactive websites affects the increasing importance and development of multi-channeling.

Global levels of concentration in the retail trade in the EU can be seen through the participation of leading retailers. The represented retailers from Western European countries are among the biggest retailers in Europe, especially from countries that had started integration of EU market, such as Germany, France or the United Kingdom. By integrating the single European market of goods and services, European retailers were given the opportunity to simply expand their business outside the domicile country. The question about retailers' global performance is what will be retailers' strategy in the new market and how will fight the competition. By using the

multichannel strategy retailers are defining the role of different marketing channels to specific markets and thus create a unique and distinctive position in relation to competitors in the market.

Multichannel retailers have greater potential of performances. This is in favor of the fact that multichannel consumers, those who buy and thus combine for example retail store, catalog and Internet, have a higher average annual value of purchases 887$, while those who buy in combined retail store and in the catalog are spending 608$, in retail stores and on the Internet 485$, further on the Internet and catalog 446$, and below these values are those who buy only in one channel (catalog 201$, retail store 195$, Internet 157$) (Noble, et al., 2009). These data suggest that the benefits of retailers' multichannel strategies are also recognized by consumers and willingly used in order to have a complete shopping experience through available channels.

Table 3. Largest electronic retailers with a multichannel strategy with internationalized business in Europe in 2013

Top e-retail sales rank	Retail revenue rank	Name of company	Country of origin	Countries of operation	e-commerce retail sales % of total retail revenue	e-commerce growth rate
5	70	Otto	Germany	54	61.30%	7.00%
6	5	Tesco	UK	13	5.30%	11%
8	13	Casio	France	29	6.20%	19.40%
13	117	Home Retail	UK	3	32.60%	7%
21	68	John Lewis	UK	3	15.60%	22.80%
23	163	Next	UK	74	36%	12.40%
24	23	Centre Distributeurs	France	7	4.10%	63%
30	7	Metro	Germany	32	1.90%	54.50%
32	85	Dixons Retail	UK	7	13.30%	27.80%
36	14	Auchan	France	13	2.40%	11.90%

Source: Deloitte, 2015, pp. 33-34.

In Table 3 is shown a high correlation between the internationalization of retail business and existence of electronic retail stores in case of Europe retailers. The dominant participation, as in previous analyzes of retail internationalization, have electronic retailers from Germany, France and the United Kingdom. The importance of electronic retailing can be seen on the basis of the total retail revenue that retailer achieves, as well as the percentage of e-commerce growth for each electronic retailers. What is notable here is that the electronic marketing channel has a high growth, and compared to traditional retail formats of the same retailer there is much higher growth of electronic retailing. The development of the multichannel retail strategy is directed towards the implementation of the technology in traditional retailing and by that development of electronic retailing.

Technological developments and the concentration of retail market in the global electronic market are an important component of the development of new multichannel strategies. In the context of multichannel strategy, synergy means using one channel to enhance the effectiveness and efficiency of other channels in the mix (Rosenbloom, 2013, p. 8). The multichannel strategy is an important component in

the development of retailers' marketing channel. With the optimal multichannel strategy retailers tend to the new market positioning and differentiation from the competition. This multichannel strategy becomes a way to achieve sustainable competitive advantage. The efficient multichannel strategy requires long-term commitment and significant investments.

Like it was mentioned before, in the context of the multichannel strategy of different channels, the synergy means using one channel for improving the efficiency and effectiveness of other channels in the mix. The main difficulty in achieving development of multichannel strategy is conflicts between the different channels, which require a new channel strategy that will contribute to the effective management of conflicts in the channel. All of this leads to the conclusion that in the conditions of global competition achieving sustainable competitive advantage requires new channel strategies, especially focused on multichannel strategies.

5. THE INTERNET RETAILERS ON THE GLOBAL MARKET

The main priority in the evaluation of new technologies and online strategies is focused on protecting the privacy and accuracy of the data. The Internet offers the customer retention strategies, the personalization and "one to one" marketing, which is the ultimate form of segmentation, targeting and positioning of the individual consumer. The personalization by segmenting the market based on accurate and timely practical needs of the individual, aims positioning the product in relation to the competition. The personalization has made significant advantages, with the aim of better understanding and prediction of customer needs.

Personalization is the targeting of marketing messages to specific individuals by adjusting the message to a person's name, interests, and past purchases (Laudon & Traver, 2015, p. 54). The extension of personalization is related to the adjustment and modification of the product according to the priorities of customers. Customers are changing product according to their priorities thanks to interactivity in the Web environment. This creates opportunities for purchasing by order through product differentiation and adapting over the Internet (e. g. product information, online customer services, etc.). The interactivity with prospective customers is provided through: frequent questions, chat systems about customer service in real-time, automatic response systems and so on.

Large pure-play electronic retailers are dominant in a global electronic market. The following table number 4 points to the leading Internet retailers in the global electronic market. Retailers from the US, Germany, France, United Kingdom and China are in the top ten online retailers in the world with application of new technologies in their operations globally.

Table 4. Leading Internet retailers in the global market in 2013

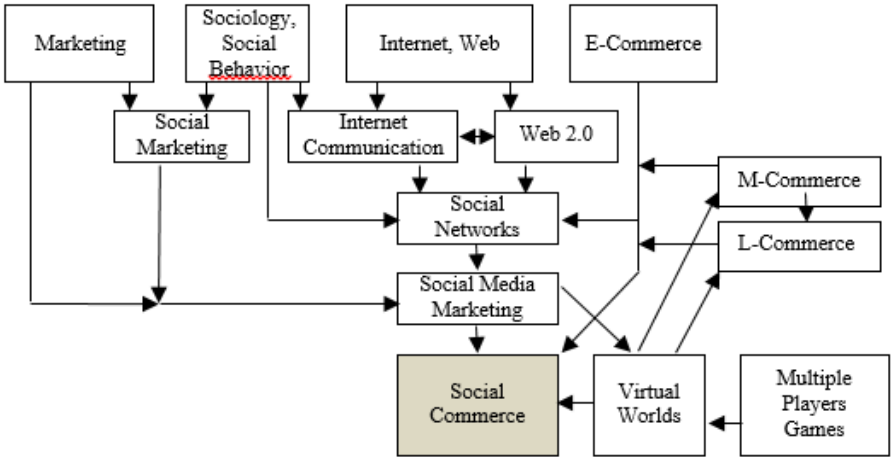
Rank	Name of company	Country of origin	Electronic commerce (US$ mil)	Growth of electronic commerce
1	Amazon.com, Inc.	U.S.	60,903.0	17.7%
2	JD.com, Inc.	U.S.	10,826.8	66.2%

16	Newegg, Inc.	U. S.	2,700.0	-3.6%
18	Zalando AG	Germany	2,340.0	52.1%
22	Vente.privee.com	France	2,125.2	23%
29	Vipshop Holdings Limited	China	1,680.6	143.5%
35	Tencent Holdings Limited	China	1,582.5	121.2%
39	Overstock.com, Inc.	U. S.	1,304.2	18.6%
42	Ocado Group plc	U. K.	1,239.5	16.7%
45	Systemax Inc.	U. S.	1,193.9	-18.2
46	ASOS Plc	U. K.	1,178.7	40%

Source: Deloitte, 2015, p. 33

Web 2.0 tools and social networks are changing the way of communication which affects the rapid and significant changes in social media related to digital words, sounds and images transmitted through the Internet. The social media use Web 2.0 technologies that communication activities direct to an interactive dialogue. The next wave of Web 3.0 Internet applications will effectively categorize and present digital (numeric) information to users in visually developed mode, which will boost the interactivity, analysis, intuition, and searching functions. Web 3.0 technologies' tools will improve and automate research of databases more efficiently. With Web 3.0, the Internet can finally realize elaborate and complex virtual worlds, where social interaction drives business operations (Turban et al., 2012, p. 122). After Web 3.0 follow the Web 4.0 generation.

Figure 1. The Major Roots of Social Commerce



Source: Turban, et al., 2012.

The figure number 1 indicates the emergence and growth of the mass media and major roots of social commerce. The extensive use of social and online media that supports social interactivity creates the conditions for online buying and selling products and services. This leads to social commerce (SC), which can be defined as subsystem of Internet retailing that involves using social media and online media that

supports social interaction and user contributions, to assist in the online buying and selling of products and services.

The roots of the social commerce are in integration in several fields with a focus on marketing and selling products and services. Companies Amazon, eBay and Wal-Mart focus on mobile applications, as the latest sales channel, with their sites and applications so advanced that sometimes compete with social networking sites[1]. The new Long-Term Evaluation (LTE) technology in a virtual environment offers to users a better experience in mobile communication services such as traditional voice and messaging services, which are transformed into rich media content[2].

Significant part and potential in the multichannel strategy on the Internet has mobile commerce. On the other hand, 4G generation of mobile standard covers Internet protocols with the aim of combining different types of access networks. IP (Internet protocol) as the universal protocol in Internet communication provides each user a unique address which is determined by its identification and location. The new trend in retailing will follow collecting information about customers thanks to iBeacone (using Bluetooth technology) with the aim of sending a personalized offer of products. The iBeacone provides personalized information and warnings based on data from micro locations[3]. This technology creates the conditions for precise placement of products to retail customers, and retailers' access to information about customers and their needs.

Social networks and mobile phones bring great changes in retailer's communication, while Internet use via mobile phones is much beyond the Internet through the desktop. Mobile connections provide the ability to pay electronically. The mobile commerce technology is still developing, and the development of mobile commerce will be facilitated with the new 5G technology. Smart phones with 5G technology has the option of changing cells, or selection of technology that provides the best and safest connection for the transmission of various data that facilitates and accelerates mobile commerce transactions.

6. CONCLUSION

The global electronic market encourages concentration of retailers affected by the increasing occurrence of multichannel strategies. The development of the multichannel strategy in terms of the internationalization of retailers in the global market is going to greater expansion and strengthening of the retailers. The optimal retailer's multichannel strategy tends to the new market positioning and differentiation in relation to competitors, all with the goal of achieving sustainable competitive advantage. Retailers, through various multi-channel strategies of entering new markets, have become leading actors of global channel marketing. The global retail concentration becomes more intense and encourages competition for market

[1] www.marketnetwork.rs/retail/vesti/vestiizsrbije , access June 5, 2015
[2] www.tajmlajn.com/svetska-premijera-prenosa-razgovora-putem-ite-tehnologije-u-virtualnom-okruženju , access June 5, 2015
[3] www.marketnetwork.rs/roba-siroke-potrošnje/vesti/fmcg-trendovi/3686-top-retail-trendovi-koje-treba-pratiti-tokom-2015 , access June 5, 2015

position. One of the important trends in internationalization is also a high correlation between global and electronic retailing. The largest multichannel retailers are Apple Inc. / Apple Stores, Wal-Mart Stores, Inc., Otto (GmbH & Co KG), Tesco PLC, Liberty Interactive Corporation, Casino Guichard Perrachon S.A., Home Retail Group plc, Best Buy Co., Inc, Staples, Inc., and Lojas Americanas S.A. / B2W Digital. The biggest revenue of electronic commerce had Apple Inc. / Apple Stores, Wal-Mart Stores, Inc. and Otto in 2013. The largest percentage of the total retail revenues in B2C electronic commerce had Otto (GmbH & Co KG), Liberty Interactive Corporation and Lojas Americanas S.A. / B2W Digital. The personalization, according to consumers' needs, has made significant competitive advantages, which is becoming possible with contemporary Web 4.0 and 5.0 technologies. Further development of multichannel strategies and huge potential has mobile commerce which is taking leading place compared to electronic commerce especially at developed markets.

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BENEFITS AND RISKS OF RFID TECHNOLOGY IN RETAIL FROM THE YOUNGER CONSUMERS' POINT OF VIEW

Blaženka Knežević
University of Zagreb, Faculty of Economics and Business
Trg J. F. Kennedy 6, 10 000 Zagreb
Phone: +385 1 238 3382
E-mail: bknezevic@efzg.hr

Mia Delić
University of Zagreb, Faculty of Economics and Business
Trg J. F. Kennedy 6, 10 000 Zagreb
Phone: +385 1 238 3465
E-mail: mdelic@efzg.hr

Matija Cegnar
University of Zagreb, Faculty of Economics and Business
Trg J. F. Kennedy 6, 10 000 Zagreb
E-mail: matija.cegnar@gmail.com

Scientific paper

Abstract

Radio frequency identification technology (RFID technology) is one of the rapidly growing technologies with a huge potential of application in retail supply chain. Numerous research papers claim that RFID technology can have enormous positive impact on business processes in supply chains: (1) due to the real time items tracking, they have a positive impact on inventory management, (2) "smart labels" improve automatic identification in warehouses and outlets and brings the idea of "smart shelf" into the practice, (3) shelf stocking and in-store product replenishment is becoming more efficient, (4) business forecasting in the field of inventories and stocks is applying the real-time quantities, (5) there are numerous advantages in the check-out procedures starting from the reduction of consumers' time and effort spent at the cashier desk throughout the increased productivity of employees within the store (6) it reduces overhead costs by improving shipping and receiving procedures and by eliminating the human error out of supply chain administration activities.

Nonetheless, the introduction of RFID technology into every-day retail activities rises up numerous issues regarding privacy and ethics of its usage. Firstly, this paper, based on secondary data, gives a critical overview of benefits and risks of RFID technology observed and explained by other authors. Secondly, upon the critical overview, the questionnaire was created and a primary research was done on the sample of younger consumers in Croatia in order to explain how they perceive advantages and disadvantages of introduction of RFID technology in retail and every-day life.

Key words: RFID technology, young consumers, retail technology, supply chain

1. INTRODUCTION

In today's modern society, where market competition has progressively grown, it is necessary that the company strengthen its competitive capacity which is influenced by various factors such as information, information and communication technology and information systems thereby creating new business intelligence, so-called competitive intelligence (Panian et al., 2007, p. 17-18).

High competition in business operations and ever greater customer demands for information on purchased items require traders to implement new technological trends in their retail sales. Radio frequency identification (RFID technology) is one of the fast growing technologies with a huge impact on speeding up the business processes. RFID is designed as an alternative to linear codes, where products are identified wirelessly by using radio waves. It is anticipated that the application of RFID technology is going to replace business line code in the future. Devi has given the most complete definition of RFID technology, which states: RFID is technology for the conversion of analog to digital, which uses radio frequency waves to transfer data between a moving object and the reader to identify, monitor and to locate the item (Mesarić & Dujak, 2009, p. 116).

During its development, radio frequency identification has been recognized as a technology that has a wide range of applications due to faster information flow, cost reduction and time saving. Today, RFID systems are used in retail, transport, medicine, manufacturing, control of entry into the buildings and logistics, i.e. where faster access to data is needed. The European Central Bank plans to introduce RFID technology for tracking bills to allow law enforcement agencies prevent transactions related to crime (Xiao & Sun, 2006, p. 64). Adoption and the use of RFID technology has increased rapidly, when large scale organizations and retailers, such as Wal-Mart and US Department of Defence, conditioned its suppliers and business partners to use RFID technology in their business. Conditioning business partners, manufacturers and suppliers in the supply chain is one of the most important factors which influenced the introduction of RFID technology in the supply chain management in individual companies (Delač, 2012, p. 11).

However, omnipresent use of RFID technology has brought up a number of privacy related issues. Unlimited possibilities for RFID technology use in applications requiring identification and data listing raise multiple possibilities for RFID technology abuse. Removing the flaws from the use of RFID technology and implementing new and better quality solutions as well as higher standards, should stimulate the business sector to invest more in this technology. Due to the increasing application of RFID technology it is necessary to improve appropriate standards and to take a number of measures to protect data from unauthorized "intrusion". RFID technology is considered one of the ten technologies of the 21st century that contribute to the technological and economic development.

This paper will present the application of RFID technology in retail, its advantages and disadvantages, as well as the impact on the privacy of consumers with

special reference to young consumers' views on privacy issues raised through the use of RFID technology.

2. APPLICATION OF RFID TECHNOLOGY IN RETAIL AND ITS IMPACT ON CONSUMER PRIVACY

Globalization, informatization and internationalization of the industry affected the retail businesses, a change in business strategy and the introduction of new technologies such as bar code and RFID technology, for labeling and sales of products, which enables us to store more data about the product. RFID technology is becoming the key to successful retail which is one of the most dynamic and fastest growing industries. Retailers are most reluctant to deploy RFID technology after the experimental period due to many advantages that this technology offers especially in creating new business value for retailers (Hellström, 2009, p. 1-21). New technologies have a major impact on automation of commodity process, warehousing, procurement of goods and transport (Renko et al., 2009, p. 157).

With the aid of RFID infrastructure used as a tool for operational business intelligence, managers get timely and quality information that are useful to avoid financial losses, improve risk management, fraud reduction and faster decision-making. By using business intelligence, companies may obtain much faster response to market demands and changes taking place, so the company can have a timely list of clients who purchased individual product in a period of time (Panian et al., 2007, p. 100). RFID technology alone does not bring benefits, but in interaction with business processes (Hellström, 2009, p. 1-21).

Strong competition in business and the increasing consumer demand require retailers to have a sufficient quantity of products on the stock in order to meet their needs, to reduce the consumption of human labor and to simplify business operations. Consumers want to make a purchase as quickly as possible - in order to achieve this, application of radio frequency technology in retail is essential which would enable the acceleration of purchase and provide greater awareness of products. Primary activities for retail management, supported by human resources, information technology and procurement are (Dunković et al., 2010, p. 180):

- internal distribution and inventory management: storage, receipt and internal distribution of goods;
- displaying goods: selection of merchandise and assortment that will ensure growing demand, setting prices;
- marketing: promotions, loyalty programs, own credit cards, market reputation;
- operational in store activities: decorating stores and other facilities in order to provide the customer with a better view and purchase experience, techniques and identification of goods on the way out.

The retail commodity processes, which account for a large portion of time spent, are connected with ordering and positioning of goods on the shelves. The stores are introducing central calculation because each commodity group within retail requires a specific approach to ordering and positioning of the product, in order to reduce the

number of erroneous decisions (Fičko, 2009, p. 63). Automatic positioning of goods allows the effective use of storage or retail space and better positioning of attractive products in visible places. In the supply chains following technologies are commonly used:

- information technologies for the collection and rough processing of data (RFID),
- information technologies for data analysis with the aim of making management decisions (database management system, storage, transport and inventory) and
- information technologies for data exchange and integration.

Significant features of RFID technology are the automatic data collection, real-time information and location system in real time, thus ensuring a broad application in the retail and supply chain. In order to successfully implement RFID technology in the supply chain, it is important that everyone benefits, not only by increasing productivity but also in the realization of surplus value for all members of the supply chain (Dujak et al., 2011, p. 265).

Following the request of one of the largest retail chains, Wal-Mart in the United States, to its suppliers that they must label their products RFID tag Ids, comes to the widespread use of RFID technology in other major retail chains. From 2010 to 2013, the share of the purchase value of the goods in net sales of the retail chain Wal-Mart was on average 74.8% (Knego et al., 2013, p. 12). In 2003 Metro opened the store equipped with RFID technology in Europe (Dujak 2006, p. 99). With the wide application of RFID technology the Metro Group company started in 2004 in selected warehouses and stores. To date, 180 Metro Group partners equip pallets and boxes with special transponders.

In order to achieve business objectives, retail stores are faced with the following business requirements (Druzijanic & Druzijanic, 2014, p. 206):

- an increase in sales volume,
- reducing the cost of procurement of goods and services,
- reducing the cost of business process,
- attracting new and retaining existing customers.

Since the beginning of 20th century we are witnessing faster development of logistics, whose role in the gross domestic product (GDP) is becoming important in all national economies. The degree of development of logistics varies in highly developed countries, transition economies and developing countries. Table 1 shows the share of the value of logistics services in GDP in highly developed countries and transition countries. It is evident that the logistics is highly developed in the tertiary sector. In Europe, 10-25% of the total operating costs of enterprises make logistics costs (Renko et al., 2009, p. 159). The company that applied RFID technology in its business has shown the greatest savings in logistics costs, that account between 20-25% of the total cost of the company (Dujak 2006, p. 94).

Table 1. Share of the logistics services in GDP in developed and transition countries

Sector	Developed countries (2000.)	Transition countries (2000.)
Primary	25%	< than 10%

Secondary	30%	< than 10%
Tertiary	50%	10 to 20%
Quaternary	30%	10 to 20%
Fifth	30%	< than 15%

Source: Renko, S., Fičko, D. & Petljak, K. (2009). Novi logistički trendovi kao potpora maloprodaji, *Proceedings of 9th international scientific conference Business Logistics in Modern Management, Segetlija, Z., Karić, M. (ed.) Faculty of Economics in Osijek, Osijek, p*. 159.

The implementation of the concept of integrated supply chain eliminates unnecessary spending of materials, time and money, thus focusing modern business on generating a higher value for consumers (Knego et al., 2013, p. 14). Since 2010, there have been improvements and upgrades of RFID technology, that may improve inventory tracking in stores and warehouses in the future (Dunković, 2011, p. 54). Reduced confidence of retailers in the profitability of the implementation of RFID technology has increased by replacing disposable tag's with multiple tag IDs for the labeling of food products. Disposable RFID tags were too expensive for implementation in food products.

Disadvantage of RFID tags is that they can not read off products with metal or liquid parts. Retailers see their advantage in using multiple tag's due to reversible logistics to production sites, while the multiple tag's are less favorable to suppliers (Dunković, 2011, p. 55).

The success in the retail business depends on good customer experiences, implementation of new technologies such as RFID, Internet and database management. For this reason, retailers are looking for ways to reduce costs and to improve their offerings through effective supply chain management. The implementation of RFID technology in the retail supply chain reduces the out-of-stock situations and improves management policies, reduces theft, and allows quicker passage through the cash register as well as improved productivity (Devi, 2007, p. 111-113). To meet the increasing demands of the market and to be competitive at European market, retailers in Croatia should turn to new technologies that already exist for many years in foreign markets and that have shown positive effects, such as RFID technology.

Investments in retail information systems in Croatia will contribute to better relations with customers and better business organization. Research related to the implementation of RFID technology suggest following benefits: reducing the cost of doing business due to automation of the processes, a better overview of the products and the increase of operational efficiency. On the other hand, problems related to the implementation of RFID technology are privacy, lack of standardization and the high cost of RFID tag's (Delač et al ., 2013, p. 194).

Table 2 provides a comparative overview of the use of RFID technology in enterprises with at least 10 employees in Europe and Croatia in 2009, 2011 and 2014. The data are downloaded from Eurostat.

Table 2. The usage of RFID in companies with at least 10 employees (in %)

	2009	2011	2014
EU (28 countries)	3	4	10
EU (27 countries)	3	4	10
Belgium	3	4	17
Bulgaria	2	3	18
Czech Republic	3	4	6
Denmark	2	3	11
Germany	4	6	14
Estonia	2	3	8
Ireland	2	6	6
Greece	n/a	2	4
Spain	4	6	11
France	3	2	7
Croatia	**4**	**7**	**12**
Italy	3	3	11
Cyprus	1	3	8
Latvia	n/a	3	8
Lithuania	3	7	11
Luxembourg	2	5	15
Hungary	2	3	7
Malta	n/a	7	15
Netherlands	9	2	12
Austria	4	6	18
Poland	3	2	6
Portugal	2	3	14
Romania	1	1	8
Slovenia	3	5	13
Slovakia	4	8	12
Finland	8	8	21
Sweden	2	3	9
United Kingdom	2	1	6
Iceland	n/a	n/a	9
Norway	1	3	8
Republic of Macedonia	n/a	6	15

Source: Eurostat, Database. Available at: http://ec.europa.eu/eurostat/web/products-datasets/-/tin00126 (access March 17 2015)

The sudden entry of foreign retailers is the beginning of the modern development of the retail structure in Croatia whose development was affected by the recession from 2008, which has slowed down the development of the retail structure (Dunković et al., 2010, p. 183). As a result of the economic crisis there has been stagnation of investment in trade sector.

In 2014 Zagreb hosted the first RFID conference focusing on the need to introduce new technologies, because in Croatia only a few companies successfully applied RFID technology (first RFID Conference, 2014). The introduction of new technologies into the domestic market is limited due to the high cost of RFID tag. However, despite the high prices and the recession, the domestic retailers should invest more in new technologies as the retail is one of the most important sectors in all national economies. In addition, by using RFID technology Croatia would strengthen its position in the region and ensure a better starting position for business expansion (Dujak et al., 2011, p. 268).

2.1. Advantages and disadvantages of the application of RFID technology in retail

The benefit of using RFID technology in the supply chain is to collect data from various objects that are, after the transfer of information in digital format, available to all users. Also, RFID technology has a great advantage in locating individual objects within a plant or warehouse or at another location in the supply chain. At the same time it can be an aggravating factor to collect huge amounts of data in enterprise operating systems. Reading several tags at the same time can lead to a collision and ultimately loss of data - therefore anti-collision algorithms are applied, while research in new methods for the prevention of such phenomena are still developing (Kaur et al., 2011, p. 154).

RFID tag IDs indicate the individual products, which leads to a gradual reduction of warehouse space in stores and move to JIT (Just-in-Time) business – in this way retailers can increase selling space (Dujak et al., 2011, p. 267). For refunds or product complaints buyers should not carry proof of purchase but the data on the location of purchase and time of purchase would be read out from the RFID tag. The implementation of RFID technology in the retail SCM represents a competitive advantage and the need to survive in the global market.

The savings in the supply chain generated by applying the RFID technology can be seen in the employee costs reduction due to increasing automation in business processes (Delač et al., 2013, p. 194). The implementation of RFID technology in retail reduces the possibility of theft of products by customers and employees, increases financial benefits, enables effective inventory management, reduces labor costs and gives a better view of the situation on the shelves. Although there is a great advantage for the business, during the introduction of RFID technology retailers are faced with the problem of high cost of RFID tags, which limits the large-scale use of this technology (Dujak 2006, p. 102). For this reason it is not implemented for labeling consumer goods and food products, but only high value products and clothing.

Greater application of RFID technology will affect the price reduction, and a prerequisite for the widespread adoption of this technology is the introduction of

universal standards that support all interested parties. After several years of using RFID technology large number of retailers note that marking of transport packaging with the disposable RFID tag is too expensive and the line codes give the same effect (Dunković, 2011, p. 55).

In the retail sales of consumer goods some technological solutions, that should be useful to customers, retailers and suppliers, are tested in the *Extra Future Store*, where the customer would have a PSA (Personal Shopping Assistant) on the trolley and all the products that the customer buys would be scanned. Therefore the buyer could have access to the list with prices and product information (Dujak 2006, p. 100). Metro Group opened the first Future Store in 2003 in Rheinberg, Germany and in 2008 in the village Tonisvorst where customers could pay by mobile phone. They recorded a successful business over several years (Metro Group, 2014). Unfortunately, this way of buying proved to be flawed because the scanner that should identify all the products cannot read products which have a metal surface or when the signal from the RFID tag passes through the liquid (Dunković, 2011, p. 55). Table 3 shows the effects of the material on the RFID communication.

Table 3. Effect of different materials on RFID communication

Composition of materials	**Effects on RF signals**
glass	attenuation/damping
cans	the effect of multiple transmission/reflection
human/animal body	absorption/frequency oscillation/reflection
metal	reflection
plastic	frequency oscillation (dielectric effect)

Source: Sweeney, J.P. (2010). RFID for Dummies. USA: John Wiley & Sons. p. 164

Some of the favorable effects of RFID are preventing the return of expired products in the supply chain as well as falsification disabled by unique RFID tags.

Problems related to consumer privacy are due to fear that the goods marked with RFID tag IDs can be monitored and after purchasing, especially if the RFID tag contains the EPC code that shows the information about the product together with the customer's personal information (Delač et al., 2013, p. 194). Certain studies found that despite the economic crisis and lower purchasing power, the most important criteria for selection of stores is the quality of the service provided, the speed of purchase, range and quality of services, while lower prices of products are not crucial (Druzijanic & Druzijanic, 2014, p. 211).

Elimination of defects and the introduction of new and better solutions and standards of RFID technology should encourage the retail sector to invest more. One of the reasons for refusal of the application of RFID technology in the retail sector is that it increases the surplus labor force which would make employees to resist the introduction of this technology.

2.2. Privacy protection in the use of RFID technology

The main challenges of the implementation and acceptance of RFID technology are related to privacy, lack of standardization, high cost, the reluctance of employees to embrace new technology, the need to redesign business processes, difficulties in the integration of data and reliability. A greatest challenge of RFID technology is the problem related to consumer privacy, which will need to be fully addressed before RFID acceptance in the business world as a new and safe technological solution, especially in retail. The advancement of technology will solve most of the challenges of implementation of RFID, but in order to solve the problem of privacy it will be necessary to involve other professions as privacy issue is also a sociological problem.

Existing RFID protocols completely neglect the protection of consumer privacy because they are primarily designed to enable optimal communication between the transponder and reader. Privacy advocates point out that the purchased products labeled by RFID tag can be monitored after purchasing. Each RFID label contains its own unique identification number that is transmitted to readers so it can monitor the person that is not even aware of. An even bigger problem may arise if personal data of the owner is stored along with the identification number. In this way, one can follow the behavior of consumers and outside stores. EPC code contains additional information about the product, which can detect things like the size of garments, preferences in clothing, medicines that are subsequently used, favorite shops, and the number of purchases in combination with the personal information of the buyer.

With the ever-growing application of RFID, big problems with the protection of consumer privacy will appear, because now there is no way to get to the users turn off the signal that RFID transponders transmit to the reader and so reveal the behavior of consumers having bought a product marked with RFID Labelling (Delač, 2012, p. 28). The basic and inalienable right of every individual is right to privacy that should not be jeopardized by any higher interests of the corporation. Unlimited possibilities of application of RFID technology in applications requiring identification and data reading opens many possibilities for misuse of this technology.

RFID technology is vulnerable to interference with radio signals, wiretaps, physical attacks (change of electronic property), denial of service attacks (interfering with the radio signal), forgery (change of product identification), unauthorized analysis of communication (interception) and fraud (Carnet, 2007). In order to increase security and to reduce the vulnerability of RFID technology following security measures can be applied:

- Self-destruct or deactivation of the transponder at cash counters in order to prevent further product monitoring;
- The Faraday cage is a container which blocks the radio signals of certain frequencies and thus protects the privacy of RFID transponders;
- Blocking passive RFID transponder disables the RFID reader and can be used against attacks on RFID systems;
- Frequent changes of cryptographic key in order to prevent unauthorized reading and tracking transponders;
- Informing consumers about a product that has an RFID transponder (consumer rights);

- Hash functions:
    - method by which the transponder responds only to his reader,
    - randomized hash lock that could allow unauthorized transponder monitoring;
- PRF (Pseudo-Random Function) authorization that ensures privacy tag that occurs, using a common key and PRF Insurance messages between the transponder and reader;
- TBP (Tree-Based Private) authorization that reduces the load on the server (with methods based on hash functions) which is proportional to the number of transponders;
- HB (Hopper and Blum) authorization use symmetric cryptographic key and provides protection against active and passive surveillance;
- A number of authorization algorithms methods that do not use encryption.

RFID technology is available for more than 50 years and is applied in various fields of human activity and has permeated modern society. So, it is necessary to carefully apply and find solutions that would help in the implementation of RFID technology in sensitive areas such as medicine. VeriChip Company developed the first commercial biochip that is intended for use on humans in 2001. VeriChip's RFID tag, with the size of a grain of rice installed under the skin, activates the ID number near the reader that allows access to personal data (Žubrinić, 2004, p.5 -6).

Observed from the point of retail and consumer protection, information on the buying habits of individuals, available and collected on the basis of purchasing tickets or using biometric passports, completely controls individuals and therefore any abuses of the data available should be prevented (Fičko, 2009, p.65). For more effective implementation of RFID technology a better understanding of all the possibilities of this technology is required.

3. RESEARCH OF YOUNGER CONSUMERS ATTITUDES ABOUT THE PROBLEM OF PRIVACY WHEN USING RFID TECHNOLOGY

This section will show empirical research on the attitudes of young consumers related to the problem of privacy in the use of RFID technology. The aim of this study is to examine the awareness of younger generation of the pros and cons of RFID technology and its impact on privacy and personal data protection.

In this research the survey was taken on student population. Research took place in April 2015. The quantitative data was collected through online questionnaire in Google Docs. Questionnaire was distributed through social networking platform – Facebook and Google Classroom.

The questionnaire consisted of three main parts: (1) General information, (2) Familiarity of the respondents with RFID technology, (3) Users' confidentiality towards RFID technology. An online questionnaire included questions of different types: one choice question, multiple choice questions and Likert scale ranking questions.

Large sample size provides more data for analysis. The number of respondents fulfills the first criterion of representativeness of research according to which N must

be greater than 30. To ensure high explanatory power of result, the target respondents of this survey is 151. Table 4 shows relative frequency of sample characteristics.

Table 4. Characteristics of the sample

RESPONDENTS (N=151)		
Gender	Male	61
	Female	90
Year	15-20	5
	21-25	96
	26-30	21
	31-35	12
	35<	17
Status	unemployed	11
	student	75
	employed	65

Source: own work

According to the gender structure of the sample there were 90 of female and 61 of male respondents at the sample. As shown in table 4 above, majority of respondents aged between 21 and 30, in which almost 65% of respondents are from the age group of 21-25, followed by the group of 26-30, which occupied 14% of the population. The largest proportion of respondents are students (almost 50%), while 43 % of respondents (i.e. 65) are employed. Only 7% of the participants in survey are unemployed.

3.1. Research results

The statistical program SPSS and MS Excel are used for the analysis of the results. Tables and graphs with accompanying explanations of the research results are presented below.

According to Table 5 it is evident how demographic variable years and the variable importance of the shopping speed correlate to the level of significance of 1%. Therefore, we can conclude that the shopping speed is more important to younger respondents.

Table 5. The correlation between demographic variable years with the variable importance of the shopping speed

		Importance of the shopping speed	**Years**
Importance of the shopping speed	Pearson Correlation	1	,263**
	Sig. (2-tailed)		,001
	N	151	151
Years	Pearson Correlation	,263**	1
	Sig. (2-tailed)	,001	
	N	151	151

**Correlation is significant at the significance level of 1%
Source: own work

For easier understanding the table 6 gives an overview of the responses to the variables of importance of the shopping speed and demographic variables year.

Table 6. The importance of variables shopping speed and demographic variable years

Years	Importance of the shopping speed	Number of respondents	% of respondents
15-20	Yes	5	100,00%
	Total	5	
21-25	Yes	76	79,17%
	No	18	18,75%
	Not sure	2	2,08%
	Total	96	
26-30	Yes	13	61,90%
	No	6	28,57%
	Not sure	2	9,52%
	Total	21	
31-35	Yes	6	50,00%
	No	6	50,00%
	Total	12	
35<	Yes	9	52,94%
	No	6	35,29%
	Not sure	2	11,76%
	Total	17	
	Total	151	

Source: own work

From the above table it can be concluded that shopping speed is more important to younger respondents. For respondents of 15-20 years of age the shopping speed is of great importance (100%). The group of respondents aged from 21-25 years has also showed great interest in the speed of shopping (almost 80%). Increased age of the respondents reduces the importance of shopping speed, thus it is essential to those 62% aged between 26 and 30 years, and for about 50% aged from 30 and over.

The following Table 7 shows the correlation between the importance of speed of shopping and demographic characteristic gender.

Table 7. The correlation between demographic variable gender with the variable importance of the shopping speed

		Importance of the shopping speed	Gender
Importance of speed shopping	Pearson Correlation	1	-,189*
	Sig. (2-tailed)		,020
	N	151	151
Gender	Pearson Correlation	-,189*	1
	Sig. (2-tailed)	,020	
	N	151	151

* Correlation is significant at the significance level of 1%

Source: own work

For a better understanding Table 8 gives an overview of the responses to the variables of importance of speed of shopping and demographic variable gender.

Table 8. Overview of answers to the importance of variables shopping speed and demographic variable gender

Gender	Shopping speed	Number of respondents	% of respondents
Male	Yes	36	59,02%
	No	23	37,70%
	Not sure	2	3,28%
	Total men	61	
Female	Yes	73	81,11%
	No	13	14,44%
	Not sure	4	4,44%
	Total women	90	
	Total	**151**	

Source: own work

According to Table 8 it is evident that the shopping speed is more important to female than male respondents, 81% and 59% respectively.

The following table shows a familiarity with RFID technology and demographic variable years. According to the answers of the respondents there is no significant difference in the ratio of years and knowledge of RFID technology and it cannot be concluded that these two variables are correlated. Most of the respondents, regardless of age, are poorly familiar with RFID technology. Majority of respondents unfamiliar with RFID technology are those over 35 years old (almost 90%). Also, respondents aged between 21-25 and those 26-30 are poorly familiar with RFID technology, 76% and 67% respectively.

Table 9. Overview of answers to the importance of variables familiarity with RFID technology and demographic variable years

Years	Familiarity with RFID technology	Number of respondents	% of respondents
15-20	Poorly	5	100,00%
	Total	5	
21-25	Good	18	18,75%
	Great	5	5,21%
	Poorly	73	76,04%
	Total	96	
26-30	Good	5	23,81%
	Great	2	9,52%
	Poorly	14	66,67%
	Total	21	
31-35	Good	6	50,00%
	Poorly	6	50,00%
	Total	12	
35<	Good	1	5,88%
	Great	1	5,88%

	Poorly	15	88,24%
	Total	17	
	Total	**151**	

Source: own work

The following table 10 gives an overview of the responses to variables familiarity with RFID technology and demographic variable gender. Regarding the poor familiarity with RFID technology the results are similar for both, females and males. 71% of male and nearly 78% of female respondents emphasized poor familiarity with RFID technology.

Table 10. Overview of answers to the importance of variables familiarity with RFID technology and demographic variable gender

Gender	Familiarity with RFID technology	Number of respondents	% of respondents
Male	Good	11	18,03%
	Great	7	11,48%
	Poorly	43	70,49%
	Total men	61	
Female	Good	19	21,11%
	Great	1	1,11%
	Poorly	70	77,78%
	Total women	90	
	Total	**151**	

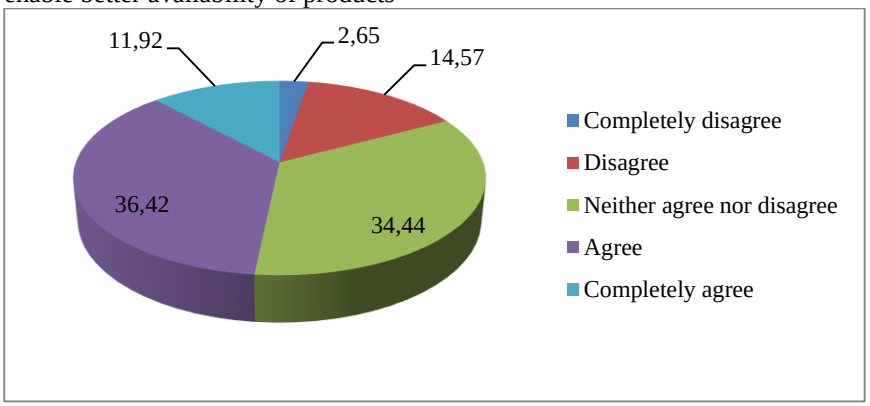
Source: own work

When talking about trust of respondents in RFID technology, 40% of respondents agreed with the statement that the RFID tag can seriously impair a person's privacy if unauthorized persons followed his movements and behavior. 29% of the respondents disagreed with the above statement where only 9% of them completely disagreed with the statement. The conclusion is that the opinions of people are divided equally to those who agree and those who disagree with the above statement.

Regarding the claim that by the use of RFID technology unauthorized person can get information about drugs we use and the diseases we suffer, 42% of the respondents agreed with the statement, while nearly 31% of them disagreed with the above statement (11% of them completely disagreed with the above statement).

As for the reduction of congestion at the box offices, the respondents believe that RFID technology can have a positive impact on its reduction. Almost half of the respondents (49%) agree with this statement, while only 6% completely disagree.

Figure 1. Introduction of RFID technology into all levels of the supply chain will enable better availability of products



Source: own work

As evident in Figure 1, the agreement with the above statement can be seen in 48% of the respondents, of which 12% completely agree. The conclusion is that almost half of respondents see the advantage in deploying RFID technology because it increases the product availability. The respondents also have a positive view on the possibility that RFID technology offers regarding the reduction of loss of luggage at airports. Almost 58% of respondents agreed with this statement, of which 14% completely agree with it.

3.2. Limitations of the research and recommendations for future research

In order to effectively use the conclusions of a survey it is necessary to be aware of certain limitations of the study that can be classified into several categories.

The first limitation of this study is the sample size. In fact, as previously mentioned 151 of respondents is acceptable for the research to be valid. But it is always easier to make general conclusions on the greater number of subjects. Another constraint is the limited control of the examining sample as it is electronically conducted survey research. The third limitation relates to the subjective assessment of the respondents by using a questionnaire and Likert scale.

This research has shown that people are still not entirely familiar with RFID technology and its possible positive impact. It is essential to point out how buying speed is important to people. But at the same time the confidentiality and secrecy of personal data is also crucial. It is necessary to explain the advantages of RFID technology and to convince people that the confidentiality of information is guaranteed in order to gain the trust of consumers towards this technology. In future research, the focus should put more on consumer confidence to RFID technology.

4. CONCLUSION

Strengthening of market competition is increasingly coming to the fore in the global market. Increased competition, financial instability and uncertainty of the market require a constant reduction of operating costs, and increase in productivity and efficiency. The solution is sought in the application of modern information technologies that have a major impact on the improvement of the business.

Globalization, computerization and internationalization of the industry have a major impact on retail businesses and contribute to the introduction of RFID technology for labeling and sale of products in the business strategy. In this way, the RFID technology is becoming the key to successful retail which is one of the fastest growing activities. The aim of introducing RFID technology in retail is to reduce costs, increase customer satisfaction, which would result in increased profitability of enterprises.

Croatian retailers are trying to adapt to global trends, by the introduction of new information technologies in order to strengthen its position in the region, which would contribute to better relations with customers and to better business organization. The advent of recession from the 2008 slowed down the development of retail structure in Croatia. The increasing application of RFID will affect the RFID tag price reduction and enable the implementation of this technology on consumer goods. For now, the technology is applicable only for the labeling of products of great value. Considering the benefits that RFID technology delivers, the application of this technology in modern business is expected to increase, that requires evaluation of the cost-effectiveness of introducing. Many companies are disappointed with the slow return on investment, which brings into question the creation of added value by using RFID technology.

Challenges of implementation and acceptance of RFID technology are related to consumer privacy, lack of standardization, high cost tag's, rejection of new technologies by employees, needs to redesign business processes and the reliability of RFID technology. Unlimited application of RFID technology in the future may threaten the inalienable right of every individual to privacy and protection of personal data by unauthorized persons.

The research conducted in this study showed that the speed of purchasing is very important to people, but also the confidentiality and protection of personal data. Young people should be more aware of the benefits that RFID technology provides since they are still not familiar with the advantages that this technology can provide. Also, it is important to convince them in guaranteed confidentiality of data when using RFID technology.

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CONCENTRATION OF THE RETAIL TRADE

Ishak Mešić
University of Zenica, Faculty of Economics
Fakultetska bb, 72000 Zenica, Bosnia and Herzegovina
Phone: +387 32 444 700
E-mail: imesic@bih.net.ba

Scientific paper

Abstract

This study was initiated by the issue of strengthening the position of retail trade in marketing channels, resulting in less bargaining power of producers and consumers. Stronger position retail trade has achieved through the dominance of a small number of large retail companies that generate a dominant market share.The purpose of this paper is to show the trend of concentration of retail trade, which results in a stronger position to retail producers and the consumers. Globalization of the market led to the intensifying of the trade internationalization, which has resulted in strengthening of the trade concentration on international level. Today, the concentration on the national level for many markets reached international proportions. However, the level of concentration in some countries is considerably different. The concentration of global retail turnover illustrates the piece of information that a very well known 250 of global retailers in 2012 with joint turnover in amount of 4.29 trillions US dollars achieved 29.4% of the share in global retail turnover. The world's 10 largest retailers saw their share of total Top 250 sales 29.3 percent of the Top 250's combined sales. During studies there are used different scientific methods: normative methods, data collection methods, content analysis, comparative, statistical, generic and other methods. Methods of data collection focused on the use of secondary data from books, magazines and websites. The research results shows that the concentration in the retail trade, observed as the market share of the top retailers at the state level, is much higher in the developed countries of the EU than in the other countries. At the end, we can conclude that concentration of retail led to strengthening of its role and domination in marketing channels. The processes of the trade concentration will continue to strength and trade policy will must to follow eventual influence of the concentration on possible monopolistic position and base on that to define the measures for preventing a monopolistic position.

Key words: concentration, trade, retail, turnover, market share

1. INTRODUCTION

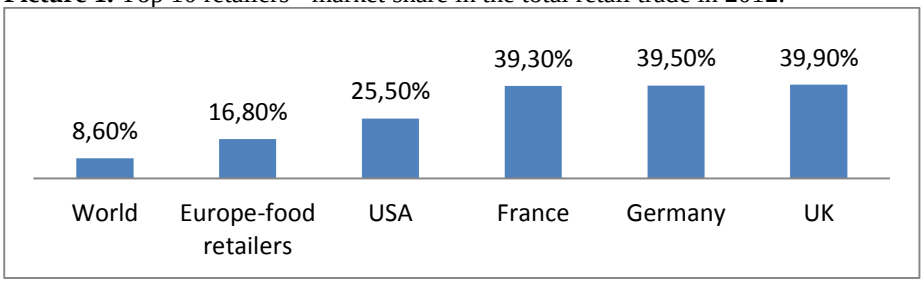
This study aims to investigate and present the trend of concentration of retail trade in the world, in countries that concentrate the most part of world's retail trade. The first part of the study shows the concentration of retail trade turnover in the world.

Study shows that the concentration in the retail trade, observed as the market share of the top retailers at the state level, is much higher in the developed countries of the EU than in the other countries. The second part of the study shows the concentration of turnover of leading global retailers. Study shows that in the Europe and in the United States concentrated two-thirds of the 250 world's leading retailers, resulting in a four-fifths (79%) of total turnover of the top 250 global retailers. Top 10 e-retailers have achieved 29.2% of the total global online retail sales. The third part of the study presents an analysis of the concentration of retail trade in the European Union. Considering the size of the European market, it can be concluded that the top 10 retailers concentrate a significant volume of sales in the food retail trade.

2. CONCENTRATION OF THE RETAIL TRADE IN THE WORLD

In last years, it is intensified the processes of retail concentration in the countries with developed market economy, which resulted by high degree of retail concentration. The concentration is the most evident in food processing sector and also it is evident stronger growth in non food retail. However, degree of the concentration in some countries is much different. According to Euromonitor, global retail sales reached USD 14.6 trillion (14,587.1 billion) in 2012, a 2% increase from 2011 (constant prices).[1] The concentration in the total retail trade, observed as the market share of the top 10 retailers, at level world, Europe and state, shows next picture:

Picture 1. Top 10 retailers - market share in the total retail trade in 2012.



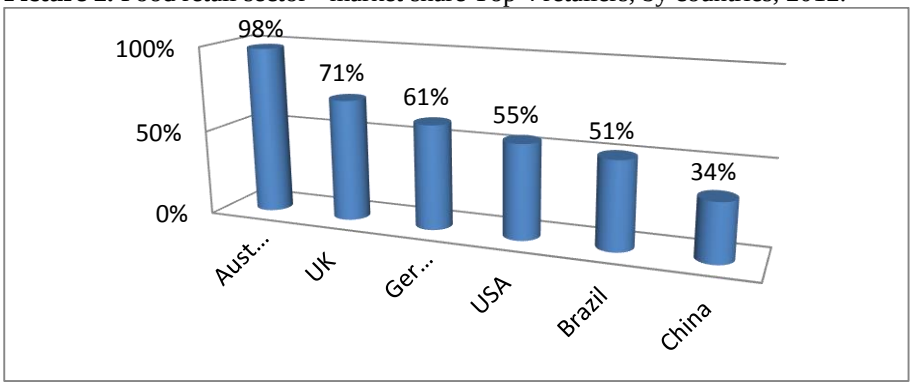
Source: Mešić, I. (2014). *Global Trends in Retail Trade*, Lambert Academic Publishing, ISBN: 978-3-659-61898-7, Germany. Top Food Retailers in Europe, (2013). [available at: http://retail-index.com/Sectors/FoodRetailersinEuropeandworldwide.aspx access: June 24, 2014].

Previous picture shows that the concentration in the total retail trade, observed as the market share of the top 10 retailers at the state level, is much higher in the developed countries of the EU than in the other countries. Concentration at the state

[1] Hutchings, D. (2014). Global Perspective On Retail: Online Retailing, [available at: http://www.cushmanwakefield.com/en/research-and-insight/2013/global-perspectives-on-retail/ access: January 16, 2014].

level, observed through the market share of the top 4 food retailers in food retail sector, by selected countries, is illustrated by the following picture:

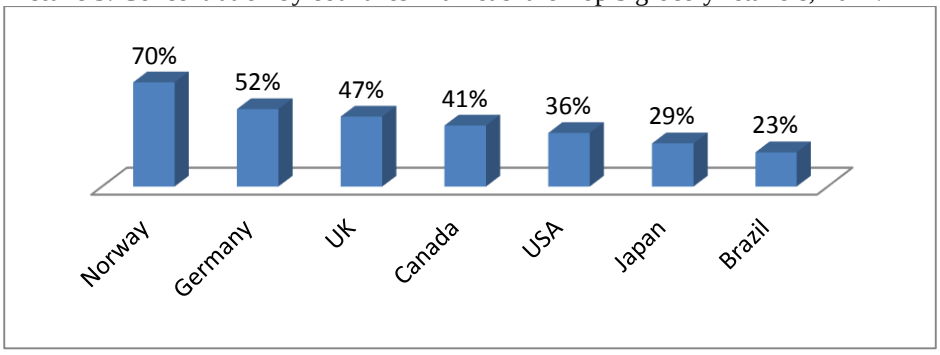
Picture 2. Food retail sector - market share Top 4 retailers, by countries, 2012.



Source: Author's construction, Data: Mortimer, G. (2014). The Conversation, [available at: http://theconversation.com/factcheck-is-our-grocery-market-one-of-the-most-concentrated-in-the-world-16520 access: September 02, 2014]; Top Food Retailers in Europe, (2013). [available at: http://retail-index.com/Sectors/FoodRetailersinEuropeandworldwide.aspx access: June 24, 2014]; Statistisches Bundesamt (2013); GAIN Report (2013).

Previous picture shows that the concentration in the food retail sector measured market share top four retailers, the highest in Australia (98%). The figure also shows a higher concentration in the food retail sector in developed European countries than in other countries (except Australia). Concentration at the state level, observed through the market share of the top 3 grocery retailers, by selected countries, is illustrated by the following picture:

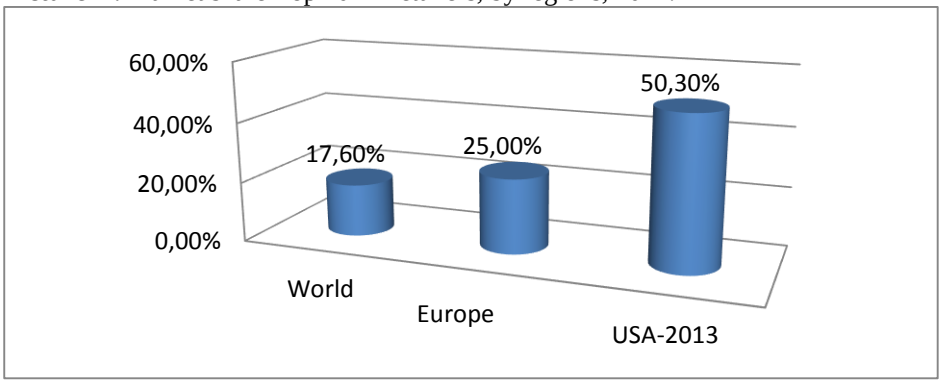
Picture 3. Concentration by countries-Market share Top 3 grocery retailers, 2012.



Source: Author's construction, Data: Euromonitor, (2014). Retailing, Country Report, [available at: www.euromonitor.com access: May 26, 2014]; Market Indicator Report, (2013). Modern Grocery Retailing in Japan, March, 2013. [available at: http://www.ats-sea.agr.gc.ca/asi/6376-eng.htm#e access: August 16, 2014]; GAIN Report (2013).

Previous picture shows that the concentration in the retail trade, observed as the market share of the top 3 grocery retailers at the state level, is much higher in the developed European countries than in the North America and Japan. On the next picture we can see a high degree of concentration at the top 10 e-retailers, in different regions:

Picture 4. Market share Top 10 E-Retailers, by regions, 2012.



Source: Author's construction, Data: Top 50 e-retailers 2012, (2014). [available at: http://www.stores.org/2013/Top-50-E-retailers access: February 22, 2014]; Internet retailers in Europe, (2014). [available at: http://www.retail-index.com/ERetail/OnlineprijsvergelijkersinEuropa.aspx access: August 21, 2014]; Top 10 U.S. online retailers, (2014). [available at: http://blog.thomsonreuters.com/index.php/top-10-u-s-online-retailers-graphic-of-the-day/ access: September 08, 2014]; Statista, (2014). [available at: http://www.statista.com/chart/2214/10-largest-online-retailers/ access: September 08, 2014].

From the previous table we can see a high degree of concentration at the top 10 e-retailers, who have achieved 17.6% of the total global online retail sales.

3. CONCENTRATION OF RETAIL TURNOVER IN THE LEADING GLOBAL RETAILERS

Concentration of global retail turnover illustrates the information that prominent 250 global retailers in the 2012, with a common turnover of 4.29 trillion dollars achieved 29.4% share of the global retail turnover. Ten world's largest retailers generated sales of 1.26 trillion U.S. dollars, which amounts to 29.3% of total 250 the leading retailers.[2] Condition of concentration of the retail trade, observed at world level illustrates the following table:

[2] Global Powers of Retailing Top 250, (2014). [available at: http://www.stores.org/STORES%20Magazine%20January%202014/global-powers-retailing-top-250-highlights access: January 15, 2014].

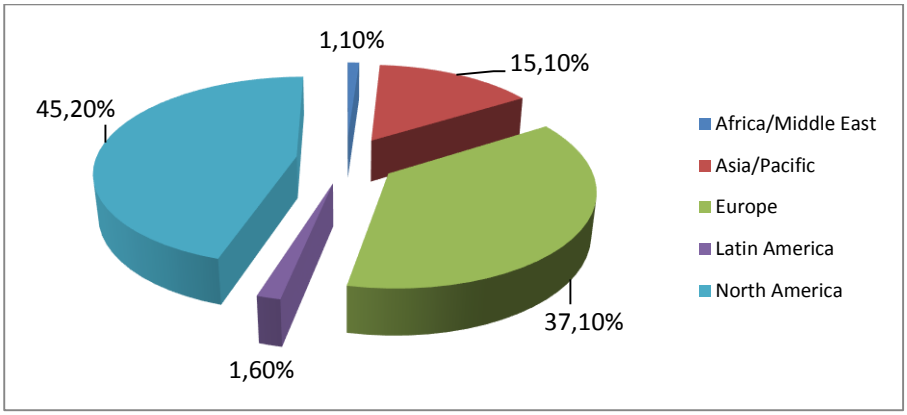
Table 1. Top 10 Retailers worldwide, 2012.

Rank	Name company	Home country	Retail revenue Million USD	Market share in world (%)
1.	Wal-Mart	US	469,162	3.22%
2.	Tesco	UK	101,269	0.69%
3.	Costco	US	99,137	0.68%
4.	Carrefour	France	98,757	0.68%
5.	The Kroger Co.	US	96,751	0.66%
6.	Schwarz	Germany	87,236	0.60%
7.	Metro	Germany	85,832	0.59%
8.	The Home Depot Inc.	US	74,754	0.51%
9.	Aldi	Germany	73,035	0.50%
10.	Target	US	71,960	0.49%
	Top 10		**1,257,892**	**8.62%**
	Top 250		4,287,587	29.39%
	Global retail sales		14,587,000	100.0%
	Top 10 share of Top 250 retail revenue		29.34%	

Source: Global Powers of Retailing Top 250, (2014). [available at: http://www.stores.org/STORES%20Magazine%20January%202014/global-powers-retailing-top-250-highlights access: January 15, 2014].

From the previous table we can see that five from the ten world's largest retailers are from Europe, and five are from United States. Ten world's largest retailers generated sales of 1.26 trillion U.S. dollars, which amounts 8.62% share of the global retail turnover (29.3% of total 250 the leading retailers). The share of sales of Top 250 global retailers from different regions is shown in the next picture:

Picture 5. The share of sales of Top 250 global retailers from different regions, 2012.



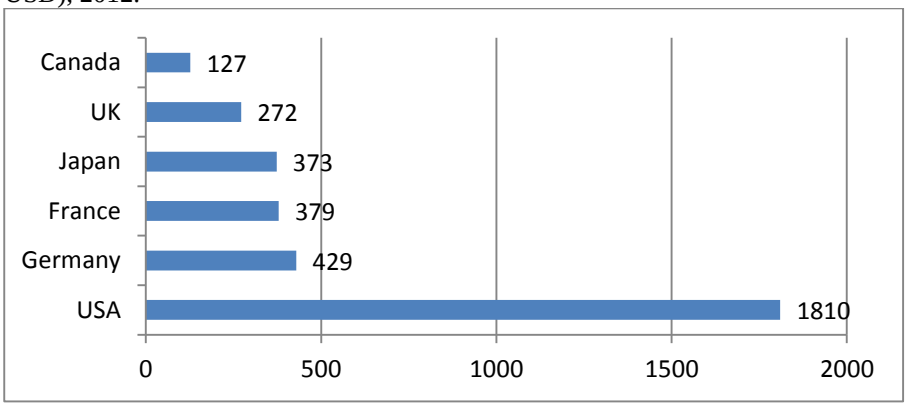
Source: Mešić, I. (2014). *Concentration of World Trade*, Lambert Academic Publishing, ISBN 978-3-659-54455-2, Germany. Global Powers of Retailing Top 250, (2014). [available at: http://www.stores.org/STORES%20Magazine%20January%202014/global-powers-retailing-top-250-highlights access: January 15, 2014].

Previous picture shows plenty of uniform share of global retailers from the North America and global retailers from Europe. Global retailers from the North America have 8.1% higher share of sales than global retailers from Europe. The picture also shows that global retailers from the North America and Europe together represent 82.3% of the turnover of Top 250 global retailers. Of the 250 global retailers, 83 retailers are from the United States with a common turnover of 1.81 trillions dollars, and the 82 retailers are from Europe with a common turnover of 1.59 trillion dollars. Leading retailers from three European countries (Germany, Great Britain and France) have 43 of 250 global retailers, with a common turnover of 1.08 trillion dollars.[3]

Sales value of global retailers from different countries is shown in the following picture:

[3] Global Powers of Retailing Top 250, (2014). [available at: http://www.stores.org/STORES%20Magazine%20January%202014/global-powers-retailing-geographical-analysis access: February 27, 2014].

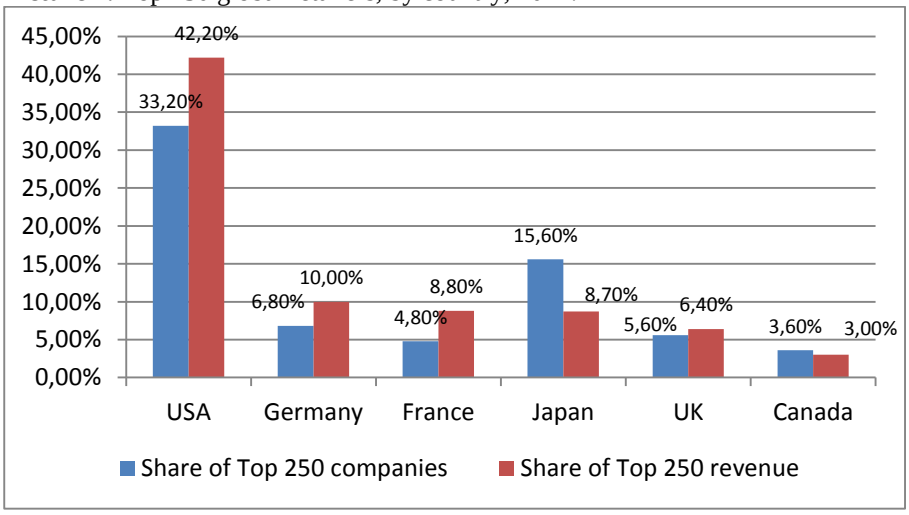
Picture 6. Top 250 - Sales value of global retailers from different countries (billion USD), 2012.



Source: Global Powers of Retailing Top 250, (2014). [available at: http://www.stores.org/STORES%20Magazine%20January%202014/global-powers-retailing-geographical-analysis access: February 27, 2014].

Previous picture shows that most of the turnover of 250 leading global retailers achieve retailers from the U.S. and three leading European countries. Comparison of concentration at global retailers, by countries, illustrates the following picture:

Picture 7. Top 250 global retailers, by country, 2012.



Source: Global Powers of Retailing Top 250, (2014). [available at: http://www.stores.org/STORES%20Magazine%20January%202014/global-powers-retailing-geographical-analysis access: February 27, 2014].

Previous picture shows that 69.6% of the 250 global retailers are located in six countries, and they have achieved 79.1% of total turnover of 250 global retailers. The

largest number of global retailers are from the USA and they achieve the largest share of sales of 250 global retailers.

4. CONCENTRATION OF THE RETAIL TRADE IN THE EUROPEAN UNION

Inside of the EU countries, the concentration of the retail trade became very strong. The concentration is highest in the food sector, but is also evident and in other sectors. The direct circumstance of the internationalization is bigger concentration of the trade in Europe. However, the rate of the concentration in few countries is still differ.[4] Condition of concentration of the retail trade, observed at European level (rather than at the state level) illustrates the following table:

Table 2. Top 10 Food Retailers in Europe, 2013.

Rank by Turnover in Europe		Retailer	Home country	Turnover in Europe Billion EUR	% Market share in Europe
1.		Schwarz	Germany	74.0	2.5%
2.		Tesco*	UK	65.3	2.2%
3.		Metro	Germany	63.6e	2.1%
4.		Carrefour	France	54.7	1.8%
5.		Rewe	Germany	50.6	1.7%
6.		Edeka	Germany	46.2	1.6%
7.		Aldi	Germany	45.2e	1.5%
8.		Auchan	France	39.2e	1.3%
9.		E. leclerc	France	36.5	1.2%
10.		Sainsbury`s	UK	28.3	0.9%
		Top 10		**503.6**	**16.8%**
		All European Food Retailers	Europa	3,000.0	100.0%

* Fiscal year 2013. e = estimate

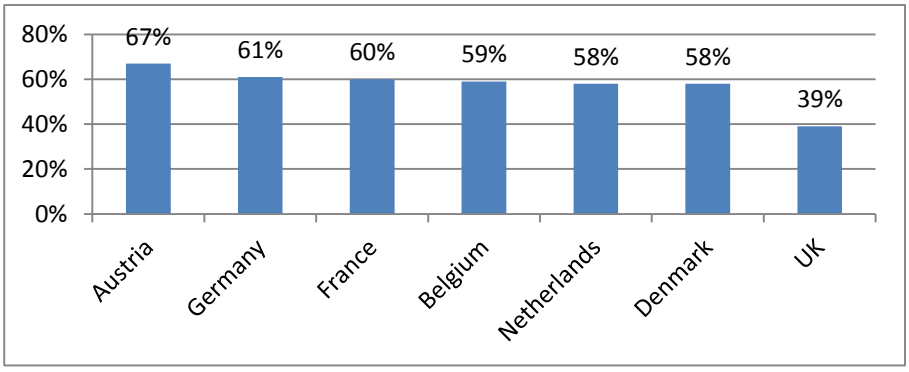
Source: Author's reconstructions, Data: European Commission (2014). *The economic impact of modern retail on choice and innovation* in the EU food sector, Final Report, September, 2014. [available at:

[4] Unstoppable Wave of Internationalisation in the European Grocery Trade and Increased Concentration (2008). [available at: http://www.eurodata.com/presse/prl_0898.html access: September 14, 2008].

http://www.google.ba/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CB8QFjAA&url=http%3A%2F%2Fec.europa.eu%2Fcompetition%2Fpublications%2FKD0214955ENN.pdf&ei=DuqWVKPKOubB7gbYqoDIDg&usg=AFQjCNGtGjXv4BzenYDBxtMI_l1q86DLcQ access: December 21,2014].

By observing data in the table above, we can conclude that the top 10 food retailers achieves one-sixth of turnover in European food retail trade. The largest share has a German retailer Schwarz of 2.5%, which is followed by the UK Tesco with 2.2% and Metro of Germany with 2.1%. Considering the size of the European market, it can be concluded that the top 10 retailers concentrate a significant volume of sales in the food retail trade. Concentration of turnover at top 5 grocery retailers in selected European countries in the 2012 illustrates the following picture:

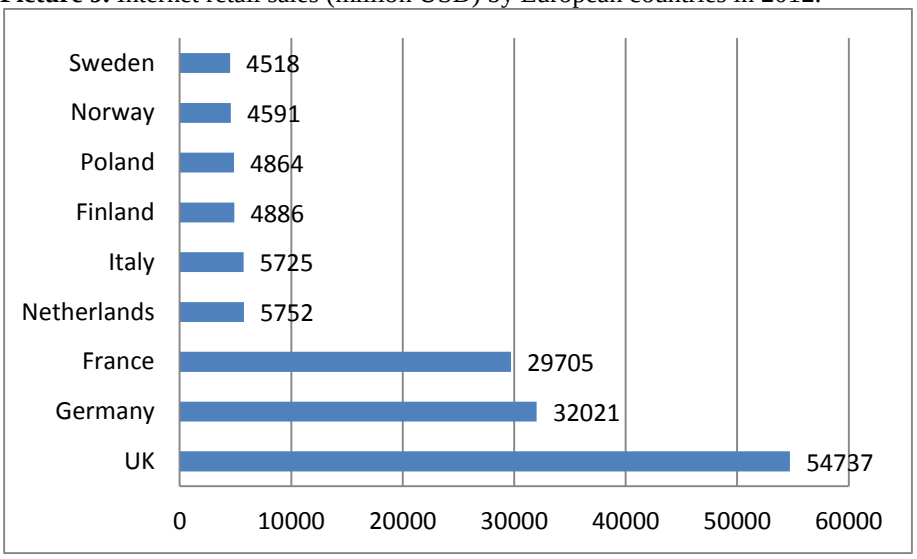
Picture 8. Concentration by country - market share Top 5 retailers (edible grocery), 2012.



Source: Author's reconstructions, Data: European Commission (2014). *The economic impact of modern retail on choice* and *innovation* in the EU food sector, Final Report, September, 2014. [available at: http://www.google.ba/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CB8QFjAA&url=http%3A%2F%2Fec.europa.eu%2Fcompetition%2Fpublications%2FKD0214955ENN.pdf&ei=DuqWVKPKOubB7gbYqoDIDg&usg=AFQjCNGtGjXv4BzenYDBxtMI_l1q86DLcQ access: December 21, 2014].

The concentration of sales in a small number of large retailers is also evident in other developed countries. In Finland, the domestic giants S Group, with a 42% value share, and Kesko Oyj with a 32% value share, continued to strengthen their positions in 2012. In Norway, the leading companies in 2012 were Norgesgruppen (32%), Coop Norge Handle (19%), Reitangruppen (17%) and ICA Norge (10%). These four companies dominate the highly consolidated grocery retail market in Norway. Norgesgruppen and Reitangruppen have continuously increased their market shares during the last few years [15]. E-commerce is one of the fastest growing markets in Europe. Internet retail sales by European countries in 2012 illustrated this picture:

Picture 9. Internet retail sales (million USD) by European countries in 2012.



Source: Autor`s constructions, Data: Hutchings, D. (2014). Global Perspective On Retail: Online Retailing, [available at: http://www.cushmanwakefield.com/en/research-and-insight/2013/global-perspectives-on-retail/ access: Januay 16, 2014].

Online retailers in only three countries, UK, Germany and France accounted for 71% of total European online sales.[5]

5. CONCLUSION

In last years, it is intensified the processes of retail concentration in the countries with developed market economy. Concentration is most evident in the food retail, but is evident growth the concentration and in other sectors retail. However, degree of the concentration in some countries is much different. Concentration of global retail turnover illustrates the information that prominent 250 global retailers in the 2012, with a common turnover of 4.29 trillion dollars achieved 29.4% share of the global retail turnover. About 69.6% of the 250 global retailers are located in six countries, and they have achieved 79.1% of total turnover of 250 global retailers. The largest number of global retailers are from the USA and they achieve the largest share of sales of 250 global retailers. In the Europe and in the United States concentrated two-thirds of the 250 world's leading retailers, resulting in a four-fifths (79%) of total turnover of the top 250 global retailers. Analysis of concentration of retail trade shows that the largest intensity of concentration of retail turnover (degree of concentration), measured by market share of leading retailers have developed European countries. Inside of the EU countries, the concentration of the retail trade became very strong.

[5] Online Retailing: Britain and Europe 2012, (2014). [available at: http://www.retailresearch.org/onlineretailing.php access: May 05, 2014].

At the end, we can conclude that concentration of retail led to strengthening of its role and domination in marketing channels. The processes of the trade concentration will continue to strength and trade policy will must to follow eventual influence of the concentration on possible monopolistic position and base on that to define the measures for preventing a monopolistic position.

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II. CHALLENGES OF PROCUREMENT AND DISTRIBUTION CHANNELS

PROCUREMENT PROCEDURES IN THE FUNCTION OF IMPROVING COMPANY BUSINESS CONDUCT

Željko Turkalj
Josip Juraj Strossmayer University of Osijek
Gajev trg 7, 31 000 Osijek, Croatia
Phone.: + 385 31 224 400
E-mail: turkalj@efos.hr

Dubravka Mahaček
State Audit Office, Regional Office Požega
Kamenita vrata 8, 34 000 Požega, Croatia
Faculty of Medicine in Osijek
Josip Juraj Strossmayer University of Osijek
Phone: +385 34 273 611
E-mail: dmahacek@vup.hr

Scientific paper

Abstract

The subject matter of this paper are activities related to the implementation of public procurement in companies owned by the Republic of Croatia. The field of public procurement is of great importance both for the economy and for companies, because it has positive effects on the economy, but also contributes to significant savings to clients, i.e. companies. The field of public procurement is the subject of interest of the public. Rational approach to public spending is a priority in EU Member States. Public procurement payers in the European Union are spending significant resources for procurement of goods, works and services. The efficiency of public procurement has become important for Member States. Public procurement is a field of interest in company business conduct. This paper examines the possibilities of improving the efficiency of public procurement in companies. The research is based on data on effectiveness audit of the procurement system in ten companies owned by the Republic of Croatia. The analysis of the value of procurement conducted, efficiency recommendations and the possibility of their influence on improving business conduct have been performed. This paper confirmed the importance of the implementation of procurement procedures and their meaning and impact on the world economy as a whole, and its importance for companies in improving business through activities in the field of implementation of recommendations related to the effectiveness of the procurement system. The analysis method is used to process data on the value of public procurement, and the method of synthesis combines the data and comparison method is used for comparison of companies. The opportunities for improving business by implementing the recommendations are different. The logistics system of the company has the task of ensuring optimal amounts of all material, information and value flows in the transformation process of the company.

Successfully planned, organized and connected all logistics functions are a prerequisite for making decisions on business conduct, which is reflected in the data reported in the financial statements that serve the owners, the public and other users. The auditor's opinion is a confirmation of the value and credibility of financial statements.

Key words: audit, public procurement, company, efficiency

1. INTRODUCTION

Companies operate in an environment that is constantly changing and evolving. In modern market conditions system management reduces uncertainty. The environment affects companies in a way that changes in the environment affect the company, but accompanies also affect changes. Knowing the situation in the environment became a necessity. The functioning of the elements of the system takes place by converting inputs (machinery, raw materials, financial resources, energy, human resources, etc.) into outputs (products, services, financial performance, etc.). As part of business process management companies establish goals, which also relate to procurement procedures. Supply should provide the necessary inputs at the lowest procurement cost. Effective procurement is one of the prerequisites for achieving set business objectives. The competence of the State Audit Office is also to conduct efficiency audits.

The term audit entails examination of documents, papers, statements, internal control and internal audit systems, accounting and financial procedures and other records in order to determine whether financial statements represent the factual financial position and results of financial activities in accordance with accepted accounting principles and accounting standards. The audit is also a procedure of examining financial transactions in terms of legal use of funds. Audit also includes an assessment of the efficiency and effectiveness of activities and an assessment of the effectiveness of achieving business goals or objectives of individual financial transactions, programs and projects (State Audit Office Act, Official Gazette 80/11, Article 7). The tasks of the audit are financial activities, as well as activities aimed at determining the effectiveness, cost-effectiveness and efficiency. In performance audit the auditor makes recommendations for improvements, which should help to strengthen accountability in the public sector, improve the activities related to the control and planning which will contribute to an efficient, effective and cost-effective use of public sector resources in achieving the desired goals. An audit of all functions in a company is based on the evidence, the compliance of all financial statements and determined criteria.

The logistics are activities used for planning, executing, implementing and controlling the space-time transformation of the goods and related transformation. Procurement procedures provide input and influence the course of the business process, therefore the audit may affect the improvement in these activities via recommendations. The success of management is confirmed through all business functions, both through the process of planning, organizing, managing, and the

function of logistics. This paper examines business conduct of companies and analyses the possibilities of improving the efficiency of public procurement. Through activities in the field of public procurement the use of resources of the public sector in achieving greater value for money is improved.

2. IMPORTANCE OF PUBLIC PROCUREMENT

2.1. Importance of Procurement in Economy

The importance of procurement in the economy is reflected in the fact that within the European Union priorities which complement each other stand out, and they refer to the "smart growth, development of economy based on knowledge and innovation, sustainable growth by promoting an economy that effectively exploit resources, which is greener and more competitive and inclusive growth with high employment rate, which brings social and territorial cohesion" (European Commission, 2010, p. 6). The Strategy states that public procurement policies must ensure the most efficient use of public funds and that procurement markets must be kept open throughout the European Union.

The economic situation requires rational approach to public spending, thus the efficiency of public procurement has become a priority for all Member States. The importance of this sector stems from the fact that 20.0 % of GDP at the European Union level is consumed by the institutions and public authorities, as well as other public entities, through procedures that involve the purchase of products, services and works (Anti-fraud measures in public procurement in the EU single market, legal, institutional and technical solutions, p. 1).

Logistics involves a series of activities carried out with an aim of efficient movement of necessary inputs. There are many definitions of logistics. One of them is "Logistics entails the totality of activities in setting up, securing and improving the availability of all people and resources, which are assumptions, assistance or insurance for flows within a single system" (Segetlija & Lamza-Maronić, 2000, p. 83, taken from: Entwurf DIN 69906, according to: Rupper, Hrsg. 1991, p. 7). From the above, we can see the importance of ensuring delivery of the right product, at the right time, at the right place, and in the right form, and at minimal cost. Logistics can also be understood as a system of flow of goods, materials and energy that connects procurement markets to the places of production and consumption. The above can be applied to business conducts of companies owned by the Republic of Croatia, which are investigated in this paper. It is necessary to carry out the procurement of goods, works and services required for the business, but at minimum cost. Therefore, the implementation of procurement procedures has a significant role. The paper analyses the value of procurements conducted in companies.

Within the frame of economic system companies are subsystems: production, sales, research and development, procurement, finance, human resources, information and others. In this respect, the logistics for managing business processes stands out, within containing logistics objectives for individual business functions. Logistics procurement objectives are: the main goal highlighted is to provide the necessary raw

materials, components and semi-finished products for production at the lowest cost, while individual targets include delivery of materials and parts required in accordance with contracts, delivery of materials or parts directly from suppliers and from own warehouse at the lowest costs of preparation, minimizing inventory and parts required for the production, arranging short delivery times with suppliers and more. Logistics can influence the achievement of rationalization, and can ensure competitive advantage of the company. For companies involved in trade there is no production, and consequently there is no logistics of production, but flows of information are very significant. Audit is also affected by the application of information technology in business conducts of companies. Using information technology increases the number of trade relations, which affects the process of audit since the auditor has to examine increased number of transactions.

International Organization of Supreme Audit Institutions has issued standards. The ISSAI 300 standard (International Standards of Supreme Audit Institutions) provides Fundamental Principles of Performance Auditing. The definition of performance audits is: "As carried out by SAIs, performance auditing is an independent, objective and reliable examination of whether government undertakings, systems, operations, programs, activities or organizations are operating in accordance with the principles of economy, efficiency and effectiveness and whether there is room for improvement" (INTOSAI, ISSAI 300, item 9, p. 2). From the above we can see that audit subject depends on set audit goal, i.e. parts of a certain whole can be audited, depending on the public interest.

This paper examines the field of procurement of goods, works and services using the example of audited companies and issued recommendations within the frame of public procurement with an aim of reducing costs and improving business conducts.

2.2. Public Procurement in Companies

Public procurement is regulated by the Public Procurement Act. From a total of ten companies, five companies were obliged to apply the said Act, and five companies were not obliged to apply the aforementioned Act.

The total value of public procurement for ten companies, from 2011 to 2013 amounted to HRK 17,453,129,837.00 (Report on performed efficiency audit of public procurement systems in companies owned by the Republic of Croatia, 2014, p. 2). Table 1 provides an overview of companies and procurement values from 2011 to 2013. From these data we can see that the value of public procurement is significant and, therefore, the field of procurement deserves great importance. Two companies have a share of 82.62 % in the total value of procurement, while remaining eight companies only have a share of 17.38 % in overall procurement value.

Five companies were obliged to apply the aforementioned Act: Rijeka-Zagreb Highway, company for motorway construction and management JSC, HEP Plin Ltd.; Hrvatska Elektroprivreda (HEP) JSC, Croatian Motorways Ltd. and Jadrolinija. The total value of procurement by companies that are subject to the Act is HRK 16,367,345,130.00 or 93.78 % of the total value of public procurement of audited companies. Of five companies obliged to apply the Act, two companies have a share of 82.62 %, whereas three companies have shares that are individually less than

10.0%. The remaining five companies that are not obliged to apply the Act have only a share of 6.22 % in overall procurement, and only one company has a significant share, while the other four companies have an individual share amounting to less than 1.00 %.

Table 1. The value of public procurement of companies from 2011 to 2013 in HRK

Number	Company name	Public procurement value	Share in %
1.	Adriatic Croatia International Club JSC	94,403,952.00	0.54
2.	Medena Apartments JSC	12,532,031.00	0.07
3.	Rijeka-Zagreb Highway, company for motorway construction and management, JSC	358,558,418.00	2.05
4.	HEP-Plin Ltd.	42,664,202.00	0.24
5.	Hrvatska Elektroprivreda (HEP) JSC	9,143,356,742.00	52.39
6.	Croatian Motorways Ltd.	5,276,353,161.00	30.23
7.	Jadranski naftovod JSC	824,584,544.00	4.72
8.	Jadrolinija	1,546,412,607.00	8.87
9.	Kaštela Greenhouses JSC	11,276,473.00	0.07
10.	Port of Rijeka JSC	142,987,707.00	0.82
Total		17,453,129,837.00	100

Source: Table drafted by the authors according to the Report on performed efficiency audit of public procurement systems in companies owned by the Republic of Croatia, 2014, p. 3.

In order to make conclusions on the effectiveness of the procurement system in the observed companies, we defined sub-issues relating to the organization of procurement planning, prescribed ways of managing public procurement procedures and the establishment of a system of controls that monitor the enforcement and application of the agreement and whether the procured goods, works and services ensured the realization of planed goals, i.e. whether the efficiency of the company has been improved.

After the audit recommendations were given to companies in three areas. In the area of procurement planning a recommendation was given to all companies, as is the case in the area of public procurement procedures management, while in the area of

monitoring the enforcement and implementation of the agreements the recommendation was given to eight companies.

2.3. Analysis of Possibilities for Improving Public Procurement Efficiency

Through activities in the field of public procurement it is possible to improve business conduct and thus affect the achievement of the objectives of the organization. "In addition to the executive tasks in the field of procurement, storage, internal transport, handling of raw materials, semi-finished goods, etc., the logistics entails the use of decision-making model regarding the performance of these activities" (Segetlija & Lamza-Maronić, 2000, p. 88). From the aforementioned, we conclude that making decisions regarding the performance of activities, should also be paid attention to since the goal is not just to perform the procurement, it involves meeting other objectives (with minimum financial resources, a certain quality, etc.), which ultimately affects the whole organization.

One of frequent questions is inventory. Therefore, models of inventory management deal with questions how often clients should order additional raw materials and how to order them and how many products should be manufactured in a given period in order to ensure that stocks of finished goods are sufficient. „Effective management is much more than just a question of working with numbers. A successful manager relies on common sense and intuition; on sensibility for people who cannot be quantified; and the creativity that goes beyond the numbers" (Collins & Devanna, 2002, p. 95). This confirms that managing the inventory necessary for business requires computational justification, but includes elements that cannot be quantified. Effective inventory management can result in a significant increase in profits with companies that have large amounts of capital tied in the inventory or those that lose sales because their stocks are constantly empty.

Stocks is an area covered by audits, by checking contracts, payments, account balances and more. The auditor in his work uses a variety of methods, including the method of samples. „The starting point in assessing the accuracy and fairness of the financial statements is sufficient evidence on which the auditor can form an opinion and a make a conclusion on the audited financial statements. In order for an auditor to in a very short time gain insight into the company's business and to check the validity and accuracy of individual transactions and events in a certain company, method of samples can be of great help "(Crnković et al., 2010, p. 134). Method of samples is gaining importance when checking the condition of individual accounts, and is often used to draw conclusions related to stocks. For companies that are included in this paper, recommendations are also made regarding stocks. After examining the individual audit on the effectiveness of performed public procurement, six companies had registered stocks. It was noted that the majority of companies had not established optimal inventory and procurement is performed on the basis of empirical methods. Written procedures on stock goods policies had not been established. For a company which had the largest stocks of all companies included in this study, the audit process found that the accounting policies of the inventories were used for determining goods or asset that constitute stocks (spare parts, supplies, small inventory in stock and in use) and that they had been evaluated according to their cost

or net market value, whichever is lower (Report on Performed Procurement Audit in Jadranski naftovod JSC Company., 2014, p. 5). Cost includes expenditures incurred by purchasing and bringing the inventories to the current situation and to their current location. Expenses are determined by using the weighted average method.

Within the audit of procurement cycle it is characteristic that it is the implementation of procedures that are not demanding, but it is assumed that misstatement are more likely than in other accounts. Business events in procurement procedure are procurement of goods and services for money or with deferred payment, payment of obligations, and return of goods to the supplier. These business events affect the accounts payables to suppliers, stocks, cost of goods sold, different accounts of assets and expenditures, monetary funds and more. The course of procurement cycle is followed by different documents: procurement orders, purchase orders, receiving reports, incoming invoices, payment authorizations, statements and more.

"The main objectives of the procurement cycle are acquisition of goods and services at the lowest cost consistent with the required quality and the effective use of available money for paying goods and services" (Messier, 1998, p. 443).

Audit procedures are used for validating business events, completeness, timeliness, approval, the acquisition price, record in the prescribed accounts, computational accuracy, and business activities related to payment (approval, recording period, amount, transfer to general ledger, etc.). Options for improving efficiency are observed in the three areas described below.

2.3.1. Public Procurement Planning

In the field of public procurement planning irregularities are frequent, which was established for all companies and recommendations had been issued in order to increase efficiency. The meaning of planning in the business process is of extreme importance.

In the audit process analytical methods are used to test financial information. Analytical methods referred include "comparison of financial information for the current year with comparable information for the previous period after taking into account known changes; comparison of financial information for the current year with budgets, projections and forecasts; the relationships between elements of financial information for the current period; comparison of the principal's financial information with the information for the overall activity; and the relationship between financial and non-financial information "(Messier, 1998, p. 166).

Analytical methods have been applied in the observed companies, comparing the planned procurement value with realized values. Often applied comparison is comparison of values from one year compared to the values of other years. In this way we come to conclusions regarding unusual items or items that have been planned, but have not been performed or have been performed, but have not been planned. The importance of procurement plan stands out because its drafting is prescribed by legal provisions.

Irregularities in the field of procurement planning are common, and most common irregularities are:

- Procedures which would determine obligations of users and organizational units in procurement planning have not been adopted
- There is no written evidence of requirements of organizational units and conducted market research, which serves as a basis for making procurement plan
- Procurement plans have not been adopted or have not been adopted before the beginning of the appropriate financial year, and have not been published on the website
- Certain planned procurement procedures have not been undertaken
- Lack of written explanations regarding deviations from planned achievements
- In some procurement cases, particularly urgent ones, there is no written explanation justifying the procurement
- Annual financial plans do not contain elaborately explained positions and connection with positions in planned procurements
- Procurement plans do not include information on the procurement and the estimated value of procurement for items whose estimated procurement value is equal to or greater than HRK 20,000.00 and less than HRK 70,000.00
- Internal acts which would regulate procurement of goods and services of estimated value up to HRK 200,000.00, i.e. HRK 500,000.00 for procurement of works have not been adopted.

Based on the established irregularities, in order to improve operations, we recommend adopting written procedures for planned procurement, drafting a procurement plan with all the required elements, foresee dynamics of procurement and procurement period, assessing the feasibility of planned procurements, preparing written reasons for deviations from planned achievements, i.e. paying more attention to planning etc. From all these irregularities and given recommendations we can confirm the importance and impact of planning on overall business conduct.

2.3.2. Public Procurement Procedures Management

Irregularities in management of public procurement procedures are common, and most common irregularities are:
- Companies have no internal regulations on procurement procedures management
- Ordinances on application, use and maintenance of purchased goods and equipment, and performance of services have not been drafted
- Before implementation of procurement procedures an analysis of the most appropriate and most convenient procurement method (selection procedures) has not been performed
- For some of the works volume has not been determined, and for certain goods no fixed quantity has been determined
- Omissions in offer analysis, since the offer analysis has not been carried out in accordance with tender documentation
- Companies have investigated market prices, but failed to identify methods of market research and analysis according to a particular object of procurement
- Some companies have not investigated market prices, but have been procuring goods and services from the same suppliers

- Companies – obliged to apply Public Procurement Act have entered into a framework agreements upon completing the negotiation procedures without prior publication, and were obliged to conduct open public procurement procedures
- Companies have procured goods directly from suppliers, without applying the prescribed procurement procedures
- Agreements on procurement of goods, works or service had no provisions regarding penalties for failure to fulfil obligations by the contracted period
- Deadlines for performing the works, i.e. provide services, have not been realistically established and agreement amendments had to be drafted for extending deadlines
- Some companies failed to determine by how much working days contracted construction period had been exceeded and failed to calculate and collect contracted fines
- In some cases different prices had been contracted for the same type of work, not bank guarantees have been given for good performance, and agreements have not been concluded in accordance with offers
- Registers of procurement agreements and framework agreement have not been established
- Deficiencies and omissions have been noted in public procurement procedures and procedures not in accordance with the provisions of the Public Procurement Act
- Companies failed to paid attention to procurement risk assessment and in some cases companies have paid default interest for untimely introduction into business
- Employees who perform procurement tasks have not received adequate training
- Some companies have not established optimal inventory and failed to draft a strategy on inventory management.

Based on the established irregularities, recommendation were issued with an aim of improving public procurement procedures management and some of those recommendations are listed in this paper. The following was recommended: adoption of written procedures to consolidate the manner of management and accountability in the implementation of procurement procedures; to determine which procurement method is the most favourable for the company in order to achieve the best price and the lowest cost; to monitor prices of goods, works and services on the market, and to determine via the internal act the method of analysis of market prices according to the particular procurement case; to establish equivalent work and implement a unified public procurement; to allow the participation of a large number of bidders in the procurement procedures; when viewing the price of items of bill of costs and choice of an offer, to take into account that equal prices are contracted for equal works; to effectively manage procurement risk; to analyse procurement costs according to type and value for the implementation of the appropriate procurement process and the realization of potential savings; regular measurement of value achieved for the money spent; to consider the possibility of cooperation with companies from neighbouring countries that deal with similar work for the application of best practices in procurement procedures; to determine the optimal inventory and to adopt a strategy of inventory management; to occasionally check whether the goods received are of the same quality as the sample on the basis of which the supplier has been chosen and others. Recommendations on improving public procurement procedures management affect all business functions and all resources in a company (material and human).

2.3.3. Monitoring and Enforcing Agreements

In the area of monitoring and enforcing agreements the following has been determined:
- Procurement control that ensures the legality and regularity of procurement procedures has not been established
- Systematic monitoring and comparison of suppliers during certain period of time, i.e. price of goods, works and services being procured and regularity of agreement execution has not been established
- Systematic monitoring and analysis of total funds spent for procurement in order to improve procurement procedures, i.e. for determining contracting strategy, has not been established
- Services more expensive than contracted have been executed and works that had not been contracted had been executed
- Received goods had not been analysed according to the provisions of the agreement, and bills of costs have not been drafted according to prices of individual services, items or parts procured
- Companies have no records for monitoring execution of individual agreements on public procurement of services,
- Companies have no analysis of utilization of existing vehicles and a feasibility analysis regarding renting personal and commercial vehicles
- In some companies internal audit is not established, while in others it failed to conduct a systematic monitoring of legality and regularity of procurement procedures, but performed occasional monitoring pursuant to individual management requests
- Internal Audit Service failed to perform public procurement procedures audit
- Companies failed to timely submit the notification on agreements concluded for publication in electronic public procurement advertiser.

Based on the established irregularities, recommendation were issued with an aim of improving public procurement procedures management and some of those recommendations are listed in this paper. The following was recommended: to establish records for monitoring execution of individual agreements on public procurement of services; to compile an overview of most common irregularities, problems, perceived failures and errors with suggestions for their elimination and reduction according to individual procurement item; to establish a mechanism of evaluating conducted procurements and inform senior management on the results; to determine the risks in performing public procurement procedures according to procurement items; to monitor and analyse costs by type, value and applied method of procurement to improve procurement procedures; to conduct utilization analysis of utilization of existing vehicles and a feasibility analysis regarding renting personal and commercial vehicles; to establish internal audit and encompass within it public procurement procedures etc. It is not enough just to plan and execute procurement. It is also necessary to pay attention to monitoring the implementation of what has been contracted. That notion is confirmed by irregularities and recommendations made in the area of monitoring and enforcing agreements.

3. CONCLUSION

Public procurement efficiency is an important question of all EU Member States, because of the need for a rational approach to public spending. Within the frame of business conduct of companies covered by this paper, the importance of public procurement has been confirmed and the importance of said field in business conduct of companies. This paper examines the possibilities for improving public procurement effectiveness in companies. Improving business conduct of companies is needed for ensuring better business results, but it is also public interest. Through the implementation of recommendations in the field of public procurement it is expected to achieve higher levels of public accountability for the economic and rational management of resources, but also to ensure significant savings. It is necessary to achieve greater transparency in procurement procedures. Changes in the environment affect the business environment, and public procurement procedures allow participation in the proceedings in the European Union. In all ten companies public procurement system was not fully effective. Business conduct improvement is possible and necessary, as confirmed by numerous recommendations. Monitoring the implementation of recommendations is an integral part of the audit procedure. Further audit procedures shall determine which recommendations companies acted on and how the implementation of recommendation has affected efficiency in the field of public procurement.

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ALGORITHM FOR THE PROCUREMENT AND INVENTORY MANAGEMENT IN THE DISTRIBUTION SUPPLY CHAIN

Valery F. Lukinykh
Krasnoyarsk State Agrarian University
90, Mira str., Krasnoyarsk, 660049, Russia
Phone: +7(391)2273609
E-mail: lukinih_vf@mail.ru

Yulia V. Lukinykh
Russian State Social University, branch in Krasnoyarsk
11, Mozhaiskogo str., Krasnoyarsk, Russia
Phone: +7(391)2463025
E-mail: yulla@bk.ru

Scientific paper

Abstract

This paper is devoted to practical testing of the developed method of harmonized volumes of purchased products in the retail networks. The problem is connected with a difficulty of forecasting demand and inventory products based on the existing methods. The peculiarity of this paper is to present a developed method of harmonic prediction of the volume and variety of the purchased and sold products in retail networks in non-stationary demand, which contributes to the development of the methods ABC and XYZ classifications. To apply the developed method of harmonization in order to optimize the inventory of the products, an algorithm for the application of the harmonization method in the supply chain has been developed and described. This allows reducing the time intervals in procurement, optimizing inventory, expediting information acquisition, improving the level of logistics services and ensuring sustainable operation of enterprises in the value chain, having the changing demand and supply.

Key words: inventory management, procurement management, supply chains, product groups, harmonization matrix

1. INTRODUCTION

The necessity to improve the distribution networks of the companies is due to market trends, where currently the main competitors have equal opportunities and potentials.

The market success largely depends on an effective system of procurement and inventory management in supply chains of commodity production, which is based on the strategic assets of logistics management.

Strategic assets of the logistics management of the company are, above all, management resources, exceeding similar resources of the competitors; and strategic competencies are strategically significant activities for the company, where the improvement of the system of management of commodity flows takes place. Thus, there is an actual task of working out the algorithm of procurement and inventory management in the distribution network and recommendations for improving the system of inventory management that may eventually become the basis for creating sustainable competitive advantage for the company in the foreseeable future in the market.

2. PREREQUISITIES TO IMPROVING DISTRIBUTION IN THE SUPPLY CHAINS

It is known that the main functions of distribution logistics are the following:

1) definition of consumer demand and its satisfaction;

2) establishment of economic relations on the supply of goods, rendering of services to consumers;

3) building an organizational scheme of distribution channels;

4) accumulation, sorting and arrangement of stocks of the finished products;

5) transportation of the finished products, returnable containers;

6) consolidation and dispersal of goods;

7) choice of the rational forms of physical distribution and trade organization;

8) maintaining quality standards of the finished products and logistics services;

9) monitoring and information support of the distribution.

From the list of functions one can identify the basic function group responsible for the inventory, stock and the dynamic compliance of the supply and demand of goods on the consumer market, namely, points 1,3, 4, 6, 9, that is five points out of nine, or about 60% of the activities in the distribution.

The most important principle is the principle of consistency, which allows improving the distribution process. The distribution system is not an arbitrary combination of elements, but a combination of interrelated and interdependent parts of the whole.

The set of distribution goals has three dimensions: economic goals generally coincide with the company's goals and aim at the maximization of profits; quantitative goals — sales increase, increase of the firm`s share in a certain market segment, increasing the speed of turnover, etc.; quality goals — quality of service, reliable customer feedback, precise knowledge of customer`s requirements to company goals. These goals are specific to each company. They can also include such tasks as accelerating the sale of the most profitable goods, getting rid of excessive stocks of the finished products, giving regularity to the sales of seasonal products, reviving the sale of goods, etc. The principle of adequacy of the logistics distribution channels with market demands is in the basis of these tasks.

The main stages in this system are the following:

• planning using forecasting, and monitoring of actual performance in distribution channels of the network;

• working out a schedule for providing the subjects of distribution channels with specific dates, number of products, range of products;

• calculation of the necessity of stocks of the material resources.

The participants of the distribution channel must work together to ensure the market requirements to the product line, i.e. qualitative and quantitative composition of the products, aimed at meeting the specific needs of the consumer considering the demand factors associated with the arrangement of retail businesses such as:

• town planning – city size, population density, location of administrative and cultural buildings;

• transport - main directions and intensity of traffic flows, growth of individual transport, availability of public transport bus-stops;

• social - demographics of the population, reducing the time for acquisition of goods, creating the conditions for a high service culture;

• economic – efficiency of commercial and warehouse areas, increasing the profitability of stores, material incentives for the staff.

The plurality of factors defines the tasks of marketing analysis in distribution supply chains:

• forecasting of market development;

• analysis of the competitiveness of the products;

• forecasting of competitors ' actions;

• forecasting of consumer`s preferences;

• commercial risk analysis.

The solution of marketing analysis tasks involves the use of extensive methodologies. One identifies the following quantitative methods:

• multivariate methods (factor and cluster analyses) are used to survey marketing solutions, which are based on numerous interrelated variables;

• method of statistical theory of decision making (Queuing theory, game theory) is applied to probabilistic description of the consumers` response to the changes in the market;

• deterministic methods of operations research (linear and nonlinear programming) are used to make optimal decisions having many interrelated variables;

• simulation methods are used when the elements that define a marketing situation, are not amenable to analytical solutions;

• regression and correlation methods are used to determine relationships between the variables describing the marketing activities;

• models of network planning and management are used to determine the sequence of work in dealing with various marketing tasks.

The idea of balance between supply and demand of goods in the market is the unifying beginning of the analysis and forecasting methods.

In this case the evolution of algorithms of procurement and inventory management shows that researchers often use the algorithms based on regression and correlation analysis. In the centre of the optimization phase of the algorithms is a well-known formula of Wilson-Harrison, which is often called the formula of optimization the procurement size EOQ. Limitations of the applicability conditions of the specified expression, observed in the works by D. J. Bowersox (Bowersox, 2005) and V. S. Lukinsky (Lukinsky, 2007) are associated with the static representation of the

business process in the form of sale and purchase transactions. Their findings can be applied to a single enterprise in the stationary conditions of supply and demand in a limited time interval. What should be used in dynamic supply chains with seasonal variations? The answer to this question is presented in this study.

3. MATRIX METHOD OF HARMONIZATION OF STOCK AND PROCUREMENT SIZE

The problem of assessing and monitoring the balance of commodity flows indicators was to some extent investigated in some works (Footlik, 2004; Sergeev, 2001; Sterligova, 2008; Kharitonov, 1999). Unlike the published materials, the authors of the present study investigated the conditions for the application of harmonic approach to solving this problem.

To synthesize the method of balanced indices there were used the Pareto principle, methods of ABC - and XYZ - classifications, the Fibonacci number series and the proportions of the "Golden ratio".

There are studies that describe the Pareto principle, or 80/20 rule (Footlik, 2004; Kharitonov, 1999). The application of this rule to the management of resources is called the ABC-classification. As noted by T. Vasilenko, "the system of ABC-classification is the most developed application of the 80/20 rule" (Vasilenko, 2004). A detailed history and interpretation of this principle can be found in (Koch, 1995).

This method of classification has developed due to its versatility and efficiency. As classification criteria there may be: the purchase price; sales revenue; profit share; share of total turnover; return on sales; the average inventory level; the share in the created stocks; the period (speed) of the turnover of the stock.

Based on the analysis of selected criterion, the groups of products or services are combined according to the degree of influence on the overall result to subgroups A, B, C. The basis of grouping in business is most often the amount of sales revenue earned in a particular group.

The basic approach of applying ABC classification, in our opinion, is the harmonization of quantitative values for a range of products in each group classification in accordance with demand.

The definition of assortment groups in the modern method of ABC - classification is based on the Pareto principle (tab.1). According to it in the analysis of income one distinguishes three groups: group "A" (about 20% of stock keeping units (SKUs), the amount of shares with the cumulative total of which makes up the first 80% of total income), group "B" (about 30% of SKUs, the amount of shares with the cumulative total of which is about 15% of total income) and group "C" (the remaining 50% of SKUs, the amount of shares with the cumulative total of which is about 5 % of total income). To assess the dynamics of changes in the sales structure it is also possible to compare the results of the ABC - classification for the current period and for the previous one.

Table 1. Grouping of goods by income shares

Group on the level of sales	Number of goods (% of total)	Cost of sales (income as % of total income)
A	20	80
B	30	15
C	50	5

Source: Lukinykh, 2008.

There is an important statement that "recommendations for the inventory management items with ABC classifications are of universal character" (Sterligova, 2008, p.89), that allows making the algorithms of management decisions in relation to the inventory movement, and making recommendations for the inventory management of the operational type in subsystems of the distribution channels of supply chains in retail networks.

The use of ABC classification for harmonization of a stock-list and inventory is an effective tool for analysis, but it is problematic for prediction. Therefore, we investigated the relationship of ABC, XYZ classifications and Fibonacci numerical series based on the trading industry data.

The principle of stock differentiation in the method of demand analysis of XYZ is different. Because this method affects the stochastic sphere of market relations, namely the dependence of demand on the varieties of stock, in this case, the entire stock requested by the consumers is divided into three groups depending on the demand stability. Thus, group X includes the goods with stable demand and deviation of not more than 20% from the average demand. Group Y includes the goods with the size of the deviation from the average demand in the interval of 20-50% and group Z - with a size of deviation of 50 % or more (tab. 2).

Table 2. The algorithm of differentiation on XYZ groups

Groups	Interval of demand variation, %
X	less than 20%
Y	from 20 to 50%
Z	more than 50%

Source: Lukinykh, 2008.

To assess the deviation indicators from the average demand, the coefficient of demand variation Y is used, which is determined by the following formula, taking into account the standard deviation:

$$Y = \frac{\sqrt{\frac{\sum_{i=1}^{n}\left(x_i - \overline{x}\right)^2}{n}}}{\overline{x}} 100\ \%, \qquad (1)$$

where *Xi* is the *i*-th value of demand by the estimated position; *x* – average demand estimated position for the period *n*, for example, in days; *n* – size of an assessed period (e.g., in days).

Combining the results of the analysis of the ABC - and XYZ - classifications allows us to generate a matrix values table for the analysis and forecasting of the demand and stock-list (table 3).

The possibility of application of this table is interpreted in the existing literature as follows: subgroups AX, AY, AZ require individual management; subgroups CX, CY, CZ are controlled by a year planning with a monthly availability control; subgroups BX, BY, BZ require less rigid planning and control than in the first subgroups, and more rigid planning and control than in the second sub-groups (Sterligova, 2008).

Table 3. Harmonization matrix of ABC-XYZ-classifications

	20	30	50
20	AX	AY	AZ
30	BX	BY	BZ
50	CX	CY	CZ

Source: Lukinykh, 2008.

We can say that this interpretation of the combining of groups analysis of ABC - and XYZ - classifications into a single table doesn`t have quantitative forecasting as necessary.

It is proposed to improve this method and supplement it with the ratios of ABC - and XYZ – classification like 20:30:50. This offer is substantiated by the fact that the ratio of the values of the subgroups in the vertical and horizontal rows is close enough to number F – number of the Golden ratio underlying the Fibonacci numerical series, that is, reflect the harmonization effect. It is proposed to express this method in the form of a table and call it as a harmonization matrix, because it combines the Pareto principle and Fibonacci numerical series, and that is related to the concept of harmonization in the terms of constant demand. In this case, the values of the parameters ratios of the two neighboring subgroups are in accordance with the criterion of stability of the system studied.

The criterion of stability of the distribution system is determined on the basis of preserving the ratios between the yields of commodity groups in adjacent sectors of the harmonization matrix as follows. As can be seen from table 3 the ratio of the number of SKUs between the groups lies in the number of 0.6, namely: range of group A refers to the range of group B as 0.6. Similarly, the range of group B refers to the range of group C = 0.6. This coefficient is correlated with a universal stability criterion of the system known as "Golden ratio". Further, based on the principle of Pareto group A is about 80% of the revenue, group B– about 15%, group C – about 5%. It is seen that the ratio 80/15 is equal to 5 and 15/5 is equal to 3, and the coupling ratios of 3/5

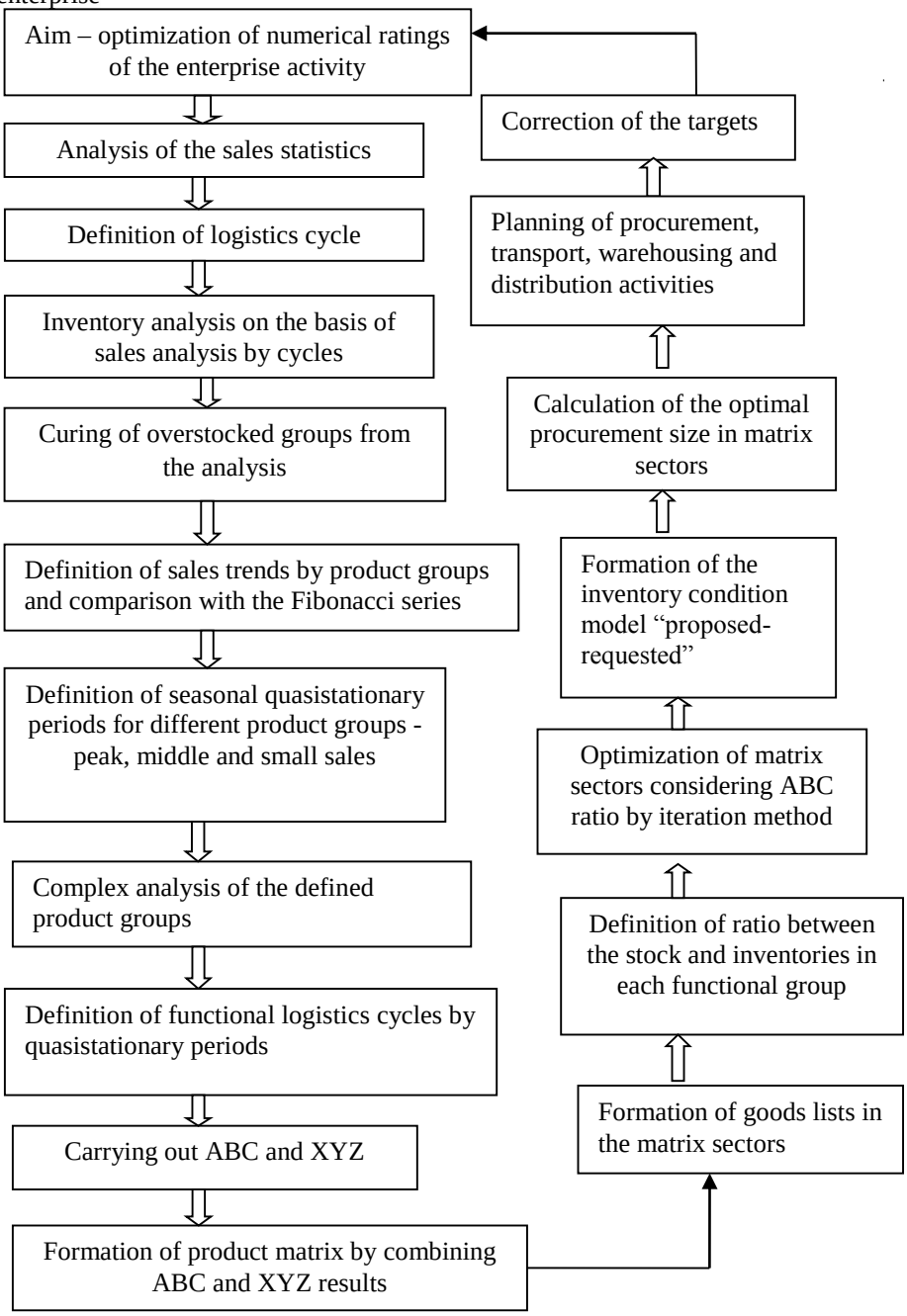
gives the parameter of 0.6. As a result of our observations, it was concluded that support in practice the above ratios characterizes the stability region of supply and demand in the local retail market with stochastic demand. These ratios are shown in table. 3.

Thus, turning to the analysis of the applicability of ABC, XYZ classifications, it is possible to determine that the use of the harmonization matrix is identified as a method allowing to distribute the available resources in the system by the rules close to the harmonious ones at the enterprises, i.e. to ensure the allocation of system resources which can best ensure its harmonized and, as a consequence, sustainable development.

The method is developed for coordination between the manufactured products and the demanded ones in the market. ABC - and XYZ – classifications are considered as the ones which express evaluation of the products offered in the market (ABC) and real stochastic market demand (XYZ), respectively. The optimality criterion of the relationship between two analyzed evaluations is a cumulative curve diagram of ABC classification with the settings of the Fibonacci series, and the quantitative relations are defined using the matrix method of harmonization. In this interpretation it is possible to carry out forecasting of the product matrix ABC–XYZ for the selected market segments and product groups on the basis of statistical data of sales results.

This method of forming the nomenclature matrix captures the essence of the harmonic approach to the balance of supply and demand in a market environment when generalized economic indicators of the company are given. It can be considered as an applied method on the wording “made–requested”, which allows predicting the inventory item groups of goods in the trade enterprises. For the method “proposed-requested” the algorithm of harmonization of stocks and market resources is developed (Fig. 1) (Lukinykh, 2008).

Figure 1. The algorithm of stock-lists and market resources harmonization in the enterprise



Source: Lukinykh, 2008.

4. METHOD APPROBATION

The method was tested in "SuperSport" company which was founded in 2001. It includes eight sports shops that specialize in the sale of goods for the following kinds of sports: Alpine skiing, snowboarding, cross-country skiing, hockey, figure skating, biking, hiking, boxing, swimming, tennis, soccer, fitness and many others. The stock includes more than 20,000 kinds of goods for sports and rest. The company is engaged in retail and wholesale of sporting goods. The company operates on two sites of online stores, participates in the auctions. It has its own distribution warehouse. Today, there are 8 stores in five cities in the region. All stores are united in a retail chain of sports shops.

Trade policy of the company includes the necessary stock of sporting goods in accordance with the market situation, both in depth and breadth in most demanded SKUs.

Pricing policy is aimed at providing highly profitable activity of the company on the sports market, quick adaptation to the changing market conditions considering the average level of prices for the same products of the major competing companies in the region. There is a tendency taken into account that the location of stores in strategic places is a factor whose value is becoming smaller. A much more important factor is the breadth of product range.

Practice shows that currently the technology sales has reached a level that competing products do not differ in their consumer properties from each other. Therefore, in order to win the competition active market participants resort most frequently to two methods. For example, the famous Western marketers propose to use the method of integrated marketing communications (IMC). Marketing program based on this method is a single, multi-channel and synchronized communication, focused on the establishment of personified bilateral relations with different target audiences, for each of which its own model is selected. This implies that various elements of marketing communication, such as direct marketing, sales promotion, trade shows, advertising in media, public relations, live communication with potential customers have to be well coordinated. The skillful synthesis and coordination of various marketing communication tools makes a so-called synergy effect, when the combined use of marketing tools leads to a stronger and stimulating effect than their inconsistent use. The inherent advantages of each tool of marketing communications in this scheme reinforce each other, and the disadvantages of individual instruments are offset and disappear.

The second method is based on reducing overall distribution costs and improving customer service, primarily through the proper use of logistics tools. In this case the main emphasis is on improving the usefulness of the material product and the related service from the point of view of the consumer that requires a change of management style in the direction of establishing deeper and sustainable relationships with consumers, formation of material and service systems with flexible management structures, which are able to respond quickly to the increasing consumers demands.

Characteristics of effective sports activities on the market are:

- maximum use of modern information technologies, which are the main base of progressive forms of product distribution;

- a constant search for the optimum ratio of the useful effect of product distribution with the costs on its organization, taking into account the company's chosen strategic priorities;

- the optimal combination of specialization and diversification to meet the ever increasing demands of consumers in the better way;

- development of infrastructure, contributing to the reduction of the cycle of products and services distribution from a producer to a consumer.

Given this, it is advisable to list the basic managerial tasks of the company "Super Sport" which should include:

1. Constant study of the condition and trends of development of the market of sporting goods not only on the regional, but also on the international market.

2. A study of potential target audience`s demand in three main parameters: segmentation; the motives of demand; unfilled demands.

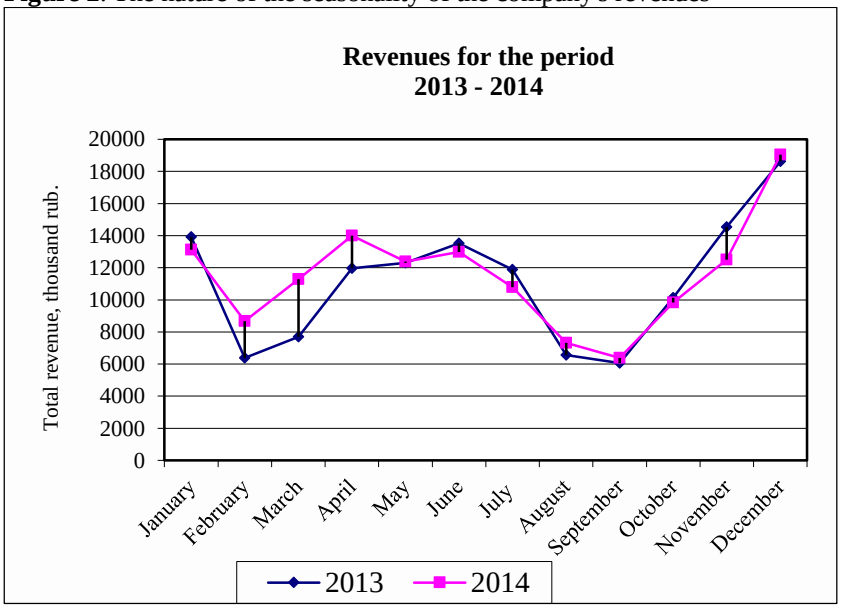
3. The analysis of competitors ' activities, and quick response to certain circumstances.

4. Standardization of the consumer`s service based on the concept of total quality control of products sold.

It should be noted that the company lacked an effective and flexible method of matching supply and demand in the whole network of stores.

SKU range varies by the seasons both by offer and demand. There are two main seasons on the range at the sporting goods market: fall / winter and spring / summer. Fig.2 reflects the turnover for two years on a monthly basis.

Figure 2. The nature of the seasonality of the company's revenues



Source: data of the company “SuperSport”

It can be seen on the graph that the highest peak of shopping is in December or January. It is due to the fact that at this time Russians celebrate the main holidays such as New Year and Christmas, consequently people buy gifts for themselves and their relatives and friends. It should be noted that there are off-season periods, when the demand for a range of sporting goods decreases, correspondingly does the revenue. This tendency is annually observed as can be seen in figure 2 for the period of 2013 and 2014. Therefore, procurement of the key seasonal items and sustaining the range should be based on primary seasons.

Analysis of the development conditions of the distribution network of the company showed some discrepancy between the volumes of the purchased goods and the realized ones. That allowed introducing the harmonized method of making goods volumes to increase sustainability of sales volumes. It was recommended to optimize stocks by moving goods between the stores on the basis of the matrix ABC - XYZ analysis.

To optimize the range of products, matrix ABC - XYZ analysis for each store was made separately by product groups. According to the analysis, each store varies in the number and revenue on the priority commodities, and the demand for them. This difference is influenced by geographic location, income level in the region, trade area and the range.

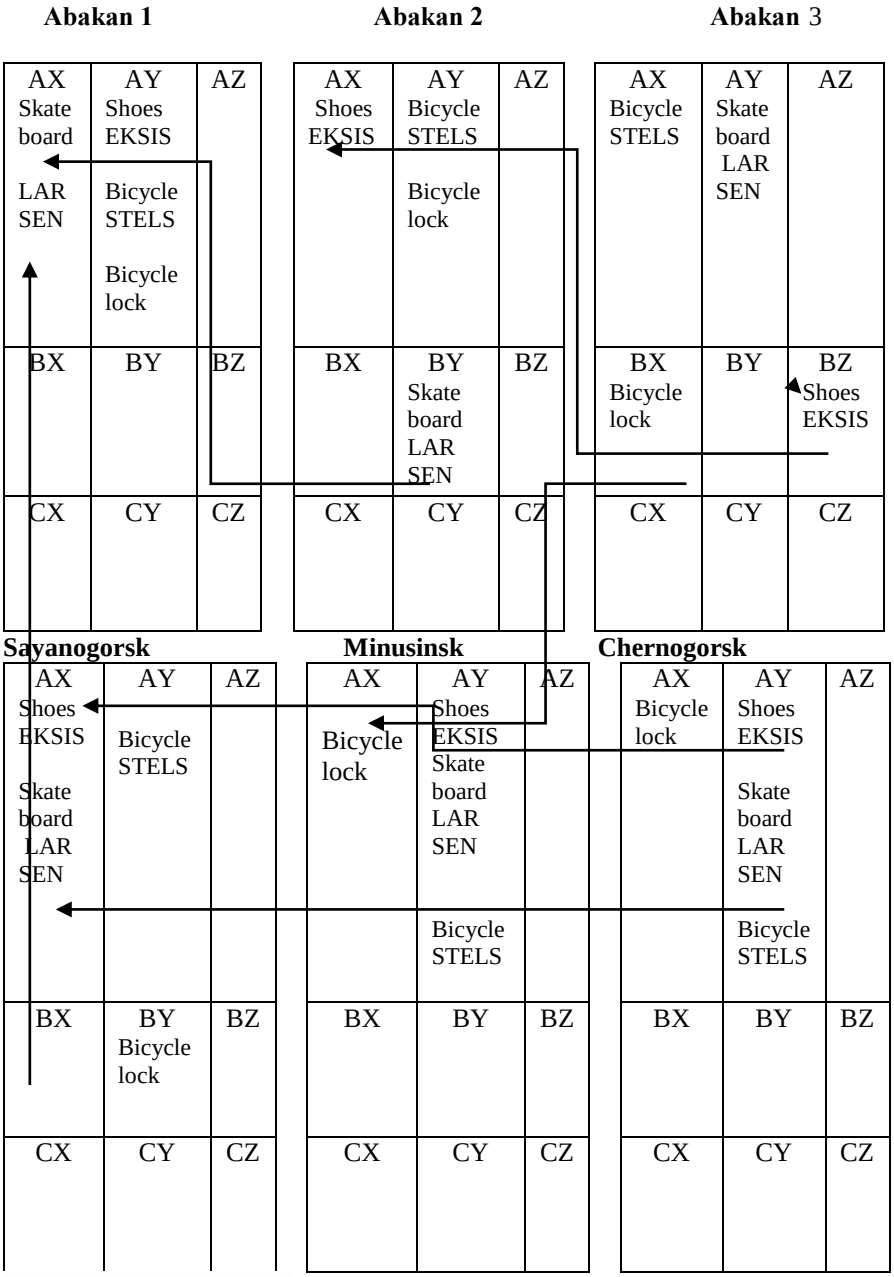
Method of moving goods between the stores will be designed on the basis of the matrix of the ABC-XYZ analysis. Let us demonstrate the method of moving on the example of four product groups of the sports goods: skateboard LARSEN, shoes EKSIS, bicycle STELS, a bicycle lock. Let`s define the location of each product group by demand and supply in ABC-XYZ matrix in each store according to the summer season 2014 (Fig.3).

As can be seen from Fig.3, product groups are located in different sectors of the matrix on the stability of demand in different stores. Accordingly, the demand for goods is different in different cities. Considering the data of the analysis, the product from the store with a lack or unstable demand should be moved to the store with a steady demand. For example, the product group “Skateboard” has a stable demand in the stores “Abakan 1” and “Sayanogorsk”, and the lowest demand for this group is in stores “Abakan 2” and “Chernogorsk”. Accordingly, the priority should be given to the stores with the highest demand.

The arrows in the figure show the suggested movement of goods analyzed in four product groups. After this movement the reduction of the turnover of goods is observed, which leads to a growth of financial indicators such as profit and profitability.

Holding the suggested activities regularly, allows maintaining a harmonious range in the sports supermarkets network, thereby accelerating the turnover, increasing revenue, profits and profitability of sales by 10-15%. This harmonious distribution will allow the company to be competitive.

Figure 3. The movement of goods between the stores of different cities on the basis of the matrix of the ABC - XYZ analysis



Source: authors` development

5. CONCLUSION

It is shown in the paper that along with the existing marketing methodological tools for the formation and forecasting of goods demand in retail networks, one can effectively use the harmonic method of supply and demand. It allows predicting a range of frequently demanded goods in retail networks and, most importantly, generating simultaneously the optimum size of the multiproduct inventory of goods in terms of non-stationary demand. The main limitations in the application of the harmonic method can be in the following situations: small range (less than 50-100 items); the lack of competition in the market for the analyzed group of products; incorrect choice of the duration of the logistic cycles of commodity groups in the analysis (the analysis time must be a multiple of the period of circulation of goods on the market); the widespread use of software to ABC – analysis without taking into account the above limitations.

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ECO-FOOD PRODUCTION AND MARKET PERSPECTIVES IN CROATIA

Marija Ham
Faculty of Economics in Osijek
Trg Lj.Gaja 7, 31 000 Osijek, Croatia
Phone: +385 31 224 400
E-mail: mham@efos.hr

Ana Pap
Faculty of Economics in Osijek
Trg Lj.Gaja 7, 31 000 Osijek, Croatia
Phone: +385 31 224 491
E-mail: anapap@efos.hr

Helena Štimac
Faculty of Economics in Osijek
Trg Lj.Gaja 7, 31 000 Osijek, Croatia
Phone: +385 31 224 443
E-mail: shelena@efos.hr

Scientific paper

Abstract

The importance of ecological production and ecological products has significantly increased during the last decade especially in the domain of food products. The main reason for this trend is increasing environmental and health awareness of consumers. The purpose of this study is to identify main determinants for the future development of ecological agriculture and all of its market dimensions in Croatia. To understand current state and perspectives for development of eco-food production in Croatia, the study investigates present trends on the eco-agricultural product market on both the demand and supply side. On the demand side, it is crucial to understand basic characteristics and present changes in consumers' behavior, attitudes and preferences. From supply aspect, it is necessary to identify basic determinants and changes in the production process. Special attention was paid to distribution channels since distribution channels are often referred to as a key problem by eco-food producers in Croatia. Apart from supply and demand trends on the home market, the study analyzes main trends on the global market which directly or indirectly affect direction of eco-agriculture development in Croatia and perspectives of eco-food market. The paper puts forward the systematized overview of above mentioned trends in the "Eco-food market trends matrix" which has been developed

for the purpose of this paper based on the analysis of strategic documents and relevant literature review. An additional, third dimension of the matrix is the dimension of expected future trends. This matrix can indicate strategies and marketing activities needed for optimization of marketing program for effective satisfaction of consumer needs and for fostering the undoubtedly desirable social change in the direction of greater demand (and consequently supply) of ecologically acceptable food. It also enables the recognition of main challenges and issues which need to be considered when designing strategies on macro level.

Key words: eco-food, eco-agriculture, food production, distribution channels, trends

1. INTRODUCTION

In order to understand the situation and prospects for the development of eco-food in Croatia, it is important to understand the key trends present in the organic agricultural products market. These trends can be viewed from several different aspects. Present trends can be observed from the aspect of demand, i.e. the fundamental characteristics and the present changes in behavior, attitudes, needs and preferences of existing and potential consumers of organic agricultural products. Current trends on the demand side indicate strategies and necessary actions in order to optimize the marketing mix of organic agricultural products, to effectively meet the needs and demands of consumers and to encourage the general social change in the direction of greater demand (and consequently a greater supply) for environmentally friendly and sustainable food production mode.

The second dimension of this market consists of organic agricultural products' suppliers. On the supply side, it is also possible to identify key trends, i.e. underlying determinants and directions of development of organic agriculture or the fundamental characteristics and changes in the process and the structure of production and distribution channels. In this way it is possible to identify the fundamental challenges and issues that need to be taken into account when designing strategies at macro and micro level in order to improve and direct the synergy effect of all stakeholders in the desired direction.

In addition to the existing trends in supply and demand that are present in the Croatian market, it is necessary to examine the main trends in the global market, which directly or indirectly affect the trend of the organic agriculture development in Croatia and its market prospects. Croatian membership in the European Union further strengthened and formalized the influence of the European market conditions on the bases of the organic agriculture development. A certain influence on the attitudes of consumers is also present. In addition to the primary impact of the European market, specific global flows should not be neglected, which are particularly important for designing long-term general strategies.

Based on an analysis of existing trends of the supply and demand of organic agricultural products on both the domestic and international markets and on the basis of the general social, political, technological and economic trends, it is possible to

identify the basic future determinants that will in the near and distant future mark the development of the eco-agriculture and all of the dimensions of its markets.

2. ECO-AGRICULTURE DEVELOPMENT

According to the Research Institute of Organic Agriculture (2015), the country with most organic agricultural land is Australia (97% of the farmland is extensive grazing area). Argentina is second, followed by the United States on the third place. Countries with the highest organic share in the total agricultural areas are Falkland Islands (36.3%), Liechtenstein (31%) and Austria (19.5%).

When it comes to European Union market, according to European Commission Report (2013c) in the EU-27 (27 countries as members of European Union), total organic area amounted to an estimated 5.4% of the total utilized agricultural area (UAA) in 2011 increasing from 3.1% in 2002. With a share of about 19%, Austria is the Member State where the importance of the organic sector in the total UAA is the highest in 2011. Sweden and Estonia follow with 15.7% and 14.1% respectively. The Czech Republic in which 13.1% of its total area was dedicated to organic farming is followed by Latvia where this share amounts to 10.1%. It is interesting to note that among the EU-N12, five Member States (the Czech Republic, Estonia, Latvia, Slovenia and Slovakia) already exceed the EU-27 average of 5.4%. These Member States have experienced an extremely fast development of the organic sector in terms of area. (European Commission, 2013c, p. 12). Croatia, with the average of 3.12 % also belongs to abovementioned group with organic farming area shares bellow European Union average of 5.4%.

Due to its preserved nature and environment, Croatia has an advantage over other developed countries and can produce diverse consumer safe high-quality food. The agriculture is followed by the diverse and developed food and processing industry with capacities that not only satisfy domestic needs, but also the market needs of neighboring countries. (Croatian Chamber of Economy, 2010, pp. 1-3) Foods which are safe to use, have fine quality, are nutritious, take into account concerns for the welfare of animals and are grown and produced in line with the principles of sustainable development, are known as green food (Saleki & Seydsaleki, 2012).

Given the characteristics of Croatian agriculture marked foremost by small capacities compared to the competitive countries, and the aforementioned comparative advantage reflected in the protection of environment, but also foreign influences (opportunities) arising from being the tourism-oriented country and aforementioned changes on the tourist market in the sense of growing ecological awareness of the tourists, the logical way of development of agriculture and food industry which should be focused on is eco-agriculture and the organic food production.

Domestic organic agricultural production is growing year after year. According to official statistics in the Republic of Croatia there were only two registered eco-producers in 2002, whereas only a year later there were up to 130 producers registered in the Register of eco-producers. In 2005 this number amounted to 269, and according

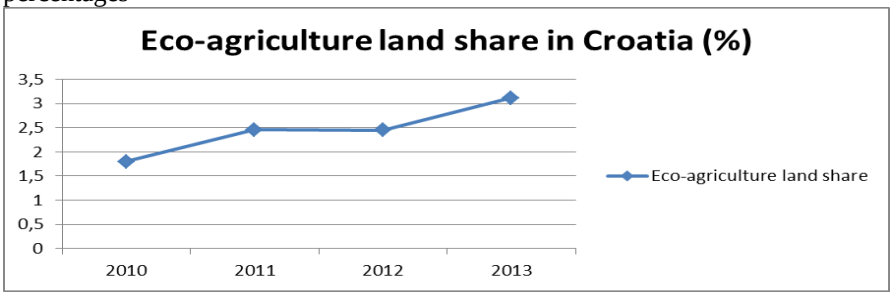
to the latest available data, in 2013 there were 1609 registered eco-producers (Ministry of Agriculture, 2013).

At the same time the number of hectares under eco-agriculture is rising. According to the data provided by the Croatian Ministry of Agriculture, in the 2010 this number amounted 23.282,37 ha i.e. 1.80 % of the total arable land. According to the last available data, the amount of hectares under eco-agriculture in 2013 was 40.640,65 ha which means 3.12% of the total arable land (Ministry of Agriculture, 2013).

If we take into consideration that European Union demands that the share be a minimum of 10 %, which means that Croatia is supposed to have 130,000 hectares, it is obvious that it will take a lot of time to reach the European standards in that sense.

Despite of the aforementioned encouraging growth trend concerning the share of eco-agriculture, Croatia still belongs to the group of rare European countries which have insufficiently developed this type of agricultural production. This is even more surprising having in mind the extraordinary natural conditions and high agro-ecological diversity of regions.

Figure 1. The share of eco-agriculture land in the total arable land in Croatia in percentages



Source: Authors' work based on the data of Ministry of Agriculture (2013)

Croatia disposes of several undoubted and important comparative advantages concerning the production of organic food consisting foremost of relatively well preserved environment (soil, water and air quality). Hence, it is possible for Croatian agriculture to take advantage of its former deficiency and weakness (lagging behind in using mineral fertilizers, additives and agricultural mechanization) as the basic advantage i.e. the opportunity. The existence of long-time neglected agricultural areas was formerly often regarded as weakness due to high arrangement costs of such a land. This also refers to huge surfaces which have more than ten years been inaccessible due to the fact that they were marked as suspected landmine areas. After demining and clearing, those pieces of land represent an extraordinary potential for eco-agriculture application. In addition, among comparative advantages the existence of native, quality agricultural crops, tourism orientation, and great number of protected areas (11.43% of terrestrial area) should be emphasized.

A market for these types of products exists in Croatia, which is confirmed by the amount of imported goods sold in our country. However, although Croatia could be one of the more important exporters of organic goods, rather than importers, this is

not the case. Croatia's annual import value of organic products amounts to Kn 200 million despite the fact that 90 % of those products could easily be produced in Croatia (Prica, 2011). Hence, it is clear that next to the aforementioned comparative advantages and supporting factors there are also problems, which to a certain extent overlap with the problems present in conventional agriculture and food industry and which represent structural problems.

Some of the basic problems related to organic food products comprise of the following: domestic eco-agricultural supply is mostly related to the domestic market, there are no diverse products, and the quantities are too low for a serious appearance on the export market. The very issue of quantities is the biggest problem regarding a more significant development of both eco-agriculture and conventional agriculture. Small surfaces of individual producers make their appearance on the market and better competitiveness harder (Krpeljević, 2011). Participants in the eco-agricultural system in the Republic of Croatia consider that the weaknesses of the entire eco-agricultural development are: frequent changes of law and development strategies, and the nonexistence of institutional cooperation between State and County bodies (Ministry of Agriculture, Fisheries and Rural Development, 2011, p. 14).

The main factor for the development of organic farming is the market itself, in which the agricultural holding as a basic unit of the organic food market encounters with a series of problems such as inconsistent legislation (Zanoli & Jukić, 2005.), lack of education about the methods of eco-agriculture and organic food production (Petković, 2002), high costs (Ribić Dugandžić, 2007; Štefanic et al., 2001) and narrowed distribution channels (Richter et al., 2000; Richter, 2005; Zanoli & Jukić, 2005).

Having the export in mind, the growing problem lies in the double certification. Namely, the products bearing the Croatian eco-certificate are not recognized as such on the international market. Hence, in order to export goods one should additionally obtain international certificates and eco-labels.

3. DISTRIBUTION CHANNELS OF ECO-FOOD

Distribution channels are often referred to as a key problem by eco-food producers in Croatia. Comprehensive analysis of ecological food products' distribution channels in Europe is discussed in the publication Specialized Organic Retail Report Europe 2008 (Vaclavik, 2009). According to the publication, in EU member states ecological food products are mostly being sold in traditional channels of food distribution, and are available in supermarket chains. In addition to the traditional channels of distribution, ecological food products are sold in specialized stores and other distribution channels. The above is a result of market development from the early 1990s (Aertsens et al., 2009, p. 138), i.e. the changes that have affected the market - many scandals associated with conventional food (Fitzpatrick, 2002; Blanchard & Shuping, 2007) when some of the large European retailers offered organic food products as an alternative in the supermarket chains (Jonas & Roosen, 2005, p. 637).

Supermarket chains became channels of distribution with the largest market share and, therefore, are considered to be the main driver for the further development of the European market of ecological food products (Richter, 2005, p. 54), both in urban and rural areas. According to Richter (2005, p. 5), there are three basic levels of ecological food products' market development within Europe: matured markets, growing markets and emerging markets.

Leading distribution methods differ in countries with different levels of ecological food products' market development. In countries with matured markets, supermarkets have an important role, and the market is dominated by a small number of retailers and distributors of ecological food products. To stimulate matured markets, Richter (2005) proposes product related marketing, branding and unpremeditated buying activities.

Growth rates in growing markets range from 5% to 15%, and the market is growing continuously (Richter, 2005, p. 5). In these countries, specialized stores and direct sales are the primary methods of distribution of organic food products.

Emerging markets are markets that will grow rapidly. On these markets activity of organic farming is represented by a marketing niche; players on the market are the pioneers of organic farming, and a common feature of these markets is the lack of organized structure (Padel & Midmore, 2005, p. 631).

The aggravating fact for the development of Croatian organic food producers is that most of the organic food offered by supermarket chains is from foreign origin. Supermarket chains are the leading distribution channel for food in Croatia and further development of the organic food market is inconceivable without supermarkets significantly entering in that area. Croatian producers of organic food must increase their production capacity and/or join together in an umbrella organization. Only large independent producers or association of organic food producers could guarantee adequate quantities and quality for retail chains, and most likely it would be umbrella organizations made of organic producers. By increasing the supply of organic food in supermarkets, physical availability of organic food, which was identified as the biggest obstacle to further expansion of the market, would also increase. If Croatian producers of organic food don't find a model which would enable them to increase their presence in supermarkets, they will not achieve significant benefit from the expected market expansion. Except of supermarkets, it is necessary to develop other distribution channels.

When analyzing the country of origin of organic food products, the research conducted by Petljak (2010) showed that 50% of leading food retailers in Croatia offer imported ecological products in their stores. 30% of leading food retailers offer domestic and imported ecological food products, and only 20% of food retailers offer exclusively local organic food products. From the stated results, it can be concluded that the market of ecological food products in the Republic of Croatia is still emerging, as given in range of products, leading food retailers still did not recognize the importance of this category.

Initially, the biggest role in the distribution of organic agricultural and food products had markets and organized delivery per order or sale at the eco-estate itself. However, nowadays there has been a certain progress related to the distribution and

reaching the consumers. An important role in that process played the specialized organic food stores.

Apart from chain stores, the increased interest for eco-agricultural and food products can also be seen by drugstores and restaurants. Motivated by the demand side requirements, but also by the need for differentiation on the increasingly demanding gastro market, a certain number of caterers introduced their menus with dishes prepared from organically grown groceries. So far those have been rather isolated cases than the trend in catering industry of the Republic of Croatia.

HORECA channel (channel of hotels, restaurants and café bars) is at this moment quite neglected and insignificant distribution channel of organic food, but with great unused sales potential. Various institutions - customers, such as schools and kindergartens, are also a great potential distribution channel. Organic producers would through them ensure safe placement, and children would eat healthy foods and learn the benefits of organic food from an early age (Renko & Bošnjak, 2009).

4. ECO FOOD MARKET

Every day consumers around the globe are making a shift toward healthier and more environmentally conscious lives, especially concerning their food preferences. It can be said that there are undoubtedly strong positive trends on a demand side both on the domestic and global market which are expected to be even stronger in the future (Salleh et al., 2010) under the influence of consumers' increased and continuously growing interest in nutrition, health, and environmental protection (Brčić-Stipčević et al., 2013; Gil et al., 2000) and also due to the influence of consumer education, strengthening of trust based on certification, and based on improvements concerning the availability of those products by means of their growing penetration into standard distribution channels. In line with that, many food producers focus their efforts on targeting prospective green food buyers in the best possible way.

For the purpose of depicting the trend some other data from the global statistics are taken out. The value of the global organic products market in 2012 reached 50 billion €, with the leading US market (22.6 billion €), followed by Germany (€ 7 billion) and France (€ 4 billion). The European market recorded a growth of 6% and the market value of organic products reached 22.8 billion € (Poslovni dnevnik, 2014).

Of all the forms of environmentally-oriented consumer behavior in Croatia, the most accepted and widespread is precisely the behavior related to the purchase of green food products, and this kind of behavior has recently become one of the main research focuses for Croatian scientists from the different scientific disciplines. Another reason for this lies in the fact that the Republic of Croatia's strategic development directions are based on factors that are closely related with the production of healthy food and the preservation of the environment.

An individual's attitude towards consuming a product is one of the most important antecedents for predicting and explaining consumers' choices across products and services, including food products (Honkanen et al., 2006). Previous studies have associated organic food consumption with behavioral attitudes such as health consciousness, environmental consciousness, trust of organic food claims,

desirability of organic food attributes such as taste, texture, freshness (Voon et al., 2011, Salleh et al., 2010; Michaelidou & Hassan, 2008; First & Brozina, 2009) and other attitudes such as attitudes toward local origin of products, fair trade (Tanner & Wölfing Kast, 2003) and reference knowledge (Amran & Nee, 2012; Saleki et al., 2012).

Trust of organic food claims is a strong determinant of intention to consume due to the credence nature of organic food. Credence products are those for which consumers are not able to evaluate effectively as the benefits of consumption cannot be directly or immediately observed. Consequently, consumers may rely on product labeling, advertisements and certifications as signals of the trustworthiness of product claims. The extent to which these engender consumer trust will therefore influence the intention to consume organic food (Voon et al., 2011). The lack of consumers' confidence in the credibility of environmental products and producers is often identified as one of the main barriers to increasing the purchase of ecological products in general (Kalafatis et al., 1999, p.459).

Furthermore, the growing level of interest, awareness and knowledge about health and nutrition, and easier access to all information in this regard leads to increasing levels of so-called health awareness. Consequently it leads to greater willingness to adopt healthy lifestyles. As green food is generally believed to be more nutritious, healthier and safer than conventional food, it is likely that the health-conscious consumer will have positive attitudes towards green food which will drive the greater demand for this type of products. Accordingly, many studies found that health benefits are the main motives for buying green food products (Wier & Calverly, 2002; Roitner-Schobesberger et al., 2008). Salleh and his associates (2010) determined that health consciousness factor has more impact on customer purchase intention of organic food products rather than the environmental concern.

According to the research of Voon et al. (2011) health and environmental concerns together with trust of organic food claims and desirability of organic food attributes form Malaysian consumers' attitude towards organic food. The importance of health and environmental concerns reflect the growing affluence of consumers. The rising educational levels coupled with better access to worldwide communication and information channels have raised their awareness of health and environmental issues. Following Tanner and Wölfing Kast (2003), it is also important to consider the attitudes toward local origin of products.

Zanoli & Jukić (2005) conducted a research about the purchase of organic food in Croatia. The results showed that the purchase of organic food was especially influenced by the level of information and knowledge of consumers with reference to these products. Those with greater knowledge and information buy organic products more frequently. When asked about reasons why they don't purchase organic food, price was the main reason for 22% of the sample, difficulties in finding organic products for 13%, poor offer for 26%, and scarce information about the places where organic food products can be purchased for 13%.

In the research findings of Radman (2005) it is indicated that Croatian consumers think of organic products as healthy, of good quality and tasty. However, they perceive organic food as expensive and are not satisfied with its appearance. Furthermore, the

research has shown that consumers do not know where organic food is typically being sold.

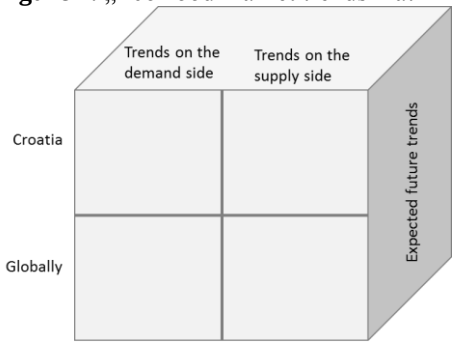
Brčić-Stipčević & Petljak (2011) found that among the characteristics of a place of purchase of organic food, the regular buyers of organic food consider supply diversity and availability of a place of purchase to be the most important. Results have shown that higher monthly household incomes and a higher level of education of the respondents predict more frequent purchases of organic food. Moreover, the perception of organic food as healthier and tastier than conventional food also predicts more frequent purchases of organic food. The response of the respondents who stated that they do not buy organic food have shown that high organic food prices are the main reason for not buying or for buying organic food only occasionally while insufficient information on organic food ranked as a secondary reason for their lack of purchases.

4.1. Analysis of the current and future trends in the eco-food market

As previously stated, in order to understand the situation and prospects for the development of eco-food in Croatia, it is important to systematically examine the key trends that are present in the market of organic agricultural products. Based on the analysis of existing trends of the supply and demand of organic agricultural products on both the domestic and international markets and on the basis of the general social, political, technological and economic trends, it is possible to identify the underlying determinants of the future that will in the near and distant future mark the development of eco-agriculture and all dimensions of its markets.

In order to provide the systematized overview of above mentioned trends, the "Eco-food market trends matrix" has been developed for the purpose of this paper based on the analysis of strategic documents and relevant literature review. The matrix has two basic dimensions that refer to the market side (demand/supply) and to market scope (Croatia/globally). An additional, third dimension of the matrix is the dimension of expected future trends. The matrix can be illustrated graphically as on the Figure 2. Basic dimensions are described in table 1, and the third dimension is described in the table 2.

Figure 2. „Eco-food market trends matrix"



Source: Authors' work

Table 1. Trends on the demand and the supply side in Croatia and globally

	Trends on the demand side	Trends on the supply side
Croatia	• Croatia, among all European countries, records the highest growth rate of the market of organic products by 20% (Naturala, 2013) • 15 percent of the urban population often buys goods labeled bio or eco - most are concerned about water pollution and possible adverse effects of chemicals in food (Ja trgovac, 2013) • The highest demand is for organic baby food and beverages from soybeans and grains (IFOAM, 2013) • Consumer confidence grows based on more effective regulation and certification (European Commission, 2014) • Consumers believe that organic food tastes better (46%), is healthier (72%), safer (56%) and more expensive (83%) than conventional (Brčić-Stipčević & Petljak, 2013, p. 196) • 53% of consumers believe that they can recognize organic products on the point of sale (Brčić-Stipčević & Petljak, 2013, p. 193) • 37% of consumers recognize these products under the label Croatian ecological product (Brčić-Stipčević & Petljak, 2013, p. 193) • An urban population with sensibility towards environmental issues as a way of life appeared (Ja trgovac, 2013)	• Processing of organic products is still in the early stages of development, but it is becoming more represented (IFOAM, 2013) • The majority of baby food in Croatia is organic, but almost all of it is imported (IFOAM, 2013) • The majority of organic products is distributed through supermarkets - two major Croatian specialized chains (Bio & Bio and Garden) are dominant in the specialized retail segment (IFOAM, 2013) • The role of hypermarkets and supermarkets increases (IFOAM, 2013) • Supermarket chains and drugstores are expanding the offer of organic food (IFOAM, 2013) • Imported products account for 60% of the domestic organic products market value (IFOAM, 2013) • Manufacturers offer more organic products through the Internet (IFOAM, 2013) • There is more and more organic products of animal origin (Progressive, 2012) • Croatian organic products are up to 100 percent more expensive than conventional (Agroklub, 2010) • Meat and milk, don't even exist in domestic production because there is no proper processing of such products (Agroklub, 2010)

	Trends on the demand side	Trends on the supply side
Globally	• The demand for organic products continues to grow and its sales reaches the value of 59.1 billion dollars (Agricultural marketing resource center, 2013) • In the next three to five years a new social layer called eco-citizens will be formed and to them care about the environment will come first and also represent their lifestyle (Ja trgovac, 2013) • 52% of Europeans claim that they can identify environmentally friendly product on the basis of eco-label (European Commission, 2013a) • 71% of EU citizens trust food labels that are granted by third parties (European Commission, 2013a) • 24% of consumers recognize the "Organic farming logo" (European Commission, 2013b)	• Suppliers are voluntarily subjected to increasingly stricter controls and testing for banned substances in order to single out against fraudulent manufacturers (Deutche welle portal, 2014) • The European Commission plans to significantly limit the use of conventionally produced animal food and seeds and also reduce the extent to which pollution of organic food with pesticide residues or genetically modified products is tolerated (Deutche welle portal, 2014) • In the EU countries organic products are up to 30 to 50 percent more expensive than conventional (Agroklub, 2010) • The emphasis is put not only on the transparency of the production process but on the transparency of the entire supply chain (Dimitri & Oberholtzer, 2009)

Source: Authors's work

Expected future trends on the eco-food market are listed in table 2.

Table 2. Expected future trends on the eco-food market

Expected future trends
• Experts for this industry predict global further stable growth of 9% per year or more (Agricultural marketing resource center, 2013) • Political support for the development of organic farming will increase because of the fact that at the same time it contributes to resolving many structural problems (Ministry of agriculture, fishery and rural development, 2011) • More attention will be given to the transparency of price formation for organic products (Agricultural marketing resource center, 2013) • Consumer confidence and sense of security will continue to grow in the future (European Commission, 2012) • With the help of new technologies (e.g. smartphone applications) consumers will have the access to all of the required information about the environmental aspects of an individual product (Zanoli & Jukić, 2005)

• The focus will be further expanded on the fairness of the production process and supply (fair trade) (Dimitri & Oberholtzer, 2009)
Expected future trends
• Contribution to the transparency and security will be achieved through new methods of analysis and testing of the product (Dimitri & Oberholtzer, 2009) • Transparency will not only be a matter of certification but also the direct exchange of information (Dimitri & Oberholtzer, 2009) • A lot of small and micro-markets will appear thanks to the new media (Progressive, 2012) • Consumers will more and more buy organic products online (Progressive, 2012) • The expansion is expected in the range of products ready for consumption, such as bakery products, sandwiches, salads, ready meals and cakes, as well as the range of frozen products (Progressive, 2012) • It is to expect larger and faster increase in organic mariculture and freshwater aquaculture, caused by demand in the European market (Ministry of agriculture, fishery and rural development, 2011) • There will be an increasing number of organic private labels (Dimitri & Oberholtzer, 2009) • Further growth of eco-tourism will enable indirect export (Ministry of agriculture, fishery and rural development, 2011)

Source: Authors' work

5. CONCLUSION

Undoubtedly, there are powerful positive trends on the side of the demand in the global market as well as in the local market in Croatia. It is expected that they will be strengthened in the future under the influence of increased and constantly growing interest in consumer health, healthy eating and environmental protection, and additionally because of the strengthening of trust based on the certification, and also improved availability of these products through their increasing penetration into the standard distribution channels.

The market for these products exists in Croatia, as evidenced by the amount of imported products. Although with the resources it disposes, Croatia could be a significant exporter of environmental goods, and not an importer, it is not yet so. It is clear therefore that with the comparative advantage and supportive factors there are also problems which to some extent overlap with the problems inherent in conventional agriculture and food industry and represent structural problems.

Nowadays, a frequent question in scientific, economic, political and public discussions is: what is missing in order for the domestic organic production, especially that of agricultural and live-stock products, to become alive? In order to achieve that aim consumer habits need to be created and developed. Of the same importance is the continuous supply of stores with organic products, determining of the most appropriate areas for such production, creation of *brand*, consumer education and small individual producers should, in order to survive on the market, join clusters. In

order for organic products to reach the buyers, they need better marketing and better connection with tourism where one can place, especially in hotels, diverse organic food and other products (Šupraha, 2011).

One of the previously existing problems on the demand side of the market in Croatia, which was manifested in poor recognition and consumer confidence in organic products, records some positive changes (as well as at the European and global market), although it is not completely removed. Positive changes are being visible in consumer attitudes about the value and characteristics of these products. Although still at the level of market niches, some social segments to whom organic products (in particular food) is the backbone of lifestyle, appear.

On the supply side, the trends are mainly affected by global flows of stricter regulations, controls and restrictions on the use of raw materials and rising trends in demand. Plans to limit the use of conventionally produced animal food and seeds are both a threat and also an opportunity for organic producers. Croatia is characterized by low and for now, slowly increasing level of development of the organic products processing and also low capacity, high costs and high final prices of these products.

There is also the impact of modern technology on trends in placing and expanding product categories. In the distribution of organic agricultural and food products, the highest role initially had the market places, organized delivery to customer or sales on the organic farm itself. However, in recent times certain steps were taken in terms of distribution in terms of approaching to consumers. Important role in this was played by first specialized organic food stores. Increasing environmental awareness of consumers and the trend of consumption of organic products, especially food products, there was a growing interest of retail chains for this product category. In addition to retail chains, increased interest in organic agriculture and food products can be seen by drugstores and restaurants.

It can also be said that organically produced food as well as traditional Croatian products of high and specific quality are becoming an important factor in defining the tourist product of the Republic of Croatia and its differentiation in the market. Preconditions for the production of organic food and its sale in catering facilities which provide services to tourists must be further developed and used, because the sector of tourism will be more and more important. It is necessary therefore to take advantage of synergy effects of natural capital that Croatia has, as well as the complementarity of the growing phenomenon of environmentally oriented tourism (eco-tourism, green tourism, agro-tourism) with a powerful surge in the market of ecologically grown food and market of green products in general.

Looking at global future it is clear that political support for the development of organic farming will further be strengthened by the fact that it contributes at the same time to sustainable environmental management, poverty reduction and the employment increase of the rural population, conservation of biodiversity and other structural targets. Also the future is reflected in the expansion and deepening of the issues that will be taken into consideration when assessing the environmental and social acceptability of products, and modern technology and new methods of analysis will contribute to the direct exchange of information, further growth of trust and safety, and seek to achieve full transparency in the whole value chain of products as well as of all elements of the marketing mix. The law of supply and demand will

ensure the spread on the new product categories where organic farming has not previously been represented.

Overall there is currently no evidence to indicate that, when it comes to the demand for organic food, it is just a temporary trend. On the contrary, it is a real redirection and irreversible departure from the present way of consumption, production and understanding of food. Most of the forecasts about the growth of the global organic food market are about 9 percent a year while some experts predict even double-digit growth.

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INNOVATIVE SOLUTIONS FOR A "LAST-MILE" DELIVERY – A EUROPEAN EXPERIENCE

Maša Slabinac
College of Applied Sciences "Lavoslav Ružička" in Vukovar
Županijska 50, 32 000 Vukovar
Phone: +385 32 444 688 / Fax: + 385 32 444 686
E-mail: mslabinac@vevu.hr

Scientific paper

Abstract

The "last-mile" delivery represents the last part of a supply chain that is considered to be the most inefficient due to its specificities such as a spatial distribution of relatively small receiving points, demands for more frequent but smaller shipments, delivery time windows, etc. As far as its ecological dimension is concerned, the "last-mile" delivery done by common type of delivery vehicles for an inner urban supply is thought to be significantly ineffective especially in cities that are faced not only with modern distribution practices but with increasing urbanisation and e-commerce development as well. This leads to the conclusion for necessity to introduce innovative types of delivery vehicles that improve business results while reducing a negative ecological and social impact of transport on functions in inner cities. With this reference, the paper presents the innovative transport technologies in the "last-mile" delivery in developed European countries that provide an ecological and social sustainability as well as an increased competitiveness of the suppliers.

Key words: "last-mile" delivery, City logistics, transport vehicles, sustainability of urban freight

1. INTRODUCTION

According to European Commission (2013a), 73% of European population live in cities where 85% of European Union's GDP is created. The process of urbanisation is foreseen to rise up further reaching 82% by 2050 or even more than 90% by 2050 in countries such as Denmark, Sweden, Belgium, Luxembourg, Malta and Netherlands. As cities are being places where population and economic activities concentrate, effective and sustainable transport is becoming more important for conducting all specific city functions and fostering its economic prosperity and economic welfare of its residents. Besides rising urbanization, other major factors that influence an augmenting importance of urban freight transport and the need for its systematic research are: increased purchasing power of the urban population that results in larger quantity and diversity of goods bought and delivered to customers in urban areas by diverse suppliers and their distribution channels, centralisation of production, JIT production and distribution and rising e-commerce with demand for

smaller but more frequent deliveries usually performed by logistics service providers (Anand et al., 2012; Crainic, 2008; Crainic et al., 2009; Ehmke, 2012). As observed by Visser (2005, p. 1): *Although delivery of goods is vitally important for residents and industries in urban areas, the presence and operations of goods transport vehicles in urban areas are often regarded more as a nuisance than an essential service.* This is a common feature of all cities, not only of megacities but as well as of small to large European cities with historic city cores. From a logistics perspective, cities provided by multitude of supply chains are important logistics nodes where transhipment as well as "last-mile" transport occurs. As such, transport conducted in urban areas comprising "last-mile" delivery is an integral element of the whole transport chain and supply chain management.

A comprehensive categorisation of a wide array of externalities of the urban freight distribution, that encompasses the "last-mile" delivery in urban environment as well, can be found in Allen et al. (2000b). Within a research project on urban freight transport in the United Kingdom, the authors have extended the one delivered by *The UK Round Table on Sustainable Development* in 1996 by introducing the negative operational impact as an additional, fourth category. The four categories of negative impacts of the urban freight transport are as follows (Allen et al., 2000b, p. 72):

1. ***Negative environmental impacts*** such as depletion of non-renewable resources, air pollution and various sorts of waste such as tyres, vehicles and other materials
2. ***Negative social impacts*** involving various aspects of lowering quality of life such as decreased public health including deaths, illnesses and injuries emanating from traffic accidents and various types of pollution – air pollution, noise, vibration and visual pollution, consumption of valuable greenfield sites and physical threats and intimidation by the size of the transport vehicles
3. ***Negative economic impacts*** comprising road congestion and an economic burden to all stakeholders involved in urban freight transport due to freight inefficiencies and its negative environmental and social impacts
4. ***Negative operational impacts*** that refer to various congestion and traffic disruptions including obstructions to other road users emerging from inbound and outbound transport activities of goods and service delivery vehicles in the urban areas such as (un)loading, parking and manoeuvring as well as their overall effect on delivery service.

As stated in some sources, only the costs of environmental nuisance emanating from pollution of increasing traffic in the European cities amounts almost 100 billion Euros on a yearly bases or 1% of GDP of European economy (Bektaş et al., 2015, p. 2; EU Commission, 2007, Anderson et al., 2005 as cited in Lange et al., 2013, p. 110).

Drawing on this common characteristic of urban freight transport, in this paper an attempt has been made to point to some of the most innovative types of delivery vehicles in the "last-mile" delivery in developed European countries, among some are still in trial phase, that might improve freight flows and business results while complying with requirements of sustainable development and environmental concerns. Prior to this, the paper aims to provide a sufficiently broad background and contribution that will enable readers to extend their existing knowledge or even acquire a new one regarding closely related terminology and system of city logistics within which the "last-mile" delivery in urban areas is carried out.

The methodology comprised desk research of printed and web-based sources. Types of literature used include books, journal articles, conference papers, reports and internet-based information. Although city logistics that comprises the "last-mile" delivery as well is considered to be a relatively new field of research, many researches, initiatives and projects with various proposals have been conducted worldwide so far to combat the negative impact of urban goods transport. Their further in-depth study could be an incentive to innovative sustainable solutions tailored for specific needs and requirements of the interested that contribute to successful dealing with the current issues and proactively anticipate and answer to the future ones.

2. DEFINING TERMS

Terms such as urban goods movement, urban freight transport and city logistics have been mainly used interchangeably to describe freight flows throughout urban areas. As observed by Lange et al. (2013), a distinction in terminology indicates to differences in origin – whereas *urban freight transport* (as well as *urban goods movement* or *urban goods distribution*, the author's remark) prevails in Anglophone literature, *city logistics* has been the most widespread, especially in Germany where the concept has been developed during 1990s. Some of definitions that can be found in the academic and professional literature describing coverage and indicating the complexity of tasks in reference to these terms are the ones that follow.

In 1992 Kenneth W. Ogden published the first comprehensive book on urban freight transport: *Urban Goods Movement: A Guide to Policy and Planning* that is considered as a pivotal source for transport experts worldwide (Dablanc, 2011). According to Ogden, urban freight transport is:

> *The transportation of, and terminal activities associated with, the movement of things as opposed to people in urban areas. It includes movement of things into and out of the area, through the area, as well as within the area by all modes, including transmission of electricity to the extent that it relates to the transportation of fuels, pipeline movement of petroleum, water and waste, and collection and movement of trash and mail, service truck movements not identified with person movements, and even some person trips which involve substantial goods movements such as shopping trips. Activities involving urban streets, waterways, railroads, terminals, loading docks, and internal distribution systems including elevators and related facilities must all be considered in fostering greater efficiency in the movement of urban goods.* (Ogden, 1989, p. 12 as cited in Allen et al., 2000a, p. 20).

In the study on urban freight transport in the United Kingdom, Allen et al. (2000a) elaborated coverage of the urban freight transport that includes: (1) all types and sizes of transport means for core goods deliveries and collections at urban premises, (2) all types of means used for movement goods to and from urban premises including core goods transfers between urban premises, ancillary goods deliveries to urban premises, money collection and delivery, waste collections, postal collection and delivery, other goods collected from premises and home deliveries from urban

premises to customers, (3) service trips and other trips for commercial purposes to the urban premises of vital importance for its regular operation. *OECD Working Group on Urban Freight Logistics* defined urban goods transport as *(...) the delivery of consumer goods (not only by retail, but also by other sectors such as manufacturing) in city and suburban areas, including the reverse flow of used goods in terms of clean waste*. (OECD, 2003, p. 19 as cited in Lindholm, 2013, p. 7). In *An overview of the European research and policy*, European Commission (2006, p. 2) sees urban freight transport and logistics operations as *(…) concerned with the activities of delivering and collecting goods in town and city centres. These activities are often referred to as 'city logistics' as they entail the processes of transportation, handling and storage of goods, the management of inventory, waste and returns as well as home delivery services.* According to Dablanc (2011, p. 13) urban freight transport is understood as *(…) goods movements generated by the economic needs of local businesses, that is, all deliveries and collections of supplies, materials, parts, consumables, mail and refuse that businesses require to operate. It also includes home deliveries by means of commercial transactions.*

As city logistics is concerned, Taniguchi et al. (1999 as cited in Ehmke 2012, p. 13) explains it as *(...) the process for totally optimizing the logistics and transport activities by private companies in urban areas while considering the traffic environment, the traffic congestion and energy consumption within the framework of a market economy.* Later on, the definition has been extended by introduction of information technology as a foundation for optimization of these activities (Benjelloun et al., 2010) to state city logistics as *(...) the process for totally optimizing the logistics and transport activities by private companies with the support of advanced information systems in urban areas considering the traffic environment, its congestion, safety and energy savings within the framework of a market economy.* (Taniguchi, 2012). An emphasize on the optimization of employed transport means that reduce transportation and environmental costs can be found in Crainic (2008, p. 2) who takes city logistics as one that *(…) aims to reduce and control the number, dimensions, and characteristics of freight vehicles operating within the city limits, improve the efficiency of freight movements, and reduce the number of empty vehicle-km.* Further on, Crainic (2008, p. 3) indicates fundamentals of increased efficiency as seeing the city logistics as *(…) a system characterized by an optimized consolidation of loads of different shippers and carriers within the same delivery vehicles and the coordination of freight transportation activities within cities.* Similarly, Visser (2005, p. 7) points to systems view and collaboration as the main means to increase profits: *City logistics is an integrated approach for urban goods distribution based on systems approach. It promotes innovative schemes that reduce the total cost (including economic, social and environmental) of goods movement within cities. City logistics encourages collaboration between key stakeholders within a market based economy.*

Finally, the "last-mile" delivery in urban environment as an integral part of the urban freight transport and city logistics can be seen as *(…) the final haul of a shipment to its end receiver, be it a shop, a business, a facility or a residence in case of home deliveries.* (Dablanc et al., 2013, pp. 4-5). Such a broad definition could apply to various environments in which delivery might occur, from traditional distribution to e-commerce or both. Chopra (2003, p. 133) sees it as a part of one of six possible

distribution network's designs, where *(...) the distributor/retailer deliver[s] the product to the customer's home instead of using a package carrier*. Specifically, in the context of rising e-commerce, the "last-mile" delivery can be defined as *(...) the last stretch of a business-to-consumer (B2C) parcel delivery to the final consignee who has to take reception of the goods at home or at a cluster/collection point.* (Gevaers et al., 2009, p. 2).

Due to significant share of logistics costs in retailing and their special impact on efficiency of urban delivery, further study could be continued toward Urban Retail Logistics, a new research area proposed by Lange et al. (2013), that builds and carries on the conjoint achievements of urban freight transport, city logistics and cooperation between suppliers in warehousing and transport activities.

From the definitions above one could agree there are no unique definitions of the terms but rather their different apprehension depending on the aims of the specific research. In reference to that, the "last-mile" delivery of goods in urban environment should be observed as the last leg of the integrated logistic system that aims to increase efficiency through various collaborative practices.

2.1. "Last-mile" delivery within the system of city logistics

Although the "last-mile" delivery, especially its direct-to-consumer deliveries by mail order companies, has been present since the 1980s and 1990s, it has drawn a significant scholars' and practitioners' attention with the rise of online and mobile shopping and increasing costs associated with the "last-mile" delivery that may range from 13% up to 75% of the total supply chain costs (Gevaers et al., 2009).

Since the "last-mile" delivery in urban environment represents a constituent part of city logistics as the final leg conducted over short distances to reach the customer, it could be observed within this broader system.

City logistics has been introduced as a special field of study in logistics by Ogden and Taniguchi (Anand et al., 2012). The literature points to the probably beginning of its development in 1970s - a period marked by traffic regulation aimed to reduction of heavy freight vehicles in the cities. Due to rising traffic problems, the new wave of interests in city logistics arose again in 1990s when the first projects undertook mostly in cities in Japan and countries of Western Europe prevalently due to a common constraints such as scarcity of available land and strong urban planning tradition (Anand et al., 2012; Benjelloun et al., 2010; Crainic, 2008; Crainic et al., 2009). As stated in Benjelloun et al. (2010, p. 6217), *[t]he City Logistics concept has emerged as a comprehensive approach aimed to mitigate the negative impact of urban freight transportation without penalizing the city's many economic, social, administrative, cultural, touristic, and other activities.* A sole term has been coined in Germany where researchers of that time studied city logistics as a joint delivery system of different transport companies for local purposes. The decade concluded by establishing the *Institute for City Logistics* (in further text – *ICL*) in Kyoto, Japan in 1999 as a centre of excellence in fundamental and applied research on city logistics and urban freight transport symbolizing the beginning of a heyday of city logistics research and its application (Anand et al., 2012; Benjelloun et al., 2010; Crainic, 2008; Crainic et al., 2009; ICL; Visser, 2005). Since then, the city logistics have come forth as an emerging

field of research that evolves rapidly (Bektaş et al., 2015; Crainic, 2008; Crainic et al., 2009; Dablanc, 2012 as cited in Dablanc et al. 2013; Rodrigue, 2004 as cited in Dablanc et al., 2014).

2.1.1. Main stakeholders in the "last-mile" delivery

The basic feature of city logistics is heterogeneity of the stakeholders whose different behaviour and objectives should be integrated into unique logistics system that involves the "last-mile" delivery as well (Taniguchi et al., 2012). The four key stakeholders are (1) shippers that tend to minimize their total costs while maximizing the level of their service through timely delivery, (2) freight carriers that aim to minimize transport costs while maximizing the level of their service through strict designated time, (3) residents (consumers) who tend to maximize their gain by timely purchase of needed goods at a reasonable prices due to which are being exposed to traffic nuisances and (4) administrators aimed to maximize economic prosperity of the city and to align conflicting interests of all by establishing a sustainable transport system (Taniguchi et al., 2008 as cited in Ehmke, 2012; Taniguchi et al., 2012). Other categorizations of the main actors involved in the "last-mile" freight delivery derived from the aforementioned one can be found in the literature as well (for example: Russo & Comi, 2012; Wohlrab et al., 2012).

2.1.2. The "last-mile" delivery and subsystems of the city logistics

As stated by Bektaş et al. (2015), the system of city logistics is based on the following four subsystems: (1) *(...) the demand for transport the system aims to satisfy* referring to freight flows (p. 5) and (2) facilities as nodes that split freight transport into outside (external) and inside city area and where many value-added logistics activities are carried out, such as: consolidation of delivery flows, coordination of transport, transhipment and storage. Two pivotal facilities within the system of city logistics are city distribution centres (in further text - CDC) or urban-freight consolidation centres (in further text - UCC) and satellites platforms. In their study on potential development of the UCCs, Browne et al. (2005, p. 4) described UCC *(...) as a logistics facility that is situated in relatively close proximity to the geographic area that it serves be that a city centre, an entire town or a specific site (...), from which consolidated deliveries are carried out within the area.* It is a share–user hub settled outside the city area where long-haul freight vehicles coming from various suppliers are received, sorted, consolidated, uploaded and distributed to the final receiver point (either satellite platforms or direct to customer) by fully-loaded larger urban friendly vehicles. Very similar to UCCs are satellite platforms located close to or even in the dense city centres where only cross-docking transfer of freight coming by urban vehicles from UCCs or other external points is performed onto the city freighters for its "last-mile" delivery to the final consumer. City freighters are small vehicles adapted for delivery in dense city centres (Crainic et al., 2009) while parking spaces, bus stations, train stations, city squares or other similar existing sites can be used as satellites (Bektaş et al., 2015). The third subsystem of city logistics as indicated by Bektaş et al. (2015) is (3) layout determined by tiers or echelons – a number of

subjects providing similar service. Depending on the number of levels where consolidation-distribution activities take place, it is possible to distinguish single-tier systems where freight consolidated in CDC is delivered directly to final receiver and multi-tier systems where freight is passed through several different sorts of facilities, transport modes and vehicles before reaching final customer. The last subsystem is (4) transport that deals with appropriate choice of green vehicle ranging from light rail to bicycles (Bektaş et al., 2015).

2.1.3. Specifics of the "last-mile" delivery

According to Boyer et al. (2005), a product can be moved to a customer by four "last-mile" delivery types (extended supply chains) that differ in two dimensions - order fulfilment and delivery type. While order fulfilment can be done in a store or in a distribution centre, delivery can be conducted either directly to customers' home from the company or by freight carrier or indirectly at collection/pick-up point. The authors have differentiated these types as semi-extended supply chain (with store-based fulfilment and indirect delivery), fully extended supply chain (with store-based fulfilment and direct delivery to consumers' home), decoupled supply chain (with fulfilment via distribution centre and indirect delivery) and centralised extended supply chain (with distribution centre fulfilment and direct home deliveries). Each type varies in four critical factors that companies have to balance – customer convenience, delivery cost, picking efficiency and capital investment (Boyer et al., 2005). A similar and comparable approach with detailed advantages and disadvantages of each option can be found in Chopra (2003). Further elaboration of the typology of Boyer et al. (2005) can be found in Greavers et al. (2009) or in Hübner et al. (2014) if "last-mile" delivery in online and offline presence concerns.

The special issue regarding "last-mile" delivery that particularly arises in the e-commerce environment are attended home deliveries that are either marked by so called "not-at-home syndrome" (without specific delivery time assigned) or "ping-pong" effect (with specific delivery time assigned) that increase economic and environmental costs including driven kilometres (Greavers et al., 2009; Edwards et al., 2009; Hübner et al., 2014). Furthermore, there are problems of low consumer density that lacks the advantages of economy of scale (in the case of home and clustering deliveries), secure reception problem (in the case of unattended home deliveries) and returns (Edwards et al., 2009; Greavers et al., 2009). Other main issues common to all types of "last-mile" delivery are (Greavers et al., 2009; Edwards et al., 2009): empty running, additional sorting requirements and inefficient routing due to small consignment lacking the economy of scale and increasing carbon footprint. The list could be extended by restricted delivery routing and timing and general competitiveness of delivery industry (Xing et al., 2010 as cited in Dablanc, 2013).

3. INNOVATIVE VEHICLES

Many initiatives, projects and innovations have been carried out so far to contribute to positive environmental outcomes regarding urban freight activities

especially since city logistics has come forth. According to Patier and Browne (2010, p. 6230), innovations carried out in city logistics can be grouped to those that refer to: *[c]onsolidation of goods flows within the urban area (achieved through new organisation or new concepts such as consolidation centres); [u]se of new non (low) polluting vehicles (e.g. electric powered vehicles); [r]egulation (usually focused on restricting certain types of activity by time of day, size/type of vehicle).* Greavers et al. (2009, p. 6-11) point to five characteristics of the "last-mile" delivery and their sub-characteristics as subjects of innovation that directly influence efficiency, costs structure and environmental impact. These are: consumer service level (with sub-characteristics: time windows, maximum lead times, frequency of delivery, possibility of returns), security and type of delivery (with sub-characteristics: (un)attended deliveries, collection points, delivery boxes), geographical area and market penetration (with sub- characteristics: market density, average distances between points of reception, share of goods to be pooled/clustered during delivery routes), fleet and technology (with sub-characteristics: type of vehicle and ICT used) and the environmental issues that depend on the aforementioned sub-characteristics.

A review of projects and initiatives introducing innovations to mitigate negative impact of urban road traffic in the "last-mile" delivery reveals a number of innovations regarding transport vehicles. New freight delivery vehicles are required to be of small size, flexible to operate within urban core and in compliance to low emission standards. The usage of electric vehicles or trucks on alternative fuel technology or environmentally friendly transportation modes are preferred (Visser, 2005). As observed by Bektas et al. (2015), specially designed trams, regular rail, barges or buses are taken into consideration or even implemented as well.

According to the European Commission's White Paper (European Commission, 2011), usage of all conventionally fuelled vehicles should be halved by 2030 and completely banned in the city centres by 2050. Research data of the European project CycleLogistics
[1] (CYCLELOGISTICS, n.d.) shows the potential to shift 51% of all motorised private and commercial trips[2] related to goods transport among which 25% refers to delivery in an average European Union's cities to bicycles or cargo bicycle. This proportion makes 25% of all trips made in European Union's cities or 42% of all trips made by motor vehicles in European Union's cities. The share reaches 50% in case of the light goods. All the shares could be even be bigger if electric assistance is used. (European Cyclists' Federation, 2012; CYCLELOGISTICS, n.d.)

Usage of cycles for the "last-mile" delivery is mainly suited for short distances (2,5km to 3,5km in average) and light goods transport usually made with lorries and vans below 3,5 tones (CYCLELOGISTICS, n.d.). According to the data from CycleLogistics projects, commercial bikes could be used for light loads of 80–200kg with some exceptions reaching up to 400kg. In terms of volume, this amounts to 400 – 800 litres delivered to a distance up to 7km with electric assistance. Besides common mail services, bikes are particularly convenient for a delivery of small weight

[1] The research was limited to transport of light goods weighing less than 200kg/m³ and to trips length less than 7 km with trip chains excluded (CYCLELOGISTICS, n.d).
[2] Private trips are all personal trips that include commuting, shopping and leisure trips. Commercial trips include delivery cargo trips, service trips and business trips (CYCLELOGISTICS, n.d.).

packages, ranging from online purchases, takeaway foods, drinks, flowers, office supplies, newspapers, mail, small parcels or even furniture. Among standard bicycle with shoulder bag or panniers for loads up to 40kg or standard bicycle with trailer for loads up to 80kg, other types designed for professional use including security and weather protection are: cargo bike for loads up to 80kg and volume of 0,5m³ (Figure 1) and cargo trike/quad for loads up to 250kg (Figure 2) (CYCLELOGISTICS, n.d.).

Figure 1. Electric cargo bike

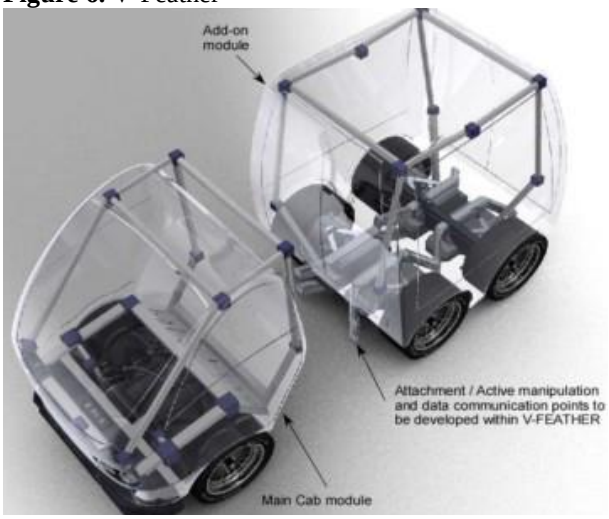
Source: Institute of Transport Research (n.d.)

Figure 2. Cargo trike/quad

Source: European Cyclists' Federation (2012)

V-Feather vehicle represents a light electric freight vehicle composed of multiple building modules of various sizes and types. One cabin module is where a driver sits while others are adaptive freight modules for carrying various goods (refrigerated goods, dangerous goods, etc.). These modules can easily be dropped off or picked up after recharging at different locations within the city, meeting different delivery requirements (new system of "last-mile" delivery known as Deposit, Rapid Recharge and Recollect - *D3R*) (Luxembourg Institute of Science and Technology, n.d.; European Commission, Horizon 2020).

Figure 6. V-Feather



Source: Aggoune-Mtalaa (2014)

Another light electric delivery vehicle is Deliver (Figure 7). It is a next generation vehicle intended for large scale production. It is 40% more efficient compared to other conventional vehicles in the category. It has a maximum load capacity of 700kg or 4 m³ for urban delivery services with extensive stop-and-go driving (EUCAR, n.d.).

Figure 7.

Source: EUCAR (n.d.)

Delivery drones – remotely or automatically piloted aerial vehicles are another innovation. So far, they are still in a trial phase and mainly used for parcel delivery of medical supplies and other urgently needed goods. First civil drone known as *parcelcopter* launched by Deutsche Post DHL has reached travel distance of 12 km (Figure 8). It has weighted below 5 kg with loading capacity up to 1.2 kg and has reached travel speed up to 18 meters per second at an altitude of 50 meters (DHL, 2014a; DHL, 2014b). Their features have been a subject of further improvements

regarding load capacity, delivery distances and power solutions (Figure 9) (GEOPOST, 2015; YEAIR, n.d.).

Figure 8. Deutche Post DHL's parcelcopter

Source: DHL (2014a)

Figure 9. Improved delivery drone guadcopter year!

Source: YEAIRE (n.d.)

The German logistics provider DHL anticipates the introduction of autonomous driving technology. Self-driving road vehicle could be used for business purposes for the "last-mile" delivery of parcels and letters, either as an assistance vehicle to a delivery person, as an autonomous vehicle that substitutes the delivery agent in parcels' loading and unloading into standardized reception boxes or as a self-driving shipment repository. Other potential applications refer to its usage as a shared, crowd shipping, shopping car for the "last-mile" deliveries of online purchases or as a self-driving vehicles in size of the parcel (*self-driving parcels*) with individually determined and controlled delivery path, temperature and handling modes that would enter the final recipients' home through a specially designed small gate. After unloading, recipient would send the vehicle back to carrier by using a smartphone application (DHL, 2014c).

Figure 10. Self driving parcel

Source: Prestigefilms as cited in: DHL, 2014c, p. 32

Caps (Figure 11) are fully automated electrically powered freight delivery vehicles to be used in underground transport pipeline system in congested urban areas. They

are driven at constant speed of 10m/s (36 km/h) and designed to carry various goods[3] packed on two Euro-pallets maximally weighting up to 1500kg - 2000kg. Upon delivery to final destination, common automated machines are used to automatically unload Caps and to transport cargo further up to the surface. Due to flexible planning and executing of the network system, unloading stations can be placed according to the need of the customer including direct delivery to a single customer by vertical conveyers (CARGOCAP, n.d.; Rijsenbrij et al., 2006).

Figure 11: Caps with fully automated horizontal (un)loading conveyors

Source: CARGOCAP (n.d.)

There are many tram freight systems that have been implemented so far. The pioneering one can be find in Dresden that has been used by Volkswagen since 2001 to supply its production while excluding delivery by heavy trucks and its related externalities. Dresden CarGo Tram drives on the same light rail that is used for passenger transportation, although it does not interfere with it (Jacyna & Szczepański, 2013; Living RAIL, n.d.). Zurich has followed and has implemented its cargo tram system for the purpose of waste disposal since 2003 (Jacyna & Szczepański, 2013). Similar solution for Istanbul city is proposed by Gorçun (2014) where urban rail systems and freight trams could be used exclusively for goods distribution from

[3]*Consumer and investment items, bulk goods, cargo, production components, building material, parcel and express freight, as well as food and allied products rank among the goods that may be transported via CargoCap* (CARGOCAP, n.d.).

suppliers to retailers for night deliveries or in combination with passenger transportation during daytime.

Another innovative solution might be crowdsourcing delivery - engaging incentivized individuals to provide "last-mile" delivery service from a retailer to the shopper on their way by using mobile application. This approach has been implemented by Deutsche Post DHL in Sweden called MyWays (DHL, 2013) while the latest news in the field report that Amazon.com, which is recognized as the world's leader in e-commerce, considers it as well (D'Onfro, 2015; Heller, 2015).

4. DISCUSSION ABOUT BENEFITS OF INNOVATIVE VEHICLES

According to CYCLELOGISTICS (n.d.), besides environmental benefits, the advantages of using bicycles are: no fuel costs, more simple and intensive exploitation of the existing road network, exclusion of parking or accessibility problem, independence on time windows for deliveries and on vehicle weight and size restrictions, adequacy for wide range of goods, especially for light goods, faster, reliable and flexible delivery service on short distances especially at peak hours and in small but high density commercial and residential areas. In some cases, a 40% reduction of delivery by implementation of cargo bikes have been reported (Torrentellé et al., 2012, p.139). Other advantages include decreasing delivery costs and positive image. Major obstacles refer to general behaviour change toward acceptance of bicycles as an alternative delivery vehicle in urban areas. Disadvantages especially regarding cargo bikes and cargo trike/quad include purchasing costs that amount between 2000 and 5000 Euros or 3000 and 12000 Euros, respectively, greater reliance on riders' training and strength, security, storage and parking concerns and questionable reliability on weather conditions and when fully loaded and dependency of cargo trikes on road network.

V-Feather is announced as a vehicle of the near future (CORDIS, 2015). Due to its modular structure, it enables better flexibility while reducing costs. Regarding Deliver, it should be used for postal services. An intended large scale production is expected to be launched by 2020 with market penetration by 2030. More detailed figures on economical side of these vehicles are unavailable.

According to some sources, delivery drones could be in use within the next five years (Mehra, 2015). Currently, the major obstacle to their introduction refers to legal restrictions and technical difficulties – such as battery power, unreliable location data, limited weight and travel distance. Other obstacles comprise increased costs of changing existing logistics process in compliance to drones usage, investment costs, security issues and weather dependency (Mehra, 2015).

Benefits of implementation of autonomous vehicles comprise improved carbon footprint due to exclusion of returning trips for reloading vehicles and increased productivity of delivery person. Parcel station loading contributes to increased speed, shorter delivery times, reduction of labour costs and increased efficiency. Major obstacles for introducing self-driving technology to public roads refer in general to law restriction, doubtful public acceptance in terms of safety and willingness to pay more for a driverless service (DHL, 2014c).

The benefits of the underground pipeline transportation system of CargoCaps includes the provision of sustainable, reliable, cost effective and energy efficient transportation solution convenient for supplying various establishments in dense urban areas with various goods. Although rail or road have bigger maximum load capacity, due to its independence on other transport modes and traffic jams, it administers continuous and safe flows within shorter delivery time in comparison to road transport. The processes of (un)loading are faster as well. The extendable and space-saving pipeline infrastructure is considered to be easy to build with ability to be set up in a close vicinity of an already existing underground infrastructure. The tunnelling costs, although very high, are estimated to be 4 to 8 times less than those for trains due to new infrastructure with smaller diameter (in case of CargoCaps of only 2m). The economic benefits include direct and continuous freight flows with JIT delivery at competitive transport prices that applies even to small consignments. The system is able to provide additional services to retailers such as stockkeeping, picking, reverse logistics activities etc. So far, the system of CargoCaps has been planned only for Ruhr region in Germany with prediction of further increase in volume and network extension due to rise of toll charges for road freight transportation and increasing returns from network investment. Disadvantages of the system refer to its application only to massively palletized or roll boxes freight that hinders a possibility to gain interests of an adequate market player to implement the system. The system’s adaptation for usage in intermodal transport increases costs that outrange infrastructure costs savings (CARGOCAP, n.d.; Rijsenbrij et al., 2006). According to some estimation the full costs per tonne.km is 1,51 Euros/tonne.km that amounts to 70% of the costs with an average truck while infrastructure costs are about 52% of all costs (Kersting et al., 2005 as cited in Rijsenbrij et al., 2006).

As observed by Jacyna & Szczepański (2013), the major obstacle to introducing cargo trams is a difficulty to estimate the real costs of such a project. Gorçuns’ case study on Istanbul city (2014) showed multiple benefits of urban rail transportation in comparison to urban road transportation that refer to costs, environmental conditions and externalities.

Crowdsourcing is considered to be a relatively new approach whose practicability and reliability of the service is uncertain. Behind companies’ motivation to reduce shipping costs while enabling same-day delivery, there are many unsolved issues, such as secure delivery, theft or fraud (D’Onfro, 2015; Heller, 2015). Shopwing in Germany that has been proving similar service has closed down (Bershidsky, 2015).

5. CONCLUSION

In this paper, drawing on the augmenting importance of urban freight transport and its main characteristics, the terminology that relates to “last-mile” delivery has been defined and the “last-mile” delivery with its specifics has been explained within the broader system of city logistics. Based on the research of projects and initiatives introducing innovations to mitigate negative impact of urban road traffic in the “last-mile” delivery, a number of innovative transport vehicles have been presented and

their benefits have been presented. These vehicles range from labour intensive bicycles, optionally electrical assisted, crowdsourcing, electric road and aerial freight delivery vehicles, underground pipeline vehicles and freight trams.

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DISTRIBUTION CHANNELS OF MAJOR CONSTRUCTION MATERIALS

Vesna Vučemilović
Associate on College of Slavonski Brod
Slavonski Brod, Croatia
Phone: +385 98 98 244 22
E-mail: vesna.vucemilovic@yahoo.com

Professional paper

Abstract

Distribution is an important element of marketing mix which enables product to reach through distribution channels from the producer to the final consumer. Distribution channels consist from all companies involved in that process including producer, wholesale, retail, insurance companies, transport companies, banks, warehouses and key accounts, particularly those from industrial markets.

The purpose of this paper is to point out the specifics of distribution channels of major construction materials such as cement, roof tile, and bricks. Selection of the specific distribution channel significantly affects the costs, sales figures and the other elements of marketing mix. This is very important in distribution of construction materials due to the high share of transportation cost in final price and limitations based on geographical position of the producer.

The choice of appropriate distribution channel for each product is a very complex process. Final decision on the selection of distribution channels combines ideal and available distribution channels and is related to the objectives set for particular market by the company. Often companies have to accept existing conditions on the market which limits their choice in selecting distribution channel.

Practical part of this paper will cover members of main distribution channels for constructional materials which are industrial customers, resellers - retail, wholesale and government acquisitions.

Key words: distribution, construction materials, marketing-mix, retail, wholesale

1. INTRODUCTION

Distribution is a very important element of marketing mix which helps producer to deliver products and services to final consumer. Producers rarely directly deliver products to final consumers instead they are just one segment in whole distribution channel. Therefore company will conduct profitable business only if all companies involved in distribution channel are profitable. Distribution channel can also be a way of achieving advantage in relation to competition which has been used by producers of construction materials. This companies were delivering products just in time on construction site which helped their customers to cut costs of production.

Production of construction materials and this industry as a whole has a long tradition. Last several years, since the beginning of crises there has been a strong decline in this industry. The number of procured building licensees for new objects is in decline since 2009. We can say that growth and decline of demand for construction materials is in strong correlation with growth and decline of state economy.

Major construction materials are cement, bricks and roof tiles. There are significant differences between this products.

Cement is construction material which has high share of transportation costs in final price. All producers have set quality according to regulations and standards so for their customer's major factor which determines selection of the supplier is price and distribution.

Bricks market is characterized by great number of producers which have higher capacities than market can consume. Before the crises they were exporting bricks in Bosnia and Herzegovina, Romania and Hungary. Today there is strong trend of price reduction which smaller producers cannot follow and they are mostly closing their business. Bricks are the product that is used only for new buildings so this crises severely affected this particular industry.

Roof tiles are the product which can trough wide range of products and distribution channels realize comparative advantage. This construction material is used for new buildings and also for existing buildings which are only repairing roof in 50:50 ratio. Majority of final customers comes in retail with already made final decision which roof tile will buy. The most significant factor in making that decision is combination of price and quality that is most satisfactory to final consumer.

Distribution channels for major construction materials are industrial customers (concrete producers, civil engineering and building construction, producers of other materials used in construction), resellers i.e. retail and wholesale and government acquisitions.

Data used in this paper are information collected in a survey conducted by specialized company for market research (Puls) and business data collected by producers of construction materials. Market research included resellers of construction materials in Croatia and experts such as architects and engineers. The method that has been used was face-to-face interviews.

2. CONSTRUCTION MATERIALS

If we look at history we can say that development of construction materials follows evolution of civilization. The oldest monuments of civil engineering are from 12000 year B.Sc. and materials used for construction were stone and clay. The oldest organized production of construction materials was bricks production in old Egypt. Bricks were made of clay, reinforced with cane and dried on sun.

It is very hard to define construction materials because there are construction materials and materials used in construction. This definition is hard to make therefore in era of industrial construction there is a large range of semifinal products based on major construction materials such as finished concrete constructions used in building process. It is not only hard to define but also to specify the division of construction

materials. Therefore there is a vast number of construction materials division according to different criteria. I will mention just few of them.

According to type of basic mineral material construction materials divide on stone, cement, lime and gypsum, then sand and gravel and bricks and roof tiles (Brzaković, 2000, p.4).

According to type of construction materials production we differ materials produced by cutting, grinding, separation, stone-crushing and polishing, then materials produced by heat treatment, materials produced by hydrothermal treatment and materials produced by mixing water, aggregates and binding material (Brzaković, 2000, p.4).

As we can see no matter which criteria we use for dividing construction materials, as major or basic construction materials always are stated cement, bricks and roof tiles. Lime and gypsum are used rarely so we can say that cement is basic binding material in construction. In future lime will be used more in some other industries such as metallurgy.

3. DISTRIBUTION CHANNELS

Distribution is an element of marketing mix which assures change of product place as a result of sales activity. Sales implicit change of product ownership. Distribution tell us in which way product comes from producer to final consumer (Meler, 1999, p.279).

Distribution channels, or marketing channels are group of mutually depending companies included in process which will made products available for usage or consumption (Kotler, 2001, p.530). Size of distribution channel depends on type of product, producer's economic possibility, characteristic of market segment and so on. Distribution channel consists from producer, retail and wholesale, insurance companies, transportation companies, banks, warehouses, key accounts especially from industrial market.

Members of distribution channels share specific important characteristic. Every member of distribution channel has different engagement in whole distribution system and mutual profit and success is realized only trough cooperation of all members of distribution channel while the products are delivered on the market.

Decisions regarding distribution are not more important than other marketing decisions but never the less, they significantly influence other elements of marketing mix. Making decisions about distribution channels is crucial because it defines presence of product on the market and customers' ability to buy certain product. All these decisions have strategic importance because they usually have long term commitment. It is often easier to change price conditions than all distribution system. It is particularly emphasized on the construction materials market especially on the cement market, because there is greater share of direct distribution than distribution through resellers. Share of direct distribution to final consumer even increased when cement producers started expanding their business through vertical integration on concrete production.

It is very complex process to choose the right distribution channel for particular product. Producer must carefully evaluate potential middleman or agents going through data regarding sales figures, profits, range of products they are having on stock, customers etc.

Before producer determines specific distribution channel he must have in mind market characteristics, customer behavior, product characteristics and elements of surroundings.

When producer makes decision about distribution channel he usually makes combination between ideal and available distribution channels. It is very expensive to build retail network or increase direct distribution in some other way, mostly through vertical expansion. Existing resellers are the most common selection so producers put their effort in gaining resellers which already exist on certain market to be a part of their distribution channel.

Distribution channel selection is also determined by goals that company sets for particular market. It is important to define market in a terms of importance whether particular market is of primary or secondary importance. That decision defines usually distribution channel for particular market. Sometimes there are certain limitations that give no choice to producer regarding distribution channel. It is especially emphasized on cement market where cement producers must respect market position taken by companies involved in civil engineering and building construction.

When distribution channel is selected, that decision influence all other elements of marketing mix, sales figures and costs. It is even more significant for construction materials because of high share of transportation costs in final price. All producers of construction materials have limitations regarding distribution on distant markets because it is not profitable. Distribution on markets which are more distant from the factory location can be made only by shipping transportation and distribution centers in ports. Never the less, even that type of transportation increase costs of loading and manipulation.

The process of managing distribution channel demands continues selection and evaluation of resellers based on sales figures in previous period. As a result of that process is continues modification of distribution channels according to trends on the market and in surroundings.

Major members in distribution channels for construction materials are industrial customers (concrete producers, civil engineering, building construction and producers of other materials used in construction), resellers i.e. retail and wholesale and government acquisitions.

3.1. Structure of distribution channels

The number of levels in distribution channels define the length of distribution channel. Level of distribution channel is level of marketing agents or mediators which conduct certain job in process of bringing product and ownership closer to the buyer (Kotler et al., 2006, p.860).

If there is no marketing mediators in distribution channel we consider that distribution channel to be direct one. This approach is used by producers of construction materials in case of direct distribution to industrial customers and

construction companies. Share of that distribution is the largest in cement distribution and smallest in roof tile distribution.

The number of mediators in distribution channel represent the number of levels in distribution channel. As mediators we consider agents and resellers (wholesale and retail).

If we look at distribution channels according the way they are organized we differ further distribution channels:

1. Conventional distribution channel with independent participants which have individual business policy trying to gain maximal profit;
2. Vertical marketing system in which producer, wholesale and retail act as a united system. It can be corporate, contractual and administrative;
3. Horizontal marketing system in which two or more companies unite on the same level to make their businesses more profitable and
4. Hybrid marketing system in which one company develops one or more distribution channels to cover one or more market segments (Kotler et al., 2006).

3.2. Design of distribution channels

It is not easy to decide what type of structure distribution channel shall have. Several factors must be taken into consideration. Design of distribution channel demands:

- Analysis of client demands
- Determination of goals and restrictions of the channel
- Establish major channel alternatives and
- Evaluation of alternative values (Kotler et al., 2006, p.871).

Company must consider needs and desires of final consumer but always must think about level of service that is important to final consumer and price he is willing to pay.

Goals set by the company for specific market must be defined depending on product, competition, environment and service level to final consumer.

Establishing major channel alternatives includes selection of type and number of mediators in distribution channel and responsibility of each mediator. Company can use several alternatives such as direct marketing, sales force and resellers (wholesale and retail).

The number of mediators in distribution channel we also define as width of distribution channel (Kotler et al., 2006, p.880). It can be exclusive distribution with limited number of mediators in product sales. Producer and members of distribution channel have written contract agreement which gives exclusive right to limited number of mediators to sell product on particular market. It is often used on new markets and markets with high risk in terms of payment.

Second type is selective distribution which means that producer is using more than one mediator on the market which allows producer to have certain control on distribution channel and still having satisfying presence on the market.

And the last one is intensive distribution used by producers that need to cover total market with their product and have to be present with product on large number

of retail stores. Basic characteristic of this type of distribution is poor control of distribution channels.

After considering all alternatives in design of distribution channels company must select alternative which will help in achievement of long term goals set for certain market. Each alternative must be evaluated according economic criteria meaning profitability of each distribution channel. Figures that are being considered are sales figures and costs of sales by using certain distribution channel. Very important factor is control of product presence on the market.

3.3. Industrial customers

Industrial customers are on the markets characterized by smaller number of buyers which are mostly defined as key accounts due to the size of their business. They have specialized employees in purchasing departments and in process of selecting potential supplier large number of experts are involved. Sometimes even members of Board of Directors participate in that process. Industrial customers mostly buy directly from producers or importing companies.

Cement market is characterized by industrial customers as major buyers. When we talk about industrial customers on cement market we mean construction companies, concrete producers, producers of concrete products such as concrete pipes and producers of mortar and other products for construction. Contracts are made on long term basis (two or more years) with price adjustment during that time according to market conditions.

Industrial customers are strongly influenced by trends in state economy and investment cycles because of government investments in infrastructure.

Purchasing department in construction companies are usually centralized to get best conditions for quantities that are being purchased. Important role in purchasing process has technical department, laboratory and supervision.

Purchasing process starts with problem definition and description of general product characteristics together with requested quantities. Second step is detailed technical specification. This specification is part of inquiry which purchasing department is sending to potential suppliers. After receiving offers, all members of team make analysis and recommendation which supplier to select. Important elements are not only price but also other services such as technical support, product quality and terms of payment, supplier's good name and even personal relations. After supplier is selected orders are made periodically depending on required quantities and that can be daily, weekly or monthly. Each and every supplier is being evaluated and graded once a year.

In purchasing process for major construction materials, especially cement, price and delivery conditions are the most important elements in process of supplier's selection. Big producers such as Cemex have made special systems of just in time delivery on the construction site which helps their customers to make plans more accurately and also cut the costs.

This distribution channel is extremely important for cement. Bricks are distributed through this distribution channel in rather small quantities and for roof tiles industrial customers are not significant at all.

3.4. Resellers

Resellers market consists of all individuals and companies which buy products and services to resell them and gain profit (Kotler, et al., 2006, p.89).

Resellers must make some decisions to position themselves on the market best they can. First they have to define range of products they will keep on stock. It is very important to define whether reseller will have only construction material or all products used in construction.

When they define range of products they have to decide whether to select only one producer as supplier for certain product or to have more producers as suppliers. Resellers often have for cement and bricks only one or two producers at most, while they often have roof tiles produced by all available producers existing on the market.

Purchasing process is often in hands of the owner or in bigger wholesales, specialized purchasers. Final decision regarding supplier's selection is made considering price, terms of delivery and payment and of course demand of final consumer.

3.4.1. Retail

The purpose of retail is to sell products and services to final consumers. Retail can be general and specialized and it can purchase products from producer directly or from wholesale. Retail includes all activities which means selling products and services directly to final consumer for their personal, nonbusiness needs (Kotler, 2001, p.563).

Segetlija emphasizes that retail acts as mediator in product exchange between wholesale and final consumer or producer and final consumer (Segetlija, 1990, p.15).

Buyers in retail are mostly final consumers. Sometimes buyers in retail are other companies which buy products for the purpose of their business.

By insuring range of products that suits their customers' needs retail makes efficiency in terms of:

- Space – created through moving products from wholesaler or producer to location where final consumers are willing to buy certain product;
- Time – consists of management of working hours in relation to make products available to final consumers in time when they want them;
- Ownership – making easier transfer of ownership or usage of products for final consumers (Dibb et al., 1995. p. 334).

Retail can purchase products from wholesale, directly from the producer or make some kind of a combination this two ways of supply. Producers of construction materials supply retail directly and through wholesale to minimize the risk of payment.

While wholesale is limited on producers and import companies in purchasing process, retail has wider choice which depends on:

- Supply quantities,
- Range of products,
- Supply costs,
- Other economic important factors (Segetlija, 1990, p.15).

Producers of construction materials often advertise together with retail stores such as price cut off actions and presentation of new products on selling point. It is commonly used when new products are introduced to the market especially one that bring new ways of building.

All research done by specialized agencies emphasize retail as distribution channel because 30% of final consumers decide in retail store which product to by.

Table 1. Purchasing decision in buying process of constructional materials

Purchasing decision	Roof tiles	Bricks	Cement
Before coming in retail store	68%	70%	74%
In the retail store	32%	30%	26%

Source: Market research conducted by Puls and business data collected by producers of construction materials

Even 20% of all costumers makes decision according to recommendation given by employees in retail store.

Table 2. Source of influence on final consumer in deciding which construction material product to buy

Source of influence	Roof tiles	Bricks	Cement
Experts	30%	29%	24%
Promotional activities	12%	12%	8%
Final consumer makes decision on its own	34%	37%	48%
Employees in retail store	20%	20%	18%
Final consumers company	2%	1%	1%
Others	1%	1%	1%

Source: Market research conducted by Puls and business data collected by producers of construction materials

Structure of customers in retail stores for major construction materials is shown in table 3.

Table 3. Structure of customers in retail for major construction materials

Types of customers in retail	Roof tiles	Bricks	Cement
Final consumers	38%	39%	30%
Craftsmen	24%	31%	51%

Construction companies	20%	15%	9%
Other retail or wholesale	14%	13%	8%
Others	4%	3%	2%

Source: Market research conducted by Puls and business data collected by producers of construction materials

3.4.2. Wholesale

Wholesaler is company that purchase products from producers or importing companies and resell them to retail and other companies. Wholesale does not supply final consumer which buys products in retail.

Segetlija says that wholesalers are mediators between producer on the one side and retail and key accounts on the other side. Their task is to purchase products from producers or importing companies and distribute it further to retail and key accounts (Segetlija, 1990, p.11).

Wholesale major activities are:

- Wholesale management,
- Making contracts with suppliers,
- Promotion,
- Warehousing and product manipulation,
- Transportation,
- Control of products on stock and data processing,
- Insurance,
- Price policy,
- Financing and budgeting,
- Management and marketing support to their clients (Dibb et al., 1995. p. 311).

Wholesalers has to specialize for particular range of products if they want to be successful. That should help them to optimize their purchasing process and cut the costs due to a larger quantities they purchase (Segetlija, 1990, p.15).

Wholesale is used as distribution channel for major construction materials on new markets and markets characterized by high risk of payment. Producers without their own selling force have no choice but to use wholesale to enter particular market. It can be risky because of small or even non control of selling activities on that market. Therefore most of the producers start on new markets with wholesale but work on establishing their own selling network as combination of retail, wholesale and selling force of their own.

3.5. Government acquisitions

Government acquisitions or procurements market consists of units – federal, state and local – which purchase products and services to produce public services or transfer products and services to one they need it (Kotler, at al., 2006, p.89).

This market is probably the most complicated one due to a very demanding procedure which has as a result slow purchasing process followed by many documents and procedures connected with control of government acquisitions. Special attention has to be taken to contracts which usually have more variants and can be changed during the contractual period.

Important factor in supplier selection on the government acquisitions is price. Sometimes there are noneconomic criteria involved such as either supplier is from within the state or from abroad.

On a construction materials market government is very important factor in segment of laws and regulations regarding product quality standards, ecology, concessions and procedures regarding construction. Very important is also total economy policy and government investments especially in roads and infrastructure.

Significant factor for construction materials are companies owned by state such as Croatian Roads and Croatian highways especially in Croatia for cement.

4. CONCLUSION

Development of construction materials trough history follows evolution of mankind. The oldest organized production of construction materials was bricks production in old Egypt. If we look on our region production of construction materials has long tradition.

No matter which criteria is used to classify construction materials cement, bricks and roof tiles are always stated as major or main construction materials.

Demand for construction materials is closely related to tendencies in state economy as a whole. For producers of construction materials state has very important impact also in segment of legislation regarding product quality standards, concessions, ecology and laws related to construction.

All producers try to gain better position on the market through vertical and horizontal integration processes. Vertical integration towards the concrete production and retail is a part of developing distribution channels and gaining better control over distribution. It is common on the construction materials market, especially cement, that 20% of all buyers hold 80% of total sales. Therefore investments in concrete production and retail makes sense to cut the dependence on small number of buyers.

As we saw retail is very important for construction materials producers especially bricks and roof tiles. It is important to build partnership relations and also by strong promotional activities create demand for particular products.

Wholesale is used on new markets at the beginning and on markets with high risk of payment. All producers try to reinforce their presence on the market with sales force of they own.

Last crises which is still present on the construction market, showed that companies with larger range and control of distribution channels easier handled difficulties. Therefore producers of major construction materials should invest in distribution channels especially retail for bricks and roof tiles and industrial producers for cement.

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III. TRANSPORT AND WAREHOUSE TRENDS

THE COST AND NON-COST CONDITIONALITY OF TRANSPORT CORRIDOR LOGISTICS PERFORMANCES AS DETERMINANT OF PORT COMPETITIVENESS

Borna Debelić
University of Rijeka Faculty of Maritime Studies
Studenstka 2, 51000 Rijeka
Phone: +385 (0)51 338 411 / Fax: +385 (0)51 336 755
E-mail: debelic@pfri.hr

Neven Grubišić
University of Rijeka Faculty of Maritime Studies
Studenstka 2, 51000 Rijeka
Phone: +385 (0)51 338 411 / Fax: +385 (0)51 336 755
E-mail: grubisic@pfri.hr

Saša Milanović
University of Rijeka Faculty of Maritime Studies
Studenstka 2, 51000 Rijeka
Phone: +385 (0)51 338 411 / Fax: +385 (0)51 336 755
E-mail: sasa@pfri.hr

Scientific paper

Abstract

Transport corridor logistics performances are largely influenced by the transportation cost, but at the same time the non-cost elements play a significant role, which sometimes can be crucial. This paper examines the conditionality of logistics performances of transport corridor with cost and non-cost factors related to transport corridor where the port is located, in order to provide measurable basis for assessing the port hinterland as a competitiveness determinant of the port itself and transport route in general. From a methodological point of view, the authors systematize the key cost related factors and qualitatively determine key non-cost related factors as well as the most common ordinal size of their impact intensity. The authors also elaborate on possible models of evaluation and assessment of the impact intensity of cost and non-cost elements that determine transport corridor logistics performances. The authors conclude that the impact intensity of cost and non-cost factors affecting the transport corridor logistics performances is variable in size and largely dependent on political factors and hinterland development. That is a substantial determinant of port competitiveness.

Key words: transportation costs, port competitiveness, logistics performances, transport corridors

1. INTRODUCTION

In today's highly globalized world transport is an increasingly cost integral part of a product. However, overall costs on a corridor have a strong impact on the attractiveness and even "competitiveness" of a single transport corridor. Regarding this relation between transport corridors can be considered as some kind of competitive relation between transport corridors as flows of freight traffic. Logistic performances of a corridor are one of the key determinants of competitiveness. Logistics performances can be observed as a level (intensity) to achieve the desired logistic goals, or achievements. Transport corridor logistics performances are largely influenced by the transportation cost, but at the same time the non-cost elements play also a significant role, which sometimes can be even crucial. In maritime transport it is extremely important to consider the logistics performances of an entire transport corridor, because the sea ports are an important logistical point along the route, and most often are route starting points. For these reasons the development of port systems and the justification and appropriateness of an investment in a port infrastructure is highly dependent on the entire port hinterland and port gravitational area (zone), and especially on the transport corridors logistic performance that extend throughout the port gravitational zone. From aforementioned we can conclude that the seaport competitiveness is largely determined by logistics performances of all correlated systems in the port hinterland, and especially by transport corridor logistics performances observed as an integral unit.

The objective of this paper is to examine and clarify the conditionality of logistics performances of the whole transport corridor with cost and non-cost factors of the infrastructure and transportation service on the corridor where the sea port is located and which directly influence the port competitiveness.

This paper examines the conditionality of transport corridor logistics performances with cost and non-cost factors related to transport corridor where the port is located, in order to provide measurable basis for assessing the port hinterland as a competitiveness determinant of the port itself and transport route in general.

In order to develop a systematic approach for determining the transport corridors logistics performances and their coherence and impact on the competitiveness of a port, the systematized and evaluated assessment methodology of performances and transportation costs on the transport corridor is elaborated and provided in this paper.

In last decades a very prominent EU approach (European Commission, 2015) towards transportation networking system has produced something that is today well known as Trans-European Transport Network (TEN-T). This is a solid foundation for further transport development in the EU but continuous effort needs to be done for its enhancement and strengthening. In this sense the practical relevance of the problem researched in this paper represents the necessity to establish some kind of measurable basis for evaluation of transport corridor logistics performances and their influence on port competitiveness as well as impact on economic development in port's hinterland. Contribution of this paper to the existing knowledge can be found in the integral perspective on logistics performances of the transport corridor as a whole and as a system while identifying and analysing cost and non-cost conditionality of its

logistics performances that are determinants of competitiveness of a port as a starting/ending point of most of transport corridors.

2. THEORETICAL BACKGROUND

Chow et al. (1994) performed very extensive and important theoretical researches and systematisation of researches performed by other prominent scholars from the field. Also significant part of their research is focused on comparison and evaluation of methodological solutions focused on determination of logistics performances. This paper is following their research approach and is oriented on applicative upgrade. According to Chow et al. (1994) it is possible to define logistics research as a systematic and objective search for, and analysis of, information relevant to the identification and solution of any problem in the field of logistics. They particularly emphasize that majority of logistics research is conducted emphasizing the premises that a relationship exists between a particular course of action and logistics performance. In the literature it is emphasized that logistics performance can be associated with a concept of logistics effectiveness, but this relation between performances and effectiveness is frequently relatively blurry, unclear and ambiguously, and this is particularly emphasized by Chow et al. (1994) arguing that definition of performance is a challenge for researchers in any field of management because organizations have multiple and frequently conflicting goals, so this goals mix can limit the clarification and unification of performance definition. This more because the dynamics of objective changes in present time is growing continuously under the influence of more rapid market and non-market changes in the environment. This largely applies also to institutional changes understood in the broadest sense, which are under strong pressure for changes, particularly in the transition and post-transition economies. Partly it is the impact of the inevitable changes that are brought together with the transition to competition in transition economies and strengthening of market relations in the post-transition economies. On the other hand it is the cause of ever-increasing pressure from the developed market economies in the direction of the needs for institutional harmonization with the aim of establishing integrated logistics chains and transport corridors.

Literature dealing with the area of logistics performances according to Chow et al. (1994) can be divided into six key areas in which there are a number of different directions, but summarising these six rounded approaches are taken into account:

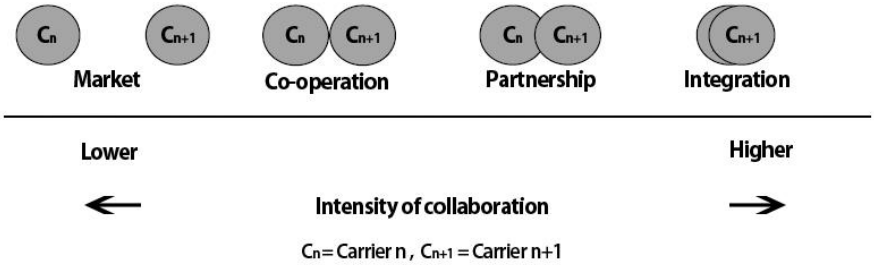
- Conceptual works;
- Performance definition;
- Performance measurement;
- "Leading edge" literature;
- Performance as an outcome variable;
- Mathematical/economic analyses.

From the theoretical perspective it is also important to mention the contribution of Naim et al. (2006) in their conceptual study developing definitions and models for transport flexibility. They have identified twelve definitions and key components of transport flexibility that signify a proactive approach to the consideration of the

subject within the context of a collaborative approach to relationships between carrier, supplier and customer. We can also apply such a collaborative approach in this research aiming to put a more light on the collaboration approach and integration of transport service under door-to-door basis.

Such collaboration and eventually integration movements on transport corridors can be illustrated as it is shown on Figure 1.

Figure 1. Intensity of collaboration and collaboration forms on transport corridors



Source: Authors elaboration based on synthesis of Williamson (1979) and Naim et al. (2006).

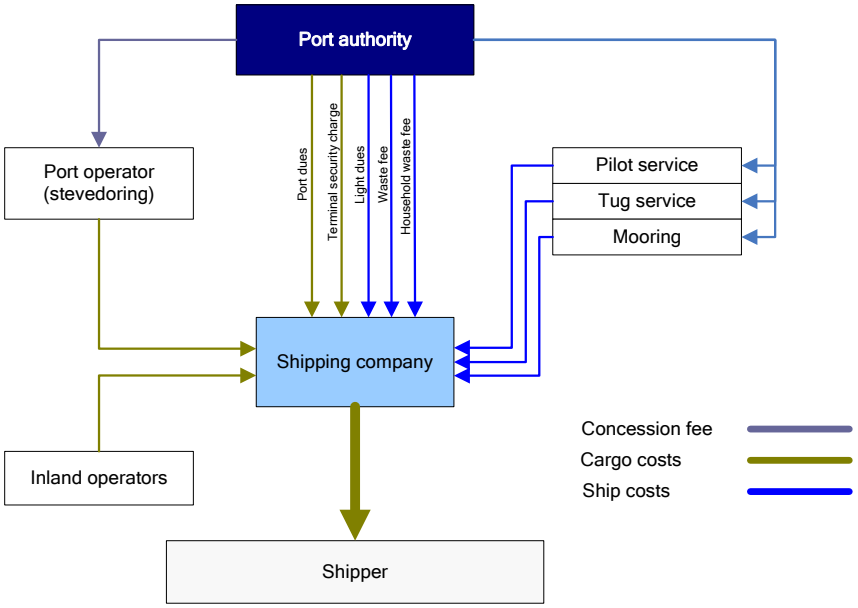
Rutner & Langley (2000) argue that logistics is an essential function within business emphasizing that it that creates value, so in order to interconnect logistics performance and competitiveness strengthening the generated value is an important cohesion factor that we find necessary to interconnect logistics performances and competiveness generation. They were primary motivated with the premise that the terms value and value added are neither clearly defined nor accurately measured so their primary goal was to clarify these definitions in the context of how value is created by logistics. Their empirical research contributed to better definitions and understanding of value and value added related to the logistics perspectives and practicing managers.

Those researches provided valuable contribution in the framework of logistics performances and their place in the business operations. Following on previous works, in our paper we are providing insight into the cost and non-cost conditioned factors that directly and indirectly affect transport corridor logistics performances and we investigate if they can be perceived as determinants of port competitiveness. To appropriately address those issues it is important to firstly review a methodology.

3. METHODOLOGY

It should be noted that competition among Adriatic ports in container transport is large enough to have excluded all possible forms of monopolistic influence of port operators on service costs. In container transport is much more important the overall price of the transport route, which consists of shipping freight, the Terminal Handling Charges (THC) and inland transport costs. For the shippers this price represents a sort of aggregate transport costs. Costs in container transport can be divided on the cost of the ship and the cost of goods. The fee structure is best illustrated by Figure 2.

Figure 2. Relations between the subjects in the transport process in terms of transportation costs



Source: Authors elaboration

One of the important indicators of the port attractiveness in container transport are THC costs. They are the reference indicators of receivables by a shipping company who is entrepreneur of the transport service, to the shipper who provides the goods for transport.

Two main contracting principles exist in container multimodal transport. Those are so-called "port-to-port" principle and "door-to-door" principle.

In "port-to-port" based contracts, goods are carried from the port of origin to the port of destination under so-called merchant haulage clause. That means sea-haulage cost are included in overall transport costs, including sea freight, port dues and cargo handling costs in the port of destination. Transportation of cargo to the final destination is beyond the scope of shipping company. Therefore the costs of inland transport are dispersed on a case by case basis. It should be noted that in that case there is no single transportation entrepreneur who would take over the responsibility for the whole transport route.

On the other hand, "door-to-door" based contracts include the transport services on the whole transport route together with organization and responsibility for the inland haulage. In such a case goods are carried from the port of origin to the port of destination under so-called carrier haulage clause. To make this possible, two important assumptions are important:

- Existence of an entrepreneur in multimodal transport - inland operator who would be responsible for the entire organization and implementation of the inland haulage of transportation to the final destination and who could arrange this type of service with a shipping company,

- Balanced transport demand where import and export flows of goods have close transport share ratio (eg 60/40 ratio could be considered acceptable). Otherwise, it would generate additional logistics costs due to repositioning, delivery and re "recruitment" of empty containers.

It should be noted that, with excessive deviations in the import-export transport flows, management of empty containers presents special logistic problem. In such cases, additional expenses occur. These costs must be compensated by higher shipping freight or increasing THC. In such situations shipping companies left to forwarders the repositioning and recharging for further container use (re-use of container). These circumstances affect the final cost of inland transportation and the total cost of corridor transportation.

4.MONITORING METHODOLOGY AND INDICATORS ESTABLISHMENT

4.1. Port performance monitoring

A port performance indicator shows the quality of service towards the port users. In intermodal transport that is very important for shipping companies and logistic providers to have exact information of the ability of the particular port or terminal operator to perform its services. Underperforming port or terminal may not be able to compete for significant transport share between other ports, especially in container transport. Therefore, majority of shipping companies will not include that port in their regular service schedule.

Monitoring of port operator activities includes operational and financial indicators as well as standards and evaluation criteria. Continuous monitoring of performances should be required during the concession period. The main performance criteria for port service (The World Bank, 2007) are shown in Table 1.

Table 1. Port performance indicators

Operating performances indicators	***Explanation***
Average ship turnaround time	Total hours vessels stay in port divided by total number of vessel
Average waiting rate	Total hours vessels wait for a berth divided by total time at berth
Gross berth productivity	Number of container moves divided by the vessel's total time at berth
Berth occupancy rate	Total time of vessels at berth divided by total berth hours available
Working time over time at berth	Total time of vessels being serviced at berth
Cargo dwell time	Number of days container cargo stay at the terminal
Ship productivity indicator	Total number of moves handled in a time

TEUs per crane-hour	Total number of TEU handled by one crane in a hour
Financial performances	*Explanation*
Operating surplus per ton handled	Net operating income from port operations divided by total cargo handled
Charge per TEU	Total charges for container
Collected charges	Total collected charges as a percent of accounts billed

Abbreviations:
TEU - twenty-foot equivalent unit represents an inexact but dimensionally comparable unit of cargo capacity used to describe the capacity of container terminals as well as container ships.
Source: The World Bank: Port Regulation Module 6

4.2. Corridor performance monitoring

There are methodologies established for the evaluation of transport corridor performance, which is based on valuable collection and measurement of transport data between two or more network nodes and on some critical points (i.e. ports, intermodal terminals and border crossings). The practical implementation of these methods includes:

1. Filling in travel forms or travel diaries by road carriers. Such questionnaires can be created in order to monitor the quality of service by the port authority and could authorize and oblige forwarders to recollect them from the carrier (the driver). The questionnaire could be created in the form of a check list so data of certain control points on the corridor should be entered.
2. Occasional and periodic interviews with the operational management of shipping and transportation companies. Before that it is necessary to prepare a questionnaire with the required information. The advantage of this method is the ability to obtain information about transport costs and qualitative indicators that are not quantified by current indicators of the transport efficiency. However there is no guarantee that it will gather information about the commercial terms of transportation (price) because such information is protected. Informal form of interviews with freight forwarders / carriers usually gives better results than a formal interview.
3. Calculation of vehicle operating costs - VOC. It is useful to put the transportation costs in relation to the type of transport vehicle. This indicator is usually used as benchmark for measuring the effectiveness of the road or railway (infrastructure). VOC depends on the characteristics of the transport (technological, technical characteristics, speed, resistance ...) and on the infrastructure characteristics (the number of lanes, speed limits, flow, vertical gradient, curves ...). For railways it would be useful to know the VOC for the rail section and for the whole corridor. Railway line with higher rises have a higher VOC, also railway lines that are not electrified have higher VOC. Delays i.e. "Congestion cost" may also be included in the VOC.
4. Measuring of performance at critical points. The most common places are those where bottlenecks or congestion are created (e.g. border crossings).

Measuring indicators refer to the waiting time for border crossing or to the percentage of lost time from the total journey duration.

For quality and comparable performance measurement the selection of appropriate indicators is necessary within the meaning of ordinal as well as cardinal performances comparisons. Selection of the right performance indicators depends on the purpose that must be fulfilled. It can be two-fold: to establish criteria to monitor the competitiveness of the route or impact assessment of the investment project. In the first case it is necessary to consider the wider context in which the entire transport process in the corridor is conducted, while for a specific project should be taken into account more detailed indicators in the narrow space (i.e. Port or border crossing), where the project is implemented and which can measure the success of its implementation.

To measure logistics performance on the corridor there is necessary to establish measurable indicators and methods for their collecting and processing. Therefore we proposed key performance indicators covering port and hinterland area in the Table 2. The indicators are redeveloped according to (Raballand et al., 2008).

Table 2. Transport logistic performance indicators in the port and hinterland area

Corridor performance indicators	***Method for collecting/processing***
Travel flow and duration	
The total duration of transportation between the port and the industrial / logistics center in the hinterland regarding the type of cargo (containers / bulk)	The monitoring system should be developed
Time of intermediate storage / retention of goods in the port (dwell time)	Concessionaires have to report this data to the port authority. Implementation and/or upgrading the PCS system
Status of containers in the port - time required to obtain information about the position of the container	Establish / improve the information system at container terminal and data interchange.
Amount of cargo transported through the port according to the type of cargo and type of container (full / empty)	If necessary unify procedures for collecting statistics data about the cargo
Amount of cargo in import / export and transit which is transported through the port	Unify procedures for collecting and sharing data
Transport time from and to the checkpoints, including arrived	Establishment of geo-referenced information system on corridor level

time, waiting time and departure time at checkpoint.	
Delays	
Time for the border crossing (if possible with specification of causes of delay)	Check lists/questionnaires reports. GPS and/or geo-referenced information systems at the border crossings.
Delays in road transport (in relation to the reference time)	**Reference time should be established for each OD pairs on the transport route.**
Delays in rail transport (in relation to the reference time)	
Operator efficiency	
Productivity / performance	Port authority reports and concessionary reports
The time required for the preparation and dispatch of trains	Concessionary reports (shunting train operators)
Number of formed block trains / daily / weekly / monthly	Concessionaire reports (shunting train operators)
Number of trucks in both directions /daily /weekly /monthly	Porth authority reports
Annual distance per truck	Port authority reports Check list/questionnaires reports
Tariffs	
Prices of transport services in road and rail traffic on the main routes.	Identify the main trip O-D matrix. Make a list of key public and private transportation companies. Periodically conduct interviews (e.g. quarterly) If needed use of external teams services.

Abbreviations:
PCS - Port Community Systems
O-D matrix - Origin–Destination Matrix.
Source: Authors elaboration

5. ANALYSIS OF FACTORS AFFECTING LOGISTICS PERFORMANCES AS DETERMINANTS OF PORT COMPETITIVENESS

Detection and determination of transportation costs on the transport corridor is next important step in the evaluation of performances. A large number of entrepreneurs and intermediaries exist in the container transport on the market. The most common are: legal entities that manage infrastructure, operators in different transport sector, port and terminal operators, service providers in inland transport segment, freight forwarders, logistic companies and more recently so-called system integrators. In such business environment it is very difficult to determine the

mechanisms of pricing the transport services in a way to be standardized and universally applicable.

The commercial transportation costs, by the sources of costs, can be grouped into several key categories:

- Amortization
- Staff costs
- Fuel costs, lubricants costs and others
- Maintenance costs
- Insurance costs
- Toll and other fees
- Third parties services.

The elements that affect the cost of transport services in road and rail transport are shown in Table 3.

Table 3. Types of impact of each factor on the transport price for services in inland transport

Impact factor	***Type of influence in inland transport***
Capital cost of infrastructure	No direct influence on tariffs unless toll payment
Condition of infrastructure, maintenance and availability	Directly affects the duration of the trip, safety, capacity, reliability and operating costs
Capital cost of the device and equipment and efficiency	Directly affects the operating costs; flexibility of equipment, provides higher yield and lower unit costs
Tools and equipment condition	Impact on safety, reliability and consequently on the costs
Fuel costs	Significantly affect the direct costs of road traffic
Relief and vertical slope of the terrain (ascents and descents)	Big ascents and descents reduce speed and safety and increase operational costs
Size and weight of the package	Because of its size large cargo can affect the capacity of the infrastructure
The regularity of service	It is important in rail transport for planning of employment capacity. The absence of regular services (transportation demand) can significantly increase railway tariffs
Balanced cargo flow (transportation demand)	Directly affects the costs. One-way transport almost twice increases transportation costs due to the cost of return travel and / or additional logistics costs (e.g. empty containers)
The long-term transport contracts	Affects the services price, but not crucial, depending on market conditions, it is possible to arrange commercial discounts. In rail transport this element is very important and can significantly reduce the cost of transportation

Cargo amount	No significant cost savings in road transport, but very important for reducing costs in the railway transport. Large amounts of cargo allow better use of resources and lower tariffs.
Destination distance	Direct impact on the road transport costs. In rail transport less impact on tariff.
Commercial speed	In terms of cost it is important to avoid congestion due to which there is an increase of costs
Turnaround time and duration of the trip	Directly affects the costs.
Delays at border crossings	Major cost factor.
Service "door-to-door"	Essential because of the additional costs to final destinations
Cargo tracking and implementation of ITS	Affects logistics costs
The service "just-in-time"	An integral part of the regular services in road transport; very difficult applicable in railways due to inflexibility.

Abbreviations:
ITS - Intelligent Transportation System
Source: Authors elaboration

As it is illustrated in the Table 3 each of the detected main impact factors plays a significant role in transport corridor logistics performances which can be observed as significant determinant of port competiveness. Disturbance in any of the factors has direct impact on attractiveness and cost efficiency of the corridor as a system and in the same time has indirect impact on port competitiveness.

Part of the factors are highly cost conditioned mainly because their implementation and improvement requires significant financial resources:

- Capital cost of infrastructure,
- Condition of infrastructure, maintenance and availability,
- Capital cost of the device and equipment and efficiency,
- Tools and equipment condition,
- Fuel costs,
- Relief and vertical slope of the terrain (ascents and descents),
- Size and weight of the package,
- Turnaround time and duration of the trip.

On the other hand part of the factors are mainly non-cost oriented and are primarily a result of "soft" incentives and organisational issues with high level of know-how required for their implementation and improvement:

- The regularity of service – various fluctuations in the level of transport demand can have significant negative economic results in rail transport as it requires a high level of engagement of fixed assets, so special management attention needs to be focused on quality planning,
- Balanced cargo flow (transportation demand) – in rail transport it is especially important to strive to achievement of two-way transport,

respectively the full capacity in both directions, as this directly influence transportation and logistics costs,

- The long-term transport contracts – management needs to be oriented towards conclusion of a long-terms contracts because this is important as a solid foundation for middle and long-term capacity planning, and this can be positively influenced by quality of service, speed, competitive price and other competitive aspects of business,
- Cargo amount – large amount and time balance of cargo can significantly reduce costs in the railway transport as it allows better use of resources so management can offer lower price, so it is important for management to pay special attention to volume and time balance of cargo in the process of contracting,
- Destination distance – as directly connected with resource utilization destination distance affects costs so management needs to be continuously focused on a effort of extension of the route and can stimulate such arrangements with clients
- Commercial speed – speed of cargo flows is one of the main factors that is evaluated when choosing the corridor so in order to be competitive management needs to put special attention to all time consuming risks that can potentially slow down the cargo flows, so in this area the organisational aspects on the whole corridor have a prominent role,
- Delays at border crossings – following the previous factor, the delays at border crossing as well as clearance procedures are of special importance for achievement of fast and harmonised traffic flow and in this processes the cross-border agreements play an important role.
- Service "door-to-door" – represents a way of transport integration into one service from the perspective of customer and can be a potential for reducing agency costs as well as other transportation costs,
- Cargo tracking and implementation of ITS – implementation of intelligent transportation systems represent a significant possible boost of competitiveness of the corridor because it speeds up transport due to multiple aspects and processing of documents is one of them that is of special importance for modern transportation, but it is important to be implemented and compatible alongside the corridor as much as possible,
- The service "just-in-time" - Just-in-Time logistics channel and service, applicable mainly to road transport, has to be focused on arrival of cargo at its destination right before it is needed and that lowers inventory, storage and other operational costs.

Although the cost conditioned factors are very important for corridor attractiveness and logistics performances, the non-cost oriented factors are of essential significance for competitive position improvements of the port as well as transport corridor as a whole. The non-cost factors are those that require more know-how and as such are primarily value added generators and multiplicators of the port competiveness and transport corridor logistic performances.

One of the important questions, on which we would like to especially thank to the reviewers, is a meter of a procedure targeted to aggregate all the impact factors to

a single assessment. Such a procedure would need to incorporate multiple dimensions and perspectives of each of the detected impact factors, but there is still remaining a problem of variables comparability. In other words such a system should be able to develop an objectively verifiable aggregation procedure which is hard to be accomplished without significant level of arbitrary. We would like to emphasize the importance of usage of ordinal measures instead of cardinal ones in order to minimise arbitrary decisions.

6. CONCLUSION

In this paper are systematized the key cost factors and are qualitatively determined key non-cost factors as well as the most common ordinal intensity of their influence. The paper also elaborates possible models of evaluation and assessment of the impact intensity of cost and non-cost elements that determine transport corridor logistics performances.

It is particularly important the question of a port tariffs and fees. If there are published tariffs for commercial transport, they may significantly differ from the actual price offered to the client. It is common practice that for larger amounts, more frequent shipments, or for strategically important partners the discounts are granted through a long-term contracts that are difficult to identify and support with the available documentation.

Through the analysis it is evident that the economies of scale issue is very prominent, especially reviewing a transport corridor as an integral system. This particularly because the transport throughput of a corridor depends largely on the most significant bottleneck in this corridor, and just overcoming a technical (physical) bottlenecks does not necessary bring competitive improvement, but implementation of "soft" solutions is simultaneously required in order to overcome and remove non-physical barriers and through that to improve logistics performances and to raise competitiveness level of an entire corridor. Here largely comes to the forefront the question of vertical and horizontal integration of transport companies. From the perspective of a shipping companies and port / port authority unification and integration of transport services through the system integrator could help determine the transport corridor costs, raise logistics performances level and improve competitiveness of a supply chain. Simply stated, through this approach the inland transport component would be more transparent and more reliable in terms of performances and costs. In in such a case shipping companies would negotiate transport conditions on a door-to-door basis with one entrepreneur.

We conclude that the impact intensity of cost and non-cost factors affecting the transport corridor logistics performances is variable in size and largely dependent on political factors and hinterland development which is also a substantial determinant of port competitiveness in general.

This paper opens new research directions for future research opportunities in a way of demonstrating the importance of non-cost factors that affect logistics performances of the whole transport corridor and are largely dependent on social factors emphasizing the political factors. This represents a solid basis for further

research aiming to develop a research platform that thoroughly systematize and distinguish all aspects of key social factors as well as provide measurable basis for ordinal comparison of the intensity of their influence.

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A CASE STUDY ON OPTIMIZING PARTS SUPPLY IN MANUFACTURING BY REUSABLE CONTAINERS

Volker Trauzettel
Hochschule Pforzheim University
Tiefenbronner Str. 65, D-75175 Pforzheim, Germany
Phone: +49 7231 28-0
E-mail: volker.trauzettel@hs-pforzheim.de

Scientific paper

Abstract

This case study analyzes the manufacturing system of a company producing and marketing branded power tools. The production process applies containers to transport parts within the manufacturing plant from the warehouse to the production floor as well as between several stages of production. The same containers are also used by manufacturer's suppliers to deliver parts to the manufacturer. As the containers are re-used in the production process they have to be cleaned and inventoried. Then they are allocated to internal flow of material or they are made available to suppliers so that they can furnish parts to the manufacturer. The production process is controlled by a Kanban system such that the flow of containers is also regulated in this manner. However, so far the containers were not tracked within the manufacturer as well as at the supplier. Consequently, it happened that containers were not available in the right amount so that the supply of parts from the supplier was disrupted. The purpose of this study was to evaluate methods to optimize the handling of these containers at the manufacturer. Among them is the determination of a safety stock of containers. We present the results of the findings.

Key words: Reverse Logistics, Reusable Containers, Production Control, Kanban, Parts Supply, Closed-Loop System, Case Study

1. INTRODUCTION

Within the area of supply chain management the field of reverse logistics has considerably grown in the last two decades. Reverse logistics integrates backward flowing material (products, packaging) into supply chain management. The forward direction of the supply chain comprises the movements of material to be processed and assembled to create a product or to carry the product or parts of it. The backward directed flow consists -among others- of collecting, transporting, and recycling of products and materials in order to reuse them in new production processes or to dispose them in an environmental less critical way. The logistics activities associated with the backward directed flow are called reverse logistics. See also Kroon & Vrijens (1995, p. 56), Fleischmann et al. (1997) on issues in reverse logistics.

In most production processes multiple flows of material consolidate to a single flow at the time the final product is completed and then from this node on the flow diverges when the products are distributed to wholesalers, retailers and consumers. The reverse direction of the supply chain may origin at various points of the forward chain, i.e. at the consumer for returned products, at the retailer for unsold products, at the manufacturer for reworking the product. Besides the logistics of the product there is also a logistics of packaging materials. These are items used to transport the products within the production process, i.e. to protect the parts supplied from one company to another. Packaging also enables transport and marketing to the consumer, like color-printed cardboard boxes that are common for consumer goods. The transport items may be disposable, like cardboard, or they are reusable, like beer crates. Notably, also cardboard is reused by recycling it. The difference to reusable transport items is that these are designed to be used many times for the same type of transport until they are depleted. Hence, reusable containers have to be returned to their origin in order to be reused again. There it is called a closed-loop system.

Transport items are used within a single stage of the supply chain like within a manufacturing plant or they pass multiple stages like the product's packaging that is added at the manufacturer and passes one or more distributions stages till the final user of the product.

This paper presents a case study. We examine the manufacturing operation of a manufacturer of power tools. At its main production facility parts of the various products are produced. These parts are manufactured in several steps and then they are assembled to components and finally to the product. Parts and components need to be transported between several shop floors. The factory uses containers of several sizes for most of these transports. The containers are reused after parts have been removed. Besides own manufactured parts the company also buys parts to be built into its products that are manufactured by suppliers. Some of these components are supplied to the manufacturer with the help of the same containers that are used for their internal production logistics. So, empty containers need to be transported to suppliers. After the supplier has filled them they are shipped to the manufacturer. There, containers filled with parts are transported using inner factory logistics to the respective production units.

Timely supply of parts to the productive units is affected by the availability of empty containers at the suppliers as well as at the plant's production units. Within the manufacturer's facility it is relatively easy to react to missing containers and deliver them to the productive places. At the suppliers missing containers can cause serious disruptions of the production process. The aim of this paper is to explore procedures to increase availability of containers within the plant and at the manufacturer's suppliers. Its purpose is to provide guidance on which activities are effective to solve a real world application.

2. REVIEW OF THE LITERATURE ON THE MANAGEMENT OF REUSABLE CONTAINERS

We use the terms returnable transport items or returnable containers as well as the terms reusable interchangeably. Reusable containers differ from single-use packaging (one-way packaging) as they are constructed to last longer and to be multiply used for the same type of transport and handling activity within a production plant or a transport from one facility to the next plant. In a broader sense, the idea applies to pallets, casks, etc.

As reusable containers are multiply used they need to withstand mechanical abrasion and wear-out by the transport and handling equipment. They also need to be cleaned, i.e. washed. Plastic containers are widely used for multiple transports.

Due to low price cardboard boxes are very often the preferred solution for single-use applications. However, single-use containers are subject to create large amounts of waste that need to be brought into a recycling process. So, single-use packaging is confronted with environmental concerns, their use is regulated by laws, and they are to some extent commercially unattractive. As this case study is concerned with a system of reusable containers we will not cover single-use transport items.

Regarding the design and operation of a manufacturing system using reusable containers there is the need to consider relevant aspects associated with reusable containers. Main issues are the costs of reusable containers and the control of their flow and of their availability.

The cost associated with a reusable container system are cost of the containers themselves, cost of adapting handling devices to these special containers, and -in addition to the cost of transporting full containers- the cost of transporting empty containers back to their origin or to a central point where they are sorted, cleaned, inventoried and dispatched to the place of their next use. See also Tewede & Clarke (2004).

The literature reports on shrinkage of containers due to theft, misplacement, usage in unplanned manner, damage, and end-of-life. Therefore, a portion of the literature addresses the tracking of containers to gather information regarding the current location of containers. See Welcome (2011). Maleko & Reimche (2011) and Maleki & Meiser (2011) describe how to model returnable container logistics with automatic identification technologies. See also Thoroe et al. (2009) for practical insights.

The cost of containers is determined by the amount of containers needed. This is a function of the overall volume of the production, lot sizes, and the travel times of the containers (forward and backward). Turnquist & Jordan (1986) consider the question of determining the fleet size of containers where the travel time of containers (or loading, dispatching, cleaning, or equipment downtime) is stochastic. They develop equations to determine the fleet size given a probability of a shortage of empty containers in order to balance the investment in shipping containers to the cost of container shortage. Kelle & Silver (1989a) consider the case of non-returning containers (e.g. loss or damage) with a certain probability so that new containers have to be purchased from time to time. The situation is common for consumer goods sold in returnable containers like for beverages or in industrial goods for liquid gases. Kelle

& Silver (1989b) propose forecasting methods for the requirement to acquire new containers as the time from issue to return of an individual container is not known and containers may be lost. For example, for fast moving consumer goods packaged into reusable containers the return cycles can be very long and they are very different from consumer to consumer. If supplier and customer are not directly linked by a manufacturing process the cycle time of returning containers has a large variability. Carrasco-Gallego & Ponce-Cueto (2009) develop a forecasting algorithm for this situation.

Rosenau et al. (1996) consider a returnable container system as an investment and evaluate such a system by capital budgeting procedures since cost and benefits should be evaluated in the long term. Hence, during the design phase of a reverse logistics system initial costs as well as long term costs have to be evaluated against the benefits. Twede & Clark (2004) describe costs and benefits of reusable containers. Barker & Zabinsky (2008, 2011) develop a framework for reverse logistics network design that can be helpful for network design. Böröcz (2009) focuses on the cost of one-way and reusable packaging. Also Lai et. al (2008) describe a returnable packaging network design problem.

Simulation is a widespread tool to analyze logistics systems. Hellström & Johansson (2010) analyze the problem of shrinkage in a closed-loop system by a simulation study regarding alternative control and tracking methods. Also the papers of Jarupan et al. (2003, 2004) develop a simulation model. Klug (2011) simulates container demand in an automotive supply chain. Nomura & Takakuwa (2006) use simulation to determine the number of containers to supply an assembly line. Containers are moved on a fixed route in a plant. Closed loop systems between to factories often suffer from a mismatch between the volume of parts delivered (in containers) and containers returned. See Yildis et al. (2010). Sobottka et al. (2014) analyze the consequences of superfluous container cleaning. Less cleaning phases can increase availability of containers. De Brito et al. (2005) review case studies in reverse logistics. Their review provides a source of practical approaches to reverse logistics issues.

In the remaining section of the paper the case study of a real world application is presented. It addresses the problem of increasing availability of reusable containers flowing within a manufacturer and between the manufacturer and some of its suppliers in a closed-loop system.

3. ANALYSIS OF THE MANUFACTURING SYSTEM

3.1. The Company and Its Market

The company operates a plant that manufactures electric power tools – hand-held tools as well as stationary tools. Products are designed for professional users. They are widely known for their high quality and reliability. Products are sold all over the world in far more than 100 countries. All the products are manufactured within a single large plant. This part of the company generates more than 300 million euros of turnover per year.

The portfolio of products is highly differentiated within power tools. There are many specialized tools for a single application but with different specifications, mainly due to strength of engines or the type of power supply (cord or accumulator). The total number of different products exceeds well 500. This variety is necessary to fulfil the needs of the users expecting high end tools to be well adapted to specific applications. Products close to each other we refer to as product line.

3.2. Organisation of the Plant

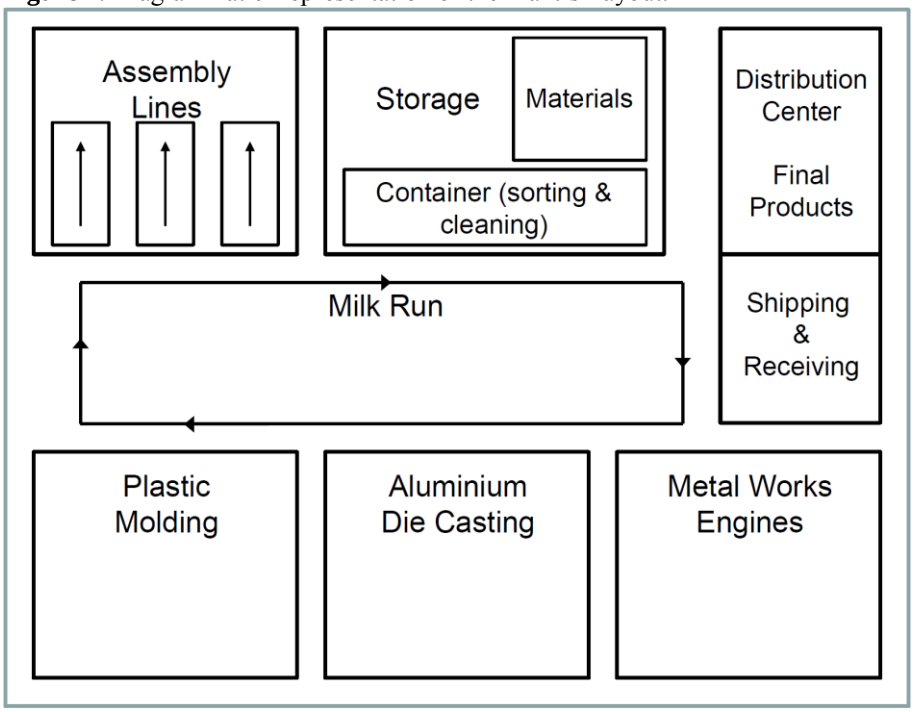
The company operates a single, large plant to produce its total portfolio of electric power tools, like drills, hammers, saws, grinders, screwdrivers, etc. [1] So, the plant is permanently required to be able to manufacture the whole portfolio upon demand.

The plant can be separated into two main sections, the component plant and the assembly plant. The component plant produces parts and components to be assembled to the final products. Main sections of the component plant are aluminium die casting, injection molding, rotor (turnery) and engine production. Within assembly operations, parts and components are assembled to the final products and then packaged to be ready for sale, stacked on pallets and brought to the company's distribution center. As not all parts are produced by the company itself, like electric cords or packaging material, these parts are sourced at specialized suppliers. Due to the wide assortment of the company, the components section is very large and consists of different shops. Similarly, the assembly operation falls into many units according to the product lines. There is an assembly line for each product line, e.g. one for the family of compact, i.e. small one-handed, angle grinders having about 23 variants, another one for the line large angle grinders.

The total floor size of the plant is about 80.000 square meters. Figure 1 sketches a diagrammatic plan of the layout of the plant.

[1] Only some tools are manufactured exclusively by selected suppliers. Outsourcing is very common in this industry as the total demand of very specialized products is too low to reach profitability.

Figure 1. Diagrammatic Representation of the Plant's Layout.



Source: Author

The plant is organized as a job-shop manufacturing in the components area and as flow-shop manufacturing in the assembly area. Within the job shop area, parts have to be transported to different manufacturing units and finally they are transported to the assembly area.

Since the demand is sufficiently large and there are set-up costs, parts and components are manufactured in lots. Lot-sizing is also done in assembly operations. For example, the assembly line for compact grinders assembles 200 units of type A and then 100 units of type B according to the production plan.

However, the demand of a single variant is not high enough to establish a dedicated line to a single variant of product to be produced continuously. This is due to the strategy of the company to provide the customers with very specialized machines. Hence, the markets for machines of special applications are relatively small compared to mass-market, e.g. do-it-yourself retailers' standard assortment.

The manufacturer is highly integrated as most parts and components are produced in-house. This is especially the case for the engines, the transmissions, the drill chucks, for instance. As the manufacturing process is highly integrated there are many successive steps in the manufacturing of a product within the plant. Between the steps, parts and components need to be handled and transported. The company decided to solve this problem by standardized containers. These containers hold parts and components for transport and for storage of lots until the production process is

continued. The plant applies 7 different types of plastic containers. They differ in size (length, width, height). Some containers hold inserts to carry special parts. The containers with inserts are only used on the site. These inserts help to protect the parts from damage and facilitate their handling and storage. Containers are also used by some of the suppliers who place parts into the containers to be delivered to the manufacturer.

The production process is centrally planned upon customers' orders or it is initiated to restock the distribution center. Given the demand of a specific product, the assembly and manufacturing process is controlled by a Kanban system. Kanbans are attached to the containers. Thereby, the flow of parts is directed and stations receive order to perform a productive task. Most movements of containers are centralized, i.e. containers are consolidated in specific areas from where they are picked up, transported together with other containers, and sent to the next station. As there are considerable distances between the components section and the assembly section they are transported by a "train" – it is a so called milk run process. Routes of the train within the factory are predetermined (fixed route process).

3.3. Circulation of Reusable Containers

Reusable containers are either empty or they carry parts. When carrying parts the containers move parallel to the production process. When they are emptied they are collected to be prepared for next use. Therefore they are consolidated at a central location where they are sorted according to type (size), cleaned by a machine, and then inventoried. Upon demand they are transported to the next place of use by the milk run transporting process.

Containers are of modular size and compatible with euro pallet size. For example, four containers of size 600mm x 400mm cover a EUR-1-pallet that has dimensions of 1200mm x 800mm. Other containers used in the system are either 400mm x 300mm or 300mm x 200mm. Their heights are between 120 mm and 420 mm. The milk run train is adjusted to transport these containers. Figure 2 depicts a reusable container.

Figure 2. Example of a Container, Size 300mm x 200mm x 120mm.

Source: Author

Empty, cleaned containers are brought either to an internal manufacturing unit, e.g. within the molding area, or shipped to a supplier. The supplier orders empty containers to refill his stock or to be prepared for a larger production run of parts. A supplier producing parts for the manufacturer fills these parts directly into the containers. Then, the filled containers are transported to the manufacturer. Upon arrival at the manufacturer the filled containers go into buffer inventory or are directly transported by the milk run process to the respective production unit where these parts are needed.

3.4. Problems of the Process Related to Reusable Containers

The main problem of the manufacturing process related to the use of containers is that there are instances from time to time when empty containers are not available for filling with parts at a manufacturing unit or they are not available when a supplier orders empty containers. According to the management there is a loss of containers due to shrinkage. Though containers are not tracked by the manufacturer, management assumes that containers are also lost at the suppliers. In reaction to missing containers –though nobody knows how many containers are lost or are damaged- the company buys new containers year over year. The following section presents and evaluates actions to increase availability of containers.

4. ACTIVITIES AND PROCEDURES TO IMPROVE THE CONTAINER PROCESS

4.1. Improving Discipline in the Plant

Management indicated that there are several reasons for missing containers. Containers are damaged, misused, misplaced, or misallocated. The latter happens if there too many containers at a single supplier or multiple suppliers reducing the amount of empty containers available.

Since some containers are not used in a planned manner they are not available for the production process. Management needs to communicate the importance that containers are to be used exclusively for transporting parts and not to be used in any other way. I.e., the usage of a container is authorized only by a Kanban. Containers without Kanban have to be returned to the central storage of containers. Defective containers should be taken out of the process and their number should be recorded. In order to monitor the stock at the suppliers the minimum requirement is to track the number of containers delivered to suppliers and the number of containers returned. This can be realized by the regular method of shipping notes that is in place for materials and products.

4.2. Dedicated Stockroom for Empty Containers

It is not known how many reusable containers are in place at the company. There is no record keeping of containers in place. Also damaged containers are not recorded. Thus, the total number of containers owned by the company is not known.

In order to create a plan how to manage containers it is necessary to determine the total number of containers in the system at the manufacturer and the suppliers. Instead of counting the containers, their number can be estimated with the help of the Kanban-production control system. The number of Kanban cards in the system points to a total number of about 30,000 containers. This number of containers is valid, as it is derived from manufacturing output that was realized by the number of Kanban cards circulating in the production system. Here, this number represents a lower bound of the total number of containers available in the system because it was estimated from the maximum observed output.

From the buying records it is derived that within the last 13 years the manufacturer bought about 20,500 containers. Hence, we estimate an average yearly loss of containers at 1,500 units assuming the effective number of containers in the system remains constant. Therefore, the average loss of total stock of containers reaches 5.2 percent per year. In the literature the percentage loss of returnable containers is reported to be on average at 10 percent or even more (See Hellström & Johnsson (2010).). So, the realized loss does not indicate a strong problem of misuse or damage of containers.

In order to increase availability of containers the idea is to have a dedicated stock of empty, cleaned containers that are ready for use in manufacturing or to dispatch to suppliers. Only authorized employees shall have the right to take containers from this stock.

4.3. Safety Stock of Containers

The production is scheduled and controlled by the use of a Kanban system. The production system is a combination of various manufacturing process types. There is job shop type manufacturing for the parts, e.g. the molding section. The assembly of final products from parts and components are performed at assembly lines. The various units are linked by the Kanban system with transports being consolidated by a milk run process.

Though, production is controlled by Kanban cards the number of Kanbans effectively in place in the production system at a point in time is not constant (variable Kanban system). It varies with the demand level. Therefore, the number of containers necessary to cope with the variable load of the production system varies.

Hence, the workload of the production system is fluctuating. In order to have enough containers available to be protected against stock-outs their number should exceed the average demand by a certain ratio, i.e. a safety stock of containers has to be determined.

The safety stock of containers to cope with varying demand of empty containers can be estimated from historical production data. As the packing of parts into containers is fixed, the number of containers necessary to keep up production can be

calculated from historical production data. The volume of production follows a stochastic process. Hence, the number of containers required to enable manufacturing at each station follows a stochastic process. The processes can be assumed to have normally distributed variables. Therefore, the safety stock of containers required to cope with fluctuating demand of empty containers is (See Monden 2012, chapter 18. See Dickmann, 2009, p. 173, for the number of Kanbans of the parts process. Note that this number is estimated from the series of production processes of parts and not from flowing containers as this information is not available since containers are not tracked.):

$$S = z \sqrt{(\sigma_d^2 * \mu_c) + (\mu_d^2 * \sigma_c^2) + \left(\sigma_s^2 * \frac{\mu_d}{\mu_s} * \mu_c\right)}$$

z = service level factor
μ_d = expected demand of parts of a specific process (containers)
μ_c = expected cycle time of a process
μ_s = expected loss of containers
σ_d = standard deviation of demand
σ_c = standard deviation of cycle time
σ_s = standard deviation of loss of containers

The first part of the sum under the square root refers to fluctuating demand of containers during average cycle time. It estimates the variance of additional containers needed due to demand variation within the cycle. The second sum estimates the need of additional containers due to variability of the cycle time. The third part of the sum reflects the effect of shrinkage. It estimates the need of additional containers due to fluctuating loss of containers, i.e. damaged or non-returning containers.

Since there is no estimate of lost containers available we set it to the fraction of new containers from above. Given the service level to be achieved the formula calculates the additional number of containers (exceeding average demand of containers) required to cope with uncertainty of demand for containers. In our case the safety stock determined is estimated at about 12% of the total number of containers available. Hence, increasing the total stock of containers by this number should protect against losses of containers and fluctuating demand at the manufacturer.

Misuse of containers can be hindered if containers carry the logo of the owning company. In our case the manufacturer should brand its containers. This can be done successively when new containers are bought.

4.4. Improving Information Exchange with Suppliers

Though suppliers are integrated into the Kanban system of the manufacturer, it is not required for them to produce simultaneously. That is, they furnish parts by delivering them packed into manufacturer's containers and attach manufacturer's Kanban cards to them: However, they schedule production on their own. For example, they define their own optimal lot sizes and they produce in advance. This is possible

as the types of parts they supply are fixed depending on the product the manufacturer is about to produce.

Some of the suppliers tend to increase production before mid of year and they slow down production at the end of the year. Hence, they build up inventory of parts. If a supplier decides to produce in advance he will need more containers to stock produced parts till the delivery to the manufacturer. A supplier reducing stock will order fewer containers from the manufacturer. Hence, the number of containers at the supplier will vary according to inventory level of parts at the supplier.

The additional containers due to suppliers scheduling cannot be estimated by the safety-stock formula from above as it considers the realized production rate at the manufacturer.

It is suggested to gather information on the suppliers' production plans. If the manufacturer has information about an increasing production at a supplier the manufacturer can potentially buy new containers to fill up his stock (depleted by defective containers). New containers should be scheduled to be bought in advance to the peaks of production at suppliers. In this case as production goes up in summer, the containers should be bought to be available before summer term.

Decoupling of container provision to suppliers and receiving filled containers should be maintained. Though it is economic to schedule deliveries of empty containers with the truck that brought filled containers, it is not necessarily a 1-by-1 exchange. That would prohibit advance production of suppliers hindering them to realize economically optimal production schedules.

4.5. Tracking of Containers

It seems attractive to track the flow of containers in order to have more information on the number of available containers at various sections in the plant and at the supplier. However, such a system comes at a cost. It was estimated that the initial investment of a software able to track the containers will be at a cost of about 10%-20% of the cost of the total stock of containers, i.e. about the average loss of containers within two to four years. In addition to the initial investment there are operational costs of bookkeeping, i.e. entering data. Therefore, it is doubtful whether this investment would pay off. So far, the fraction of lost containers is about 5%. However, this figure includes damaged containers as well. This portion of lost containers cannot be reduced by better tracking. Though the safety stock of containers is likely to be set to a lower value with a full tracking system the largest portion of safety stock is due to demand variability. Therefore, it is not recommended to invest in automated tracking systems before the other suggestions are realized.

5. CONCLUSIONS AND DIRECTIONS FOR FURTHER RESEARCH

Summarizing, within the whole plant hundreds of different products have to be produced. Therefore, a complex set of production processes including the materials flow has to be planned and managed. In addition, the supply of empty containers and their preparation for use has to be managed to realize a closed-loop system. It is found

that the company should increase its safety stock of containers in order to cope with fluctuating demand and with lot-sizing and advance production of its suppliers. The benefits of reusable containers to receive materials ready for production from suppliers and to manage materials flow on plant clearly outweigh the costs of lost containers. Considering total cost of control it is suggested not to invest into an automated tracking system before other simple activities are realized: Implementing standards of container usage by manufacturing personnel, adjusting safety stock of containers, and exchanging information with suppliers regarding their production plans.

Regarding future research opportunities there are –to the knowledge of the author- no theoretical developments available on designing closed-loop manufacturing systems with variable capacity usage. Having a better understanding on how the optimal number of Kanbans and the optimal number of reusable containers can be determined the value of information generated by a container tracking system can be identified.

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EVALUATION PROBLEM AND ASSESSMENT METHOD OF WAREHOUSE PROCESS EFFICIENCY

Adam Kolinski
Poznan School of Logistics
Estkowskiego Street 6, 61-755 Poznan, Poland
E-mail: adam.kolinski@wsl.com.pl

Boguslaw Sliwczynski
Institute of Logistics and Warehousing
Estkowskiego Street 6, 61-755 Poznan, Poland
E-mail: boguslaw.sliwczynski@ilim.poznan.pl

Scientific paper

Abstract

Warehouse processes are one of the key elements of material flow efficiency along the supply chain. In the literature and scientific research is difficult to find a comprehensive analysis evaluation warehouse processes efficiency. Lack of unambiguous definition makes it impossible to develop a universal method for evaluation of warehouse processes efficiency. In addition, element hampering the standardization of evaluation methods is the specificity of the warehouse processes. Warehouse processes can focus on ensuring flow continuity of the production or distribution process. These problems are condition for conducting detailed scientific research in this area.

Comprehensive analysis of efficiency requires both an operational data relating to technological process, supported by support processes and service, but also the data generated by an information system in order to ensure their reliability and timeliness. For this reason, the efficiency analysis should ultimately affect the warehouse process, taking into account both the material flow and information flow, as well as the aspects of warehouse management and existing feedback.

The main aim of researches presented in the article is improving of product profitability by value and efficiency enhancement of warehouse processes according to score of multi-criteria analysis (MCA) encompassing cost-efficiency and cost-effectiveness analysis – CE|EA or cost benefit analysis – CBA among other. Authors have made attempts of indicators compilation to assess the warehouse processes efficiency, including basic assumptions of Balanced Scorecard.

Key words: warehouse efficiency, warehouse process, logistics controlling

1. INTRODUCTION

The specificity of warehouse processes will need to concentrate on those factors that have a crucial impact on the continuity of the material flow throughout the supply

chain. The scientific studies of the logistics management, can be found a lot of factors - the processes and resources - that affect the whole warehouse process. It is therefore clear that the warehouse management should focus on ways to improve the efficiency of processes, both internal and external supply chain and continuous monitoring and evaluation of the results. The research problem identified by the Authors during the research literature and observations in enterprises have assessed the efficiency of warehouse process, taking into account the multi-dimensional analysis of the interrelationships within the process, as well as linkages with other processes affecting the continuity of material flow.

In economic aspect efficiency is the result of company's activity, which is a proportion of the achieved effect to borne spending:

$$E = \frac{e}{s} \quad (1)$$

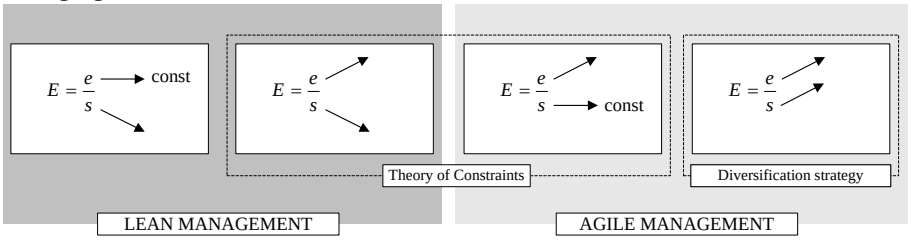
key: E- efficiency; e – effects; s – spending

Complexity of warehouse management is supported by a number of managing concepts which are implemented in order to improve warehouse efficiency. According to model (1) we can distinguish few methods of improving efficiency of actions:

- lowering spendings and keeping the level of effects at the same time,
- lowering spendings and raising the level of effects at the same time,
- keeping the level of spendings and raising the level of effects at the same time,
- raising the level of spendings and raising drastically the level of effects at the same time.

Figure 1 shows basic methods of improving warehouse efficiency and attributing them to chosen concepts of managing.

Figure 1. Attributing methods of improving efficiency to chosen concepts of managing



Source: own study based on (Kolinski, 2013)

The basis of the above picture is conviction that Lean Management concept concentrates on lowering spendings by, among others, lowering the level of expenses. Agile Management concept, on the other hand, does not focus on expenses optimisation. Therefore, the methods of improving efficiency which did not concern lowering spendings were recognised as characteristic of Agile Management concept. Theory of Constraints concentrates on two methods of improving efficiency: improving effects and keeping spendings as well as improving process and lowering

spendings (e.g. reducing the supply of work in progress). According to the definition of diversification (Kolinski, 2010), raising effects is possible thanks to increasing spendings (e.g. introducing new products or entering new markets).

Literature analysis only confirms the complexity of warehouse efficiency. Most organizations say they are continually trying to increase their productivity. There are really four ways of doing this (Waters, 2002):

- improve effectiveness with better decisions,
- improve efficiency using fewer inputs to achieve the same outputs,
- improve performance in some other way such as higher quality, fewer accidents, less disruption,
- improve morale to give more co-operation and incentives.
- Nevertheless, it needs to be remembered that aiming at maximising efficiency can entail numerous threats. The most dangerous traps of maximising efficiency are:
- lack of coordination in realisation of operational aims of individual departments with strategic aims of a company or a supply chain,
- discrepancy between strategic aims formulated by individual companies which are elements of a supply chain,
- discrepancy between operational aims of different departments of a company.

2. SPECIFIC OF WAREHOUSE PROCESS EFFICIENCY

Warehouse management is a very important element of business activity of each enterprises. Therefore, warehouse management in the enterprise is of particular importance. Warehouse management shall be examined at least in three key areas of processes jointly influenced in supply chain (Sürie & Reuter, 2015):

- procurement - the aim of warehouse management is to receive materials and raw materials for the production of suppliers, storage and issuing to production,
- production - where the task of warehouse management is reduced to an optimal allocation of materials and resources to the appropriate areas and production stages,
- distribution - where to store, completed and deliver finished goods in such a way as to meet the expectations of customers (right product, at the right time, the right place, at the right price).

Warehouse efficiency is a concept which is quite difficult to define. Generally efficiency can be defined as a measurement (usually expressed as a percentage) of the actual output to the standard output expected. Efficiency measures how well something is performing relative to existing standards; in contrast, productivity measures output relative to a specific input, e.g., tons/labor hour. Efficiency is the ratio of (APICS, 2004):

- actual units produced to the standard rate of production expected in a time period,
- standard hours produced to actual hours worked (taking longer means less efficiency),

- actual volume of output in value to a standard volume in a time period in value.

Analyzing the warehouse process in terms of efficiency, determine the objectives and tasks of effective warehouse management, which is shown in Table 1.

Table 1. Objectives and tasks of effective warehouse management

Objectives	Tasks
maximize use of storage space, achieved through appropriate measures in the design, construction and commissioning of the magazine and responding to current changes;	ensuring the availability of technical and personal resources to achieve the planned level of activity - only possible with close coordination with the leadership of the company;
	ensuring the flow of goods corresponding to the requirements for deliveries and shipments - requires cooperation warehouse with procurement and sales departments;
minimizing the use of manipulating operations - the first step eliminates redundant operations, and the second seeks to reduce the execution time of necessary activities	Solid planning, control and maintaining the use of all available resources - is made at the operational level and can be based on production schedules and orders placed with suppliers or sales plans and orders from customers;
	continuous monitoring, evaluation and improvement of the warehouse process according to established criteria - should be based on selected indicators and gauges reflecting the process

Source: own study based on (Niemczyk, 2010, p. 248-251)

Admitting the validity of the thesis that warehouse management has a significant impact on the functioning of the company, it is clear it should strive to continuously improve the functioning of the warehouse. The most important factors affecting the increase of functioning productivity of the warehouse, are:

- adjustment of flow into warehouse capacity - the starting point should be to determine the warehouse capacity. Based on it, working with the businesses, it should set a schedule for deliveries and shipments to avoid the accumulation of work during the day and excess loading units flowing through the warehouse,
- the use of storage space - refers to the efficient management of the available amount of storage area,
- rationalization of routes traveled by employees and the goods - this factor is most important for the process of completion, except that you should strive to eliminate or shorten the routes traveled by employees without the goods,
- use of staff - analyzing this factor should be paid attention to three criteria: load-time employees, they possess the competence and stability of employment,

- effective information flow - has a key impact on the implementation of all phases of the warehouse process. Any disruption in the flow of information (especially in the stage of completion and issuance) may result in delays in the implementation of contracts.

Besides organizational factors outlined above, the efficiency of warehouse processes also depend on the following factors:

- modern equipment of warehouse,
- the use of modern technology,
- utilization of automatic identification systems based on barcodes or a system of EPC / RFID,
- the use of information systems supporting warehouse management (WMS).

In its detailed analysis of the warehouse process in terms of operational controlling, should be evaluated (Śliwczyński, 2011a, p. 139):

- the efficiency of warehouse resources and their utilization,
- performance and reliability of warehouse operations,
- load handling time of the adoption until the release and warehouse capacity, taking into account downtime, queues and bottlenecks in the flow of goods.

Warehouse efficiency is a very important issue from the point of view of processes organised in a company and in a supply chain. Improving the efficiency of a warehouse process is therefore a very important factor in controlling actions. The efficiency analysis process applies the techniques of Value Stream Mapping on the value stream product of warehouse processes chain. Product value analysis for n values making up a set of dependent variables is multifunctional in its nature. A set of values W_n at the end of the supply chain depends on the results of component operations D_k in the warehouse operations chain (utilizing space, equipment, and labor effectively), e.g. timeliness and completeness of warehouse operations, warehousing quality and reliability, exact order picking and handling (ICRC, 2004, p. 285-362).

$$W_{n=1}^{N}(n) \quad = \quad f\left[D_{k=1}^{K}(k) \right] \quad (2)$$

It should be noted, however, that despite numerous references to science literature, in practice economic efficiency analysis is not applied so as to provide successful support decision processes occurring in the enterprise. Scientific research performed by the Authors in identifying difficulties in carrying out a comprehensive analysis of the efficiency of processes confirms low level of analytical tools use in business practice (Kolińska & Koliński, 2013, p. 2-6). It should be noted that 46% of surveyed enterprises did not perform such analyze or is not aware of this. Despite the fact that 54% of enterprises use efficiency analysis process, it shall be regarded as unsatisfactory and confirming the generally prevailing opinion that the efficiency analysis is a complex process and difficult to use in practice, especially due to the lack of universal analytical tools to support its implementation. However, results also indicate an increase in awareness of the need for efficiency analysis in order to improve the competitive position on the market.

3. IT SUPPORT OF WAREHOUSE EFFICIENCY ANALYSIS

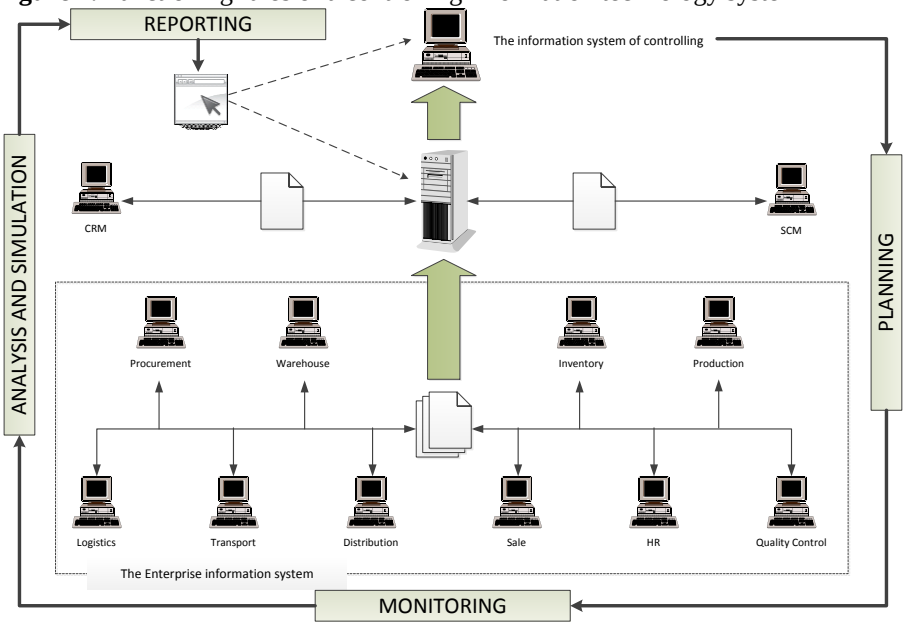
The main role of information technology tools is to support gaining, processing and distributing data, which makes the process of making decisions by the management more efficient. Nowadays, a very competitive factor is the information flow time, which shortens processes in enterprise. It is also a very important aspect of management actions concerning the analysis and assessment of warehouse process efficiency as the time of making strategic and operational decisions relies on these actions. Continuous time pressure makes it difficult to analyse data and draw the right conclusions (Kolinski & Sliwczynski, 2014, p. 206). Therefore, it seems to be vital to implement IT solutions in analytical tasks not only in a warehouse process but also in a process in company and supply chain. The main task of IT tools supporting efficiency assessment is to assist managers in a process of enterprise's management. Controlling IT systems have been undervalued and their implementation and practical use have been very scarce and general. Nowadays, IT tools for supporting the assessment of warehouse processes efficiency are taking on a special meaning, especially for companies oriented on gaining a competitive dominance on the market.

These are mainly large and medium logistics companies which generate the biggest demand for collecting, processing and storing data with the help of IT tools supporting decision making. Due to fragmentation and diversity of this sector we can distinguish three stages for IT support of warehouse process efficiency:

- carrying out efficiency analyses based on spreadsheet programs,
- implementation of analytical tools in an environment of ERP class integrated systems for managing enterprise,
- developing dedicated IT systems to specific of warehouse processes and related with other elements of material flow in a supply chain.

Controlling in a warehouse processes which is supported by a computer should take into account specific requirements of all information recipients. Information technology system of controlling takes the information necessary to carry out analyses from a data warehouse, where all the transactional data recorded in a company is saved. This transactional data contains: data concerning customer service (CRM), data for managing a supply chain (SCM), data concerning supply, warehouse, inventory, production, logistics, transport and shipping, distribution, finance and accountancy, sales, HR and payroll, and quality control. Combining all received information with the help of a controlling information technology system makes it possible to carry out cross-sectional analyses of a company's activity. The functioning rules of an independent controlling information technology system are presented in figure 2.

Figure 2. Functioning rules of a controlling information technology system



Source: own study (Fajfer et al., 2014, p. 43)

The main tasks of an independent controlling information technology system are planning (operational as well as constructive-financial), monitoring, analysis and simulations as well as reporting. The functionality of an independent controlling information technology system is compared to the functionality of a controlling module included in ERP class information technology system. Nevertheless, the independent system is much more detailed than the system of ERP class. For this reason it can not only single-handedly supervise all controlling processes in a company but also serve as a tool supporting the work of an integrated information technology system. The controlling system makes it possible to use one, integrated database which contains all current and archival information generated by all processes taking place in a company. The information obtained from a controlling system enable:

- improvement in operational and constructive-financial planning (budgeting),
- precise monitoring of logistics' plans realisation and their diversion from reality,
- state analysis and signaling a threat with the help of index analysis,
- plan and budget correction,
- reaction to diversions from a plan or a budget,
- carrying out analyses and forecasts of investments, projects and results,
- compilation of results of budget realisation analysis,
- reporting,

- determining the tools for analysis and control, which should be used in a company's economic activity so as to increase its competitiveness on the market.

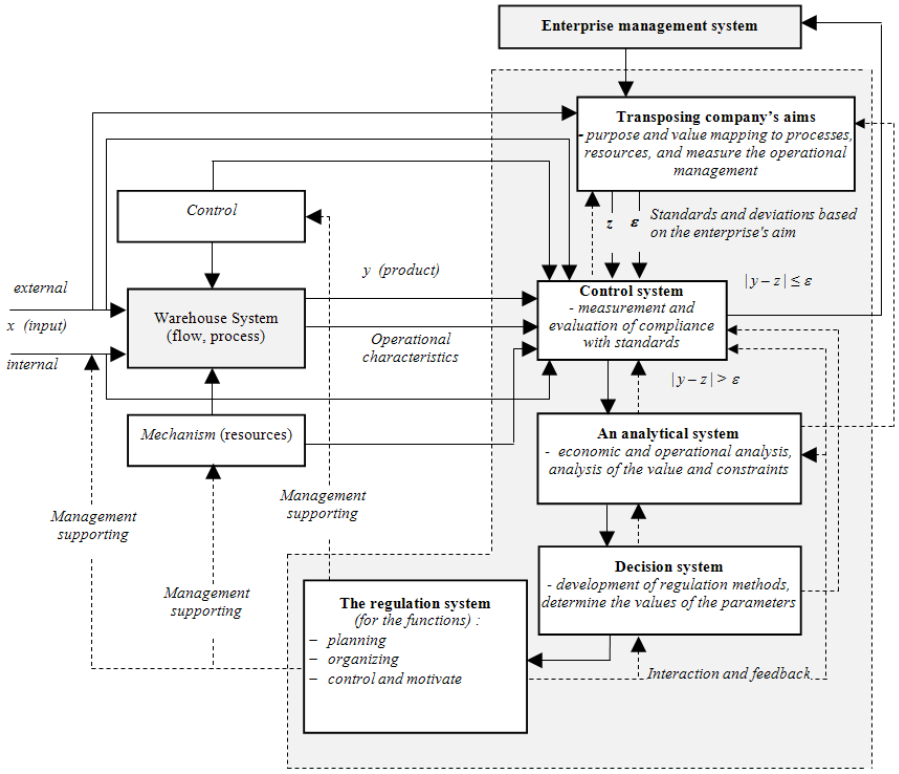
Using information technology tools of controlling entails many benefits for efficiency in a company and a supply chain. The most important benefits are (Fajfer et al., 2014, p. 44):

- quick access to managerial information,
- obtaining more detailed analyses and, in consequence, obtaining better bases for making decisions,
- possibility to carry out data analyses single-handedly,
- monitoring planned task realisation from the area of logistics,
- possibility to make a simulation of the influence which made decisions have on a whole company's result,
- possibility to carry out a comprehensive analysis and forecast of a company's logistics functioning.

4. INDICATORS FOR ASSESSING WAREHOUSE EFFICIENCY

An analysis of warehouse efficiency should be based not only on operational indicators, which are directly connected with warehouse process, but also on financial indicators. Aims and indicators used in an analysis of warehouse efficiency should result from a company's vision and strategy. An analysis of warehouse efficiency can be named complete when it does not only refer to indicators which apply to past results but also when it allows to monitor what affects future results. The problem of complete warehouse efficiency assessment has still not been polished in the matter subject literature. Taking into account ecological aspect, the problem of warehouse efficiency assessment can be based on the assumptions of Balanced Scorecard developed by R. Kaplan and D. Norton. The authors proposed the analysis of efficiency from four perspectives: financial, customer, internal business process, and learning and growth. Many companies already have performance measurement systems that incorporate financial and nonfinancial measures. What is new about a call for a "balanced" set of measures? While virtually all organizations do indeed have financial and nonfinancial measures, many use their nonfinancial measures for local improvements, at their front-line and customer facing operations. Aggregate financial measures are used by senior managers as if these measures could summarize adequately the results of operations performed by their lower and mid-level employees. These organizations are using their financial and nonfinancial performance measures only for tactical feedback and control of warehouse process in short-term (Kaplan & Norton, 1996, p. 8).

Figure 3. A general model of warehouse management controlling system



Source: own study

On the basis of the plan shown in figure 3 detailed analyses have been carried out with the aforementioned assumptions taken into account. It needs be remembered that the system presented in figure 3 is only a model. In reality, there is a lot of feedback interactions ensuing from, for example, the need for additional measurements or carrying out analyses just at the stage of working out a decision.

Carrying out an analysis of warehouse efficiency in discussed four perspectives, we have developed a set of indicators (Corbett, 1998; Sliwczynski, 2011b; Twarog, 2005) which take into account the basic characteristics of efficiency defined by model (1). Table 2 presents chosen indicators of assessing eco-efficiency of warehouse in a financial perspective.

Table 2. Chosen indicators of assessing efficiency of warehouse processes in a financial perspective

No.	name of indicator	formula	characteristic	unit
1.	Return on investment (ROI)		a - net profit	%
			b - investment*	

No.	name of indicator	formula	characteristic	unit
2.	Return on equity (ROE)	$\frac{a}{b}$	a - net income after tax	%
			b - shareholder equity	
3.	Return on assets (ROA)		a - net income	%
			b - mode of total assets	
4.	Return on sales (ROS)		a - net profit	%
			b- sales revenue	
5.	Ratio of material inventory turnover		a - material consumption costs	%
			b - average stocks of materials	
6.	Ratio of worker productivity		a - net sales	%
			b - salary costs	
* Investment, means the money which were spend for buying things which will be sold (Goldratt & Cox, 2004).				

Source: own study based on (Kolinski, 2013)

The table shows only chosen financial indicators which, in author's opinion, are most often used when assessing warehouse efficiency. There are many more indicators which can be useful in economic practice but it needs to be borne in mind that the more indicators, the bigger the threat of missing the main aim of carrying out an analysis.

Table 3 presents chosen indicators of assessing efficiency in a customer's perspective.

Table 3. Chosen indicators of assessing efficiency of warehouse processes in a customer's perspective

No.	name of indicator	Formula	Characteristic	unit
1.	Effectiveness of realization of orders	$\frac{a}{b}$	a - number of completed orders	%
			b - total number of orders	
2.	Quantity or value market share		a - volume of the customers target group	%
			b - total market volume	
3.	Average duration of material receipt		a - lead time of material receipt	h
			b - number of material receipt	
4.	Share of defective material receipt to customer		a - number of defective material receipt	%
			b - total number of material receipt	

Source: own study based on (Kolinski, 2013)

Indicators in the customer perspective should be considered as key factors for process improvement initiatives across the organization. Planning orientation and organizational integration resulted in process optimization across the supply chain resulting in a higher service level with reduction in inventories (Sehgal et al., 2006). Table 4 presents chosen indicators of warehouse process efficiency in a perspective of an internal process.

Table 4. Chosen indicators of warehouse proces efficiency in a perspective of an internal process

No.	name of indicator	Formula	Characteristic	unit
1.	The indicator of warehousemen productivity	$\frac{a}{b}$	a - the rotation of inventory	%
			b - the average number of employees in the warehouse	
2.	Warehouse capacity utilization		a - used warehouse capacity	%
			b - total warehouse capacity	
3.	The indicator of average stock rotation		a - the rotation of inventory	%
			b - number of days in the period	
4.	Duration of the warehouse orders for assortment groups		a - overall duration of orders	h
			b - number of orders	

Source: own study

Encapsulation of efficiency in warehouse process is best apparent in collation of indicators from internal business process perspective. This state of things should not be surprising as these are processes which take place on an operational level that have the biggest contribution in assessing warehouse process efficiency.

Table 5 presents chosen indicators of warehouse process efficiency in learning and growth perspective.

Table 5. Chosen indicators of warehouse process efficiency in learning and growth perspective

No.	name of indicator	Formula	Characteristic	unit
1.	Ratio of material inventory turnover	$\frac{a}{b}$	a - material consumption costs	%
			b - average stocks of materials	
2.	Flexibility of warehouse process		a - number of executed special orders	%
			b - total number of special orders	
3.	The indicator of warehousemen productivity		a - the rotation of inventory	%
			b - the average number of employees in the warehouse	

4.	Share of defective material receipt to customer		a - number of defective material receipt b - total number of material receipt	%

Source: own study

Indicators of warehouse process efficiency in learning and growth perspective are the most wanted form of assessing warehouse process efficiency. However, they are also the most difficult to develop. One needs to remember that indicators of development also entail different threats. The indicators can be inconsistent with the basic strategic aims. When preparing a collation of indicators for warehouse process efficiency assessment one needs to bear in mind the link between individual perspectives. Analysing and compiling indicators of efficiency assessment for each perspective individually can lead to the situation which is reverse to the one expected. We can then get a set of indicators which exclude one another.

5. CONCLUSION

Warehouse process is one of the key processes affecting the value-added in supply chain. This is due to the fundamental objective of the warehouse, which is to enable the availability of assortment in a specific quantity, a specific place and a specific time. The problem of warehouse process efficiency, which was presented in this article refers only to economic aspects. It should be remembered that the assessment of efficiency should also include technical and organizational aspects.

Problem of comprehensive efficiency analysis applies not only to process warehouse. Authors within the framework of research activities analyze the impact of individual phases of material flow on the supply chain efficiency. The authors of the current research analyzed the problems of evaluation of production efficiency (Kolinski, 2012; Kolinski, 2013; Kolinski et al., 2014) and procurement process (Sliwczynski & Kolinski, 2012a; Sliwczynski & Kolinski, 2012b). The aim of further research is to standardize a method of evaluation of supply chain efficiency in economic aspect, by the analogous to develop a indicators system for transport and distribution processes, generally based on assumptions of the Balanced Scorecard.

The issues of the efficiency are widely discussed in the scientific literature, but there is still lack of a comprehensive method, which enables the multivariate analysis and the estimation of supply chain. When building a model for the evaluation of the efficiency, the correlation of all levels of business management should be taken into consideration. The ecological aspect of supply chain, gaining lately the special attention, should be also considered. The implementation of IT systems, supporting the management process, is a practical problem related to the process of building the supply chain efficiency model. The functionalities of such supporting systems enable to obtain and analyze all aspects necessary to fulfil a comprehensive analysis. Therefore, it seems to be reasonable, to prepare a separate IT tool, which will focus on a comprehensive efficiency analysis of all processes in the supply chain and which should be considered as the future direction of researches in this area.

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VARIABLE PAY: A CASE STUDY IN WAREHOUSE LOGISTICS

Ilija Ćorić
MCI d.o.o.
Varaždinska 5, 88 220 Široki Brijeg, Bosnia and Herzegovina
Phone: +387 63 368 359
E-mail: ilija.coric@mci.ba

Katija Vojvodić
University of Dubrovnik, Department of Economics and Business Economics
Lapadska obala 7, 20 000 Dubrovnik, Croatia
Phone: + 385 20 445 933
E-mail: katija.vojvodic@unidu.hr

Scientific paper

Abstract

The use of variable pay schemes has been identified as a means of rewarding employees in order to increase their motivation and productivity. However, experiences from post-transition economies show prevalent use of variable pay model in the sales sector. The reason behind that is insufficient interest by top management into other sectors, such as supply chain management. In addition, supply chain management and different types of distribution channels have not yet been recognized as the sources of competitive advantage. Furthermore, when compared to the sales sector, performance is hard to measure within the supply chains suggesting the need for more complex performance indicators. The main aim of this paper is to present the introduction of variable pay schemes in warehouse logistics leading to productivity improvement. In that context, a case study method is used to compare warehouse employees' fixed and variable pay and their impact on employees' performance. The results reveal significant differences in warehouse employees' performance outputs after introducing variable pay schemes. The research is limited by the levels of technology used in the warehouse operations. Consequently, the lack of a precise classification of warehouse employees' activities can be noted indicating the need to include subjective indicators in the analysis. Finally, performance management in post-transition economies is still rather delicate field with top management still being sceptical about the use of performance pay schemes. In that sense, the efforts should be made to develop efficient solutions to improve employee motivation and performance.

Key words: supply chain management, variable pay, warehouse logistics, Bosnia and Herzegovina

1. INTRODUCTION

Traditional pay systems have been revised in response to changing business objectives and new forms of work organisation (Arrowsmith et al., 2010). As a result, performance pay is growing in importance (Dale-Olsen, 2012). In this context, it is often stated that performance pay is fundamental for competitive organizations (Appelbaum & Shapiro, 1991; Appelbaum & Shapiro, 1992). As stressed by Yeh et al. (2009), today performance-based pay systems are commonly implemented in workplaces as a business strategy to improve workers' performance and reduce labour costs. In that sense, the use of performance-related pay can enhance performance outcomes (Belfield & Marsden, 2003).

Two terms that are related to merit pay are "pay-for-performance" and "variable pay" (Heneman & Werner, 2005, p. 6). As observed by Heneman (2002, p. 214), variable pay is a method of rewarding employees for the results they achieve in organizations. In this context, individual or collective worker effort or performance is rewarded through incentive-based payments (Colling & Terry, 2010). However, Heneman & Werner (2005) emphasize that these rewards do not get permanently added to an employee's base salary. Following Armstrong & Murlis (2007, p. 298), "*variable pay is the payment of cash to individuals in form of performance pay or bonuses on the basis of their own performance or that of their team or organization*". On the other hand, pay-for-performance generally refers to any incentive plan that links employee pay to some measure of performance (Heneman & Werner, 2005).

Organizations are increasingly using variable pay plans to reward employees for the results that they achieve (Miceli & Heneman, 2000). Eriksson & Villeval (2008) emphasize that variable pay links pay and performance but may also help firms to attract more productive employees. When it comes to the advantages of variable pay, Armstrong (2002, p. 19) outlines that these are perceived as its ability to form partnership between employees and organization, to vary pay costs with performance, and to create the need for high levels of teamwork and collaboration. Furthermore, Armstrong & Murlis (2007) argue that variable pay has always been the rule in executive pay, sales representatives' remuneration and payment-by-result schemes for manual workers. Although evidence suggests there is a growing use of variable pay schemes in firms to increase employee motivation and productivity, Burke & Hsieh (2006) emphasize that the choice between fixed and variable pay affects the firm's employee productivity, operating leverage, market risk, cost of capital, and cash flows.

According to Cox (2005), two approaches in evaluations of variable pay systems can be outlined. Although it is argued that both of these approaches suffer from limitations, the first seeks to associate superior financial performance with the use of incentive schemes, whereas the second assesses the success of variable pay systems in effecting behavioural and attitudinal change. On the other hand, it is also emphasized that variable pay for performance may undermine employees' efforts. In this context, it is also argued that rewards crowd out intrinsic motivation under identified conditions, and a bonus system then makes employees lose interest in the immediate goal (Osterloh & Frey, 2002, p. 107). Similarly, Lewis (1991) argued that performance-related pay had a capacity to subvert the purposes for which it was

intended by distorting pay structures, creating unfairness in reward systems and harming team spirit.

The main aim of the paper is to present the introduction of variable pay schemes in warehouse logistics in Bosnia and Herzegovina. In this context, the paper examines variable pay as a means of motivation in the warehouse logistics and indicates possible reasons for its ineffectiveness. To this end, the paper is structured as follows. Following the introduction, recent empirical studies on variable pay are discussed in the second section. The third section deals with a case study comparing warehouse employees' fixed and variable pay and their impact on employees' performance. Finally, the paper closes with conclusions drawn from the paper.

2. LITERATURE REVIEW OF EMPIRICAL STUDIES ON VARIABLE PAY

Recent empirical studies on variable pay have identified different issues that deepen understanding of the complexity of the topic, e.g. pay satisfaction, motivational effects, risk preferences, workplace absenteeism, the education of managers, money attitudes, etc. The link between individual and group variable pay and pay satisfaction among Canadian workers was the focus of the study by Cloutier, Morin & Renaud (2013). Their results revealed that individual and group variable pay plans acted differently on workers' pay satisfaction. For individual pay plans, workers on variable pay plans wanted to be rewarded not only for performance but also for effort. On the other hand, as regards group pay plans, receiving payouts created pay dissatisfaction. Moreover, Thozhur, Riley & Szivas, (2006) suggested that individual differences in money attitudes was found to be a significant variable in explaining pay satisfaction of people in low pay.

In addition, McCausland, Pouliakas & Theodossiou (2005) examined whether significant differences existed in job satisfaction between individuals receiving performance-related pay and those on alternative compensation plans. It was found that while the predicted job satisfaction of workers receiving performance-related pay was lower on average compared to those on other pay schemes, performance-related pay exerted a positive effect on the mean job satisfaction of (very) high-paid workers. The findings of the paper suggest that using performance pay as an incentive device in the UK could prove to be counterproductive in the long run for certain low-paid occupations, as far as employee job satisfaction is concerned. On the other hand, Merriman & Deckop (2007) analysed motivational effects of loss aversion in a heterogeneous sample of respondents subject to variable pay plans in their organizations within the US. They found that variable pay framed as a loss was associated with greater work effort and performance, and less deviant behaviour in the workplace.

Another important issue in the context of implementation of variable pay schemes refers to the education of managers. Taking into consideration Italian firms, Damiani & Ricci (2014) examined the role of the education of managers with respect to the adoption of different types of variable pay bonuses at the individual, team, and establishment levels. Their results suggested that highly educated manages were more likely to use team and individual forms of variable pay schemes. In addition, in order

to identify determinants of variable pay to the subsidiary general manager, Bjorkman & Furu (2000) investigated 110 foreign-owned subsidiaries located in Finland. As a result, they found a significant 'nationality effect' on the use of variable pay. On the other hand, no effect was found with regard to the cultural distance between the home country of the multinational corporation and the location of the foreign subsidiary.

The issue of absenteeism in the workplace was also examined in the context of variable compensation. In particular, Pouliakas & Theodoropoulos (2012) explored the effect of variable pay schemes on workplace absenteeism using two cross-sections of private sector British establishments. Based on the findings, establishments that explicitly linked pay with individual performance were found to have significantly lower absence rates, and the effect was stronger for establishments that offered variable pay schemes to a greater share of their non-managerial workforce. Moreover, the results revealed that establishments that tied a greater proportion of employees' earnings to variable pay schemes experienced lower absence rates. Similarly, the study by Dale-Olsen (2012) showed that team organisation and performance pay were found to be negatively related to sickness absence incidence rates and sick days.

Furthermore, the emphasis was also put on risk preferences in the context of compensation. The study by Kuhn & Yockey (2003) revealed that people were not generally risk averse in this context, but rather that risk preferences depended on the nature of the variable pay plan. In that context, variable pay was preferred more often when incentives were based on individual rather than collective (team or organizational) performance. Moreover, participants in the study were more optimistic about the likelihood of receiving incentives as individuals. Additionally, Kurtulus, Kruse & Blasi (2011) investigated worker attitudes toward employee ownership, profit sharing, and variable pay, as well as preferences over variable pay in general. The results of their study showed that, on average, workers wanted at least a part of their compensation to be performance-related, with stronger preferences for output-contingent pay schemes among workers who had lower levels of risk aversion, greater residual control over the work process, and greater trust of co-workers and management.

In general, the link between firm size and ownership structure was also explored with regard to performance-related pay. Based on Norwegian establishment surveys, Barth et al. (2008) found that performance-related pay was more prevalent in firms where workers of the main occupation had a high degree of autonomy in how to organise their work. Moreover, it was found that performance pay was more widespread in large firms whereas the incidence of performance-related pay related positively to product-market competition and foreign ownership. Similarly, examining performance pay and corporate structures in UK firms, Conyon et al. (2001) confirmed that large firms were more likely to adopt performance related pay schemes and their results showed that such adoption was also linked with significant organisational design change through delayering. Additionally, using a representative sample of German establishments, Heywood & Jirjahn (2014) showed that those with foreign ownership were more likely to use performance appraisal, profit-sharing and employee share ownership than those with domestic ownership.

The focus of the research by Wei & Rowley (2009) was pay for performance in China's non-public sector enterprises. In that context, they identified three major

factors as reasons for management to apply pay for performance plans, namely, market practices/best practices, the need to attract and retain good performers, as well as the need to improve employee performance. The relationship between performance-related pay and firm performance was also the focus of research. In particular, Piekkola (2005) analysed the productivity effects of the introduction of performance-related pay scheme in Finland. The findings revealed that performance-related pay schemes had substantially improved firm performance without creating much wage pressures. Furthermore, it was showed that performance-related pay improved both productivity and profitability. In addition, Belfield & Marsden (2003) stated that the relationship between performance-related pay and performance outcomes was qualified by the structure of workplace monitoring environments. Their study also presented evidence that managers learned about optimum combinations of pay system and monitoring environment through a process of experimentation.

Based on a review of empirical studies, it can be observed that more related research is still needed to better understand the complexity of the topic. In particular, this refers to experiences from post-transition economies. In light of this, the next chapter deals with a case study of a FMCG company in Bosnia and Herzegovina.

3. CASE STUDY

Following the primary work motivation, this chapter looks at the case study which is the result of the introduction of variable pay in warehouse logistics. The mentioned study describes a business example from the distribution practices of FMCG products in the market of Bosnia and Herzegovina, where the system of variable pay was introduced in early 2013.

3.1. Baseline situation

Warehouse operations in the distribution of FMCG products in the Bosnia and Herzegovina market consists of several activities. In addition to order picking of goods as the core activities of warehouse operations, warehouse employees are involved in the activities of cleaning and maintaining the warehouse, unloading of goods on arrival, loading of picked goods, activities connected to operating a forklift, goods inventory control, etc. Additionally, in this case study warehouse workers are further involved in the activity of order picking goods in cold storage which is used for storing ice cream and other frozen goods the so called below freezing mode. In the end, despite numerous activities of warehouse employees, their performance is viewed through the number of picked orders or items on orders. All other activities are supporting work activities which serve the final order picking of goods.

Our case study included 15 warehouse employees. Their fixed net monthly salaries are in the range of 400 - 500 EUR. The exact amount of the net salary of each employee depends on the length of service and generally on his status in the company, but, most frequently, it comes to subjective assessments of superiors. The average monthly performance of warehouse employees is possible to measure suing parameters in Table 1.

Table 1. Statistics of order picking of warehouse employees with fixed pay

Employees	Number of items	Quantity	Net salary
Warehouse worker 1	7,595	145,630	450
Warehouse worker 2	5,114	131,597	450
Warehouse worker 3	4,040	102,660	425
Warehouse worker 4	4,951	107,092	450
Warehouse worker 5	2,027	65,505	450
Warehouse worker 6	2,950	83,475	450
Warehouse worker 7	7,183	147,792	425
Warehouse worker 8	5,503	96,985	450
Warehouse worker 9	5,683	105,108	425
Warehouse worker 10	1,094	56,408	450
Warehouse worker 11	3,293	69,512	450
Warehouse worker 12	3,935	100,579	450
Warehouse worker 13	6,690	189,277	475
Warehouse worker 14	6,364	128,513	475
Warehouse worker 15	6,595	142,807	450
Total	**73,017**	**1,672,939**	**6,725**

Source: Authors' calculations

A characteristic of such a defined payment policy is that the height of salary is not closely related to the direct performance of individual employees. The consequence is a certain constancy of salary over time, without much change, whether increasing or decreasing. The motivation of warehouse employees is not stimulated in this way and employees are only left with their "internal" motivation for work, which, for managers, does not leave much room for management in terms of increasing work efficiency in warehouse employees. Therefore, the total number of warehouse employees required for order picking of average monthly work inputs is mainly the result of subjective perception based on previous experience and not objective

indicators in accordance with the controlling principle of calculation of the necessary resources in the company (cf. Lukovic & Lebefromm, 2009; Lukovic & Lebefromm, 2014; Weber & Wallenburg, 2010).

3.2. Introducing a variable pay calculation system

Following the hypothesis that by introducing a variable pay calculation system for warehouse employees it is possible to affect their work efficiency, a variable pay calculation system was formulated, where the variable part of the pay will be calculated according to the following formula:

((item+quantity)/100)*0.15EUR)

In a variable pay calculation system each employee is guaranteed a fixed part of the pay in the amount of 250 EUR, while the rest of the net pay is calculated using formula the above. A situation is created in which every employee is faced with the fact that they themselves must "earn" the variable part of the pay i.e. that part of the pay which must be covered by performance. At the same time, the idea is that the fixed part of pay is not a "gift" to employees without any performance coverage, but, rather, it represents compensation for all other activities performed by warehouse employees in addition to regular order picking of goods. In this way, everyone should be equally motivated to work on cleaning and maintenance, loading and unloading of goods, inventory control, etc. All other activities such as operating a forklift or working in cold storage require separate "agreements" made by certain employees with immediate superiors in warehouse management.

After the initial "running-in" and accepting the variable pay system, the following performance was measured on an average month and it is presented in Table 2.

Table 2. Statistics of order picking of warehouse employees in a variable pay calculation system

Employees	Number of items	Quantity	Fixed part of pay	Variable part of pay ((item+quantity)/100 *0.15EUR)	Total pay
Warehouse worker 1	8,131	171,692	250	269	519
Warehouse worker 2	9,511	218,611	250	342	592
Warehouse worker 3	4,981	113,646	250	178	428
Warehouse worker 4	6,462	89,051	250	143	393
Warehouse worker 5	4,971	121,467	250	189	439

Warehouse worker 6	1,150	32,469	250	51	301
Warehouse worker 7	6,848	139,302	250	219	469
Warehouse worker 8	5,514	121,645	250	191	441
Warehouse worker 9	3,614	69,787	250	110	360
Warehouse worker 10	1,895	102,839	250	157	407
Warehouse worker 11	3,003	74,308	250	116	366
Warehouse worker 12	4,154	95,795	250	150	400
Warehouse worker 13	7,577	181,472	250	283	533
Warehouse worker 14	6,633	94,743	250	152	402
Warehouse worker 15	6,860	127,576	250	201	451
Total	**81,304**	**1,754,403**	**3,750**	**2,751**	**6,501**

Source: Authors' calculations

As is evident from Table 2, the range of net pays now ranges from 350 - 600 EUR, making the entire system more flexible with regard to working effects achieved. In this case, the total budget for pays is even slightly lower than the fixed method of calculation.

This system of calculation definitely better suits employees with higher work performance, who are then more motivated, while workers with weaker work performance are in a less favorable position compared to earlier, fixed pay. If such employees permanently have below-average work performance, the assumption is that they will eventually leave the company while a competitive struggle among employees will lead to long-term "survival of the fittest", all of who will have similar high performance results. Ultimately, this system of calculation will lead to a situation where the same average total work input can be achieved with fewer employees. In this way, reducing the overall expenditures for fixed salaries, which is associated with a reduction in costs for health and pension insurance, at the same time reduces other expenditures related to employees costs, such as work clothes, training for occupational safety, sanitary booklets, etc. It is a mechanism with multiple benefits for a company.

4. CONCLUSION

The introduction of variable pay in warehouse logistics is not without difficulties. This is especially true for post-transition environments such as the market of Bosnia and Herzegovina, where every major change to existing working conditions is treated very critically.

If we disregard "internal" work motivation, the work motivation of employees mostly depends on their income. Considering that the total net pay in a variable calculation system is largely dependent on its variable part, the employees' attention is solely diverted on achieving the highest possible variable pay components. Since they depend on the total of picked work orders, which are measured through the categories of items and the total quantity of goods, there is a rapid decrease of motivation for other work activities. Even though other work activities such as cleaning warehouses, control inventory, loading and unloading of goods etc. are covered by the fixed part of the pay, in time, employees form a subjective feeling that these activities will be done by "someone else". Ignoring other work activity creates negative feedback to work productivity since order picking is significantly slower in an untidy warehouse, where there is a constant increase in the number of errors in order picking.

Such a variable pay calculation system could create a negative work environment for warehouse managers, since they can often find themselves in the position of arbitrators between certain warehouse employees. The consequence of this is a possible reduction in collegiality, which represents additional negative feedback to work productivity.

No less important limitation of this case study arises out of technological limitations, since statistical effects it cannot be one measured hundred percent. The methodology of work requires work in groups, so two employees simultaneously perform order picking on one electronic device and their performance statistics is obtained through an indicator of the statistical average. Other work activities, such as operating a forklift were not recorded in this case, which requires additional subjective assessment of the time required by the Head of the warehouse. Such drawbacks can be solved with a modern Warehouse Management System (WMS). Since such systems require a huge financial investment in equipment and software, the question is raised of their justification in relatively small, post-transition markets. In this way, these markets, because of their relatively limited number of end consumers and because of their size, are condemned to technological lag in modern logistics and distribution chains.

To overcome the above technological and organizational constraints when introducing a variable pay calculation system, unified attitude of top management i.e. management of the company is very helpful. The absence of a pre-defined position on the introduction of a variable pay system can lead to additional difficulties in solving arbitrary situation.

Finally, the paper contributes to the existing body of literature on variable pay schemes by providing insight into a FMCG company in Bosnia and Herzegovina. The findings presented in the paper have important practical implications and may be useful to managers and various other subjects involved in designing pay and reward

structures. However, there is a need for more research on variable pay schemes. To this end, greater emphasis should also be placed on job satisfaction, employees' motivation and pay satisfaction.

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THE SIGNIFICANCE OF THE INTERMODAL TRANSPORT ROUTE THROUGH THE PORT OF RIJEKA FOR SUSTAINABLE TRANSPORT

Siniša Vilke
University of Rijeka, Faculty of Maritime Studies
Studentska 2, HR-51000 Rijeka, Republic of Croatia
Phone: +385 91 443 4475
E-mail: svilke@pfri.hr

Hrvoje Baričević
University of Rijeka, Faculty of Maritime Studies
Studentska 2, HR-51000 Rijeka, Republic of Croatia
Phone: +385 51 338 441
E-mail: hrvoje@pfri.hr

Livia Maglić
University of Rijeka, Faculty of Maritime Studies
Studentska 2, HR-51000 Rijeka, Republic of Croatia
Phone: +385 51 338 441
E-mail: livia@pfri.hr

Scientific paper

Abstract

The road transport generates benefits to the economic development of each country, but it also produces the largest contribution to greenhouse gas emissions. The purpose of this paper is to examine the impact of road transport on the environment and to emphasize the requirement for its substitution by environmentally-friendly transport branches. An intermodal overseas transport route between the Southeast Europe countries and the North Adriatic Italian ports through the Port of Rijeka (Bakar Ro-ro terminal) as a junction point is analysed. The scope of this paper is to highlight the significance of the introduction of new seaborne truck traffic services from the Southeast Europe countries to the North Adriatic Italian port terminals for the reduction of vehicles gas emissions and sustainable development. The main research findings of the article are: the introduction of the new intermodal transport route from the Port of Rijeka to the North Adriatic Italian ports will decrease the gas emission from heavy vehicles operating on the North Adriatic transport route and thus contribute to sustainable transport. The methodology used in this paper consists of the analysis of the impact of road transport to the environment as well as the analysis of the implementation of the Bakar Ro-ro terminal and its influence to the road infrastructure in the Rijeka traffic junction. Further research regarding the possibility of reducing heavy vehicle road traffic through the North Adriatic should be deal with introducing an intermodal railway transport.

Key words: Port of Rijeka, Bakar Ro-ro terminal, road transport, intermodal transport, sustainable transport

1. INTRODUCTION

The development of transport was always closely linked to the economic, social and political growth of a country. The degree of transport system development is correlated to the level of economic development and the quality of life and, consequently, the overall economy of the country, region or area is also dependant on it. Therefore, enhancing the quality of the transport system is of vital interest to any community. Since the basic aim of the transport system is connecting business entities and people regardless of distance, purpose or mode of transportation, transport also has an international dimension. However, in addition to the positive socio-economic influence, transport also has a negative side. Its expansion has caused a series of negative factors which continuously jeopardize the quality of life and a country's economy. In that respect, particular emphasis must be given to environmental pollution (of air and water) caused by increased greenhouse gas emissions, noise and vibrations, occupation of public areas and spaces, as well as extraordinary events (traffic accidents) (Maglić et al., 2013, p. 38).

It is hardest to curb the increase of greenhouse gas emissions in transport since the necessary measures are slowly implemented and they are predominantly relative to the advances of the technical properties of motor vehicles. One of the basic goals of the European sustainable transport policy is meeting the environmental criteria which include a series of measures, among them: technical improvements of vehicles, alternative energy sources, tax policies, subsidies, defining environmental standards, etc. The countries of the North Adriatic transport route, Croatia, Italia and Slovenia, as countries on EU route accession, must also follow the trend of reducing transport sector emissions and must adopt the proposed taxation and tax relief measures in order to make the vehicles in use environmentally friendly.

When introducing a new intermodal traffic route, all the relevant port traffic and road transport interface parameters should be investigated. In order for the balancing of capacity to be successful, it should not be studied within only one traffic branch but within a traffic route as a whole. It is precisely the balancing of various traffic branches that creates a more realistic picture of an integrated traffic route's capacity, i.e. the time parameter within which a specified cargo volume or a number of transport units can pass along a particular route. This also extends to transport costs, as well as safety sustainable development in relation to a particular itinerary.

2. ENVIRONMENTAL IMPACT OF ROAD TRANSPORT

There are approximately 500 million registered road vehicles in the world, 85-90% of which are cars and 8-12% lorries. According to OECD (Organization for Economic Co-operation and Development) data, the number of vehicles is expected to double by 2030. Due to increasingly rapid economic growth and development,

European road transport grows very quickly, and that reflects upon the increased usurpation of space, the increase in noise and vibrations, irrational energy consumption, water and soil pollution, and an overall negative effect on the environment as a whole. The world CO_2 emissions from road transport are projected to grow between 140% and 350% to 2050, depending by the changes in freight intensity and the share of rail in delivering future freight in land transport.[1]

Transport is widely considered to be one of the causes of health problems linked with toxic air pollutants that endanger the ecosystem and human health. Other problems, including noise and space usurpation, also have a substantial impact on the ecosystem. A minimum of 25000 m^2 of space is required to construct one kilometre of motorway with three traffic lanes in each direction. That is the equivalent of constructing approximately 60 residential buildings. Of all the sources of municipal noise in cities, nearly 80% is due to traffic noise - an extremely problematic piece of information since traffic noise has a negative effect on the human organism.[2] In addition to the aforementioned negative effects on people and the environment, transport is also marked by numerous positive effects like the development of tourism, economic growth, employment, rise in competitiveness and accumulation of profit. It is therefore necessary to establish a balance, i.e. to support a development concept for sustainable transport in order to intensify its positive effects and eliminate the noxious ones. Transport, especially road transport, is responsible for 25% of the global carbon (IV) oxide emissions because of the use of fossil fuels. The average car annually emits its weight in CO_2 emissions. For a one hour drive on the motorway at 130 km/h a car consumes the same amount of oxygen that a human being consumes breathing for ten days.

Regulation on the Monitoring of Greenhouse Gas Emissions, Policies and Mitigation Measures in the Republic of Croatia (Official Gazette No. 87/12) and Ordinance on Greenhouse Gas Emissions Monitoring in the republic of Croatia (Official Gazette No. 134/12) prescribe obligation and procedure for emissions monitoring, which comprise estimation and reporting of all anthropogenic emissions and removals. The monitoring comprises the main greenhouse gases which emissions are the result of anthropogenic activities: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_{2O}), halogenated carbons (HFC_s, PFC_s) and sulphur hexafluoride (SF_6), as well as the indirect greenhouse gases: carbon monoxide (CO), oxides of nitrogen (NO_x), non-methane volatile organic compounds ($NMVOC_s$) and sulphur dioxide (SO_2).

Greenhouse gas emission sources and sinks are divided into six main sectors: Energy, Industrial Processes, Solvent and Other Product Use, Agriculture, Land Use, Land-Use Change and Forestry and Waste. The largest contributor to the total greenhouse gas emissions in 2012 in the Republic of Croatia was the Energy sector with 71.5%. It was followed by the Agriculture sector with 12.8%, Industrial Processes 10.8%, Waste 4.3%, and use of Solvents and Other Products with 0.45%.[3]

[1] ITF Transport Outlook 2015 [available at: http://www.oecd.org. access May 19, 2015]
[2] http://www.bicikli.hr [access May 9, 2015]
[3] National Inventory Report 2014 (NIR 2014) – Croatian Greenhouse Gas Inventory for the Period 1990-2012, EKONERG – Energy and Environmental Protection Institute, Zagreb [available at: http://www.azo.hr, access May 20, 2015]

As the carbon dioxide emission from fuel combustion includes more than 88% of CO_2 emission it could be concluded that the Energy sector with its share of total greenhouse gas emissions presents the equivalent emission of CO_2.

The energy sector covers all activities that involve fuel consumption from stationary and mobile sources, and fugitive emission from fuels. Fugitive emission arises from production, transport, processing, storage and distribution of fossil fuels.

Transport sector is also one of more important CO_2 emission sources. This sector includes emission from road transport, civil aviation, railways and navigation. According to data from 2012, the share of greenhouse gas emissions caused by transport in the Energy sector was 21.33%. On the other hand, the CO_2 emission from Transport sector contributed with 29.3% to the national total CO_2 emission in the same year. The largest part of the CO_2 emission from Transport sector arises from road transport, i.e. 95%.[4]

3. EVALUATION OF THE CONDITION OF ROAD INFRASTRUCURE IN THE RIJEKA TRAFFIC JUNCTION

The geo-traffic position of the port of Rijeka is an important factor in its integration into the European Traffic System. In this respect, Bakar emerges as an important location, which, unfortunately, has not been sufficiently valorised and therefore holds much unused potential (particularly in the area of the former coke plant). The existing infrastructure, technical and traffic elements synthesize the aim for a well-balanced sea, road and/or railway traffic.

The road cargo transport routes correspond to the distant traffic itineraries towards Bakar, i.e. the Rijeka Traffic Junction. These are the routes from the continental hinterland, i.e. Central and Eastern Europe, which primarily exist as two access routes from Zagreb and Ljubljana and, secondarily, from Dalmatia and Istria. The Rijeka Traffic Junction access roads, together with the motorway links, is integrated into the Rijeka By-pass Road. The basic concept of connecting the Bakar Basin with access trunk roads and county roads is based on the tangential access in relation to the Rijeka city centre. The reason for this was, until recently, the limited capacity of the D8 road and the old industrial road through the Kukuljanovo industrial zone. As a result, a substantial inflow of vehicles, especially heavy cargo traffic from the direction of Zagreb, was threatening all the advantages of a balanced crossroads and access roads capacity in the so-called eastern approach area. As to the road connection with the main road network, the eastern part of the Rijeka Traffic Junction has a relatively high degree network density. Assuming that the introduction of an intermodal service results in the traffic load of 2x150 vehicles per day, the future traffic load projection may be calculated in the following way:

Q = 11280 vehicles/day (current traffic flow)

[4] Guidebook on the cost-effectiveness of fuel consumption and CO_2 emissions (2015), Ministry of the Interior, Zagreb [available at: http://www.mup.hr, access May 19, 2015]

Δq = vehicles/day (increase in traffic) = 150x2 = 300x3 = 900 assumed vehicles

$p_{\%} = Q + \Delta q / Q = 11280 + 900 / 11280 = 1.08$

Comment: The increase in traffic flow of 8% in case of 150x2 daily truck arrivals at the Bakar Ro-ro terminal by the route D8 and the decrease in the service level.

The road traffic service quality of the subject junction will influence the implementation of the intermodal transport services from the countries in the Southeast of Europe to the North Adriatic Italian ports. The biggest changes concerning directing and intensifying the traffic flows to the eastern part of the Rijeka Traffic Junction will be caused by the introduction of a Ro-ro service from Bakar terminal to the North Italian ports, i.e. Chioggia or Venezia.

In consequence of the anticipated increase in traffic due to ever increasing inflow into the Bakar Ro-ro terminal, the situation could worsen during rush hours. The only way this problem could be solved is by implementing sophisticated methods of fleet management, i.e. distance management from a distribution centre within the Ro-Ro terminal itself.

4. ROLE OF THE TRUNK ROAD D40 & D8

The introduction of a new intermodal truck traffic route from the countries in the Southeast of Europe to the Bakar terminal including onward transport by sea creates a new challenge and a test for the existing land infrastructure and superstructure, and especially for the road network. In this context, the road network within the gravitational hinterland represents the infrastructure segment of the entire logistic system (Vilke & Baričević, 2009, p. 98).

The so-called contact area of the Ro-ro terminal parking lots and the trunk roads D8 and D40 should represent the connection between the outer-city and inner-city network.

At the immediate entrance to the Ro-ro terminal or within the terminal itself, there should be a parking lot for the accommodation of heavy vehicles, trucks, trailers, semi-trailers and trailer trucks. The parking lot should have sufficient capacity to accommodate all vehicles that might, in the worst case scenario, simultaneously be waiting to embark/disembark onto the Ro-ro vessels.

Regarding the priority role of the railway for low-tariff bulk cargoes from the Bakar basin, the possibility of large increase in truck traffic has not been examined while designing the junction. Otherwise, the consideration of introducing new seaborne itineraries would certainly affect the change of parameters relevant to the position, number and type of the terminal road links to the D8 road.

More exactly, the new leg of the road link in subject might have been built with a non-levelled crossroads. In this way the continuity of traffic flows for the benefit of both networks would have been realized which is the basic principle in the design of the outer-city and inner-city road network. The existing traffic solution is insufficient for outflow as the unnecessary resistance in the network when joining the road D8 is

created, caused by the road link's lower priority rank. However, taking into consideration the current traffic connections, the requirements of the new intermodal route from/to the Bakar terminal have been achieved as the road D40 contributed to the improvement in the quality of distant traffic. Only 7.5 km of the three-lane road rise from the port to the level of Čavle Road Traffic Junction and directly to the trunk road D3 towards Zagreb. Moreover, the Sv. Kuzam Road Traffic Junction plays as an important role by directing the cargo traffic from D8 to D40 (Kukuljanovo industrial zone) and vice versa.

Secondary route towards Split (the 'old' Adriatic trunk road) plays a complementary role in the service of the hinterland. Finishing the construction of the eastern leg of the Rijeka By-pass Road, i.e. the initial leg of the Adriatic motorway stretching over the coastal area Rupa-Rijeka-Žuta Lokva, a long-term perspective for a better service of the Bakar Ro-ro terminal is created.

5. THE BENEFITS OF INTERMODAL TRANSPORT ROUTE THROUGH THE PORT OF RIJEKA

The introduction of the North Adriatic overseas itineraries, more exactly truck ro-ro transport between the Croatian and Italian North Adriatic coast was the consideration subject of many initiatives. An implementation attempt of a *joint venture* Ro-ro service between the port of Rijeka and the port of Chioggia was realized in the year 2004. Unfortunately the service was soon interrupted due to several reasons, primarily the non adequate selection of the location for loading/unloading heavy road trucks in the port of Rijeka – the city centre close to the bus station. The Bakar basin as a better quality solution could not be taken into consideration at that period due to the unprepared ground, the absence of customs, etc. (Vilke & Baričević, 2009, p. 100).

Concerning the future introduction of the intermodal route via the Bakar ro-ro terminal as the junction point, a more systematic approach is necessary in which all relevant factors, directly or indirectly providing for the success of the subject design during a long-term period will be included.

The main argument for the initiatives regarding the introduction of the new Ro-ro transport route is the deviation of truck traffic from the west Croatian, Slovenian and North Italian road network. In this way the road networks traffic density would be reduced, the waitings on customs transit as well as the procuring of expensive permissions for the road network utilization would be eliminated.

In the event of substantial increase of truck traffic between the Southeast European countries and the North Adriatic Italian ports, a possibility of introducing an intermodal railway transport should be considered. Even if the railway access track to the existing railway network is not constructed, new technologies are expected to enable the cargo in trailers and semi-trailers to be carried and delivered onto the ro-ro terminal. The same effect could be achieved by applying the „Piggyback"system (Huckepack system) „A" technique with minimal investment at the point within the existing railway network closest to the terminal.

The great improvement of the implementation of the new intermodal transport route through the Port of Rijeka as well as the introduction of the intermodal railway system would be the decrease of the greenhouse gas emissions from road transport, i.e. heavy road vehicles at the North Adriatic transport route. Since the largest part of the CO_2 transport emission arises from road transport, the new Ro-ro route through the Bakar Ro-ro terminal would create benefits regarding the diminishing of greenhouse gas emissions. Thus, the new intermodal and seaborne route will contribute to sustainable transport development.

6. CONCLUSION

Although distance, time and cost of transport are mutually intertwined components influencing extensive exploitation of the Bakar Ro-ro terminal, the fact is that each component has its own significance. Once a new traffic route has been introduced, a record should be kept of technological, transportation and exploitation indicators, and even partial studies should be carried out for particular segments of the whole system. The necessary tools for this approach should be the simulations which would enable testing of particular sub-systems, such as an interactive information support service, telematic fleet management, etc.

Due to changes in input regarding the increase/decrease in the number of freight vehicles and changes in transport locations in particular countries and in customs policy, as well as the other parameters with notable dynamic and stochastic features, there will be some necessary changes in the logistic model of the considered traffic route.

The set-up of the existing infrastructure and superstructure in Bakar, Rijeka, County of Rijeka and Croatia as a whole allows for an uninhibited start of an extremely positive initiative. However, an efficient intermodal route between the countries of Central and Eastern Europe, Bakar and the North Italian ports, i.e. Chioggia or Venezia, is possible only by way of an integrated logistic support.

The Energy sector, including Transport as a sub-sector, is the main source of the anthropogenic greenhouse gas emission with share of 71.5% in total emission. Carbon dioxide is the most significant anthropogenic greenhouse gas. The most significant anthropogenic sources of CO_2 emissions in the Republic of Croatia are the processes of fossil fuel combustion for electricity or/and heat production, industrial processes and transport. Road transport respectively vehicle fuel combustion generates great volumes of CO_2 emissions.

The introduction of the new intermodal transport route through the Port of Rijeka connecting the east European countries and the Italian north Adriatic ports will redirect the heavy vehicle road traffic from the North Adriatic transport route. Thereby, the west Croatian, Slovenian and North Italian road networks traffic density would be decreased. In addition, introducing intermodal railway transport would generate the diminishing of road transport gas emission and lead to sustainable transport development.

As the largest share of all transport emissions, more exactly about 95%, is originated from road transport, the implementation of the analysed transport route

would contribute to sustainable transport mission and goals. Moreover, the introduction of railway transport in the intermodal service will furthermore diminish the impact of road transport to environmental problems.

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INTERNATIONAL FOOD STANDARD AND FOOD SAFETY SUPPLY CHAIN OF CROATIAN CHOCOLATE PRODUCER – IMPLICATION FOR THE FINAL PRODUCTS TRANSPORTATION

Aleksandar Erceg
Kandit d.o.o.
Vukovarska cesta 239, Osijek, Croatia
Phone: +385 31 512 508 /Fax +385 31 512 575
E-mail: aleksandar.erceg@kandit.hr

Professional paper

Abstract

Today's world is demanding food safety for the final consumers. Consumers are looking more carefully for the information about the food they are buying and consuming. Besides final consumers, supermarket chains are also trying to have excellent food quality in their supply chain. Therefore there are many different food standards that are companies using in order to bring food safely to final consumers in all parts of supply chain. One of those standard is International Food Standard which is looking all parts of supply chain network from arrival of the raw materials, production until delivery to the supermarket chains.

Paper will present different food standards that are currently being used in world and will look more carefully on the International Food Standard which is needed for companies that would like to produce private labels for supermarket chains.

Since not many Croatian companies have been certified for this standard it is necessary to introduce its demands and its benefits for the companies. Therefore paper will evaluate influence of the International Food Standard on the food safety supply chain and business procedure of one Croatian company in area of chocolate products transportation. This paper will be a starting point for further research about relation and influence of food safety standards on supply chain networks.

Key words: food safety, international food standard, logistics, food safety supply chain

1. INTRODUCTION

Food safety today is one of the most important things for food producer and for the final consumers on the market. Consumer concern about treats associated with food is growing and the food quality and food safety has become major issue in media and in the public in the recent years. Production and sale of food with suitable quality is fundamental element of gaining confidence of consumers on every market.

Companies which offer and sell their products on the market are changing their behavior regarding food safety and trying to implement every standard market is

introducing in order to satisfy their buyers (i.e. wholesalers, supermarket chains, etc.) and in the end final consumers. Additionally threat for food safety is coming from the fact that international trade in food products is increasing since technical and trade barriers are reduced or completely gone in some countries so this is representing a new source of potential risks in food supply chain networks.

The main goal of this paper is to introduce different food standards companies can apply for and be certified and how this standards influence their supply chain network – what companies have to do, how to apply, what investments have to be done and what are the benefits, etc. Paper is divided in several parts. In the first part different food standards are presented and especially International Food Standard. In the second part we will talk about benefits of the standard for the company, for its food safety supply chain and for the buyers. In the last part we will present why and how Croatian chocolate producer apply for this certificate and what had to be done in company in order to be certified according to this standard and how this has improved safety of the food supply chain network toward buyers and final consumers.

2. FOOD SAFETY STANDARDS

Why do companies need food safety standards among other available quality standards is the question everyone could and probably should ask? Besides obvious answers – potential risks for health of the final consumers there are also complex challenges in today's food supply chain and that is the reason why many of the world's food retailers are asking and demanding certification of their suppliers according to Global Food Safety Initiative (GFSI) schemes. The Global Food Safety Initiative (GFSI) is an industry-driven initiative which provides guidance on food safety management systems necessary for safety along the supply chain (GFSI, 2015). GFSI work is being done through collaboration between the world's leading food safety experts from retail, manufacturing and food service companies, as well as international organizations, governments, academia and service providers to the global food industry.

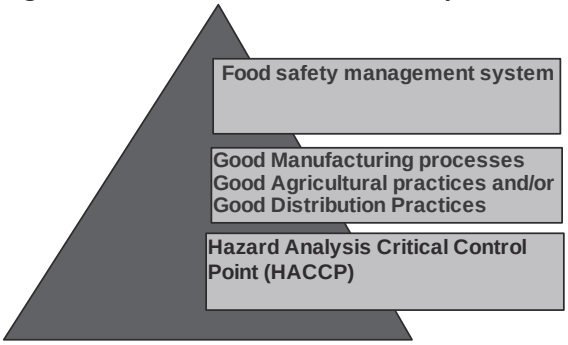
The main reason for establishing GFSI was to ensure confidence in safe food deliveries while continuing to improve food safety along the supply chain network. The GFSI standard scheme include Safety Quality Food (SQF), British Retail Consortium (BRC), International Food Standard (IFS), Food Safety system Certification (FSSC), GLOBAL G.A.P. and Best Aquaculture Practices (BAP) and CanadaGAP (NSF, 2015) and they include all parts of the supply chain network from food itself, packaging process, packaging materials, storage and distribution for primary producers, manufacturers and distributors. Standards are being verified through third-party certification and they are growing trend in the food industry. In order to remain competitive on today's more and more global market companies are increasingly adopting food standards and are subjected to food safety audits on a regular basis to maintain this certification.

Companies approach certification *at the level of the individual company, the level of individual (closed) chains of cooperating companies and the level of open networks of connected supply chains* (Beulens et. al., 2005: 482).

2.1. World food supply chain safety standards

Verification and certification to different food standards has become a growing trend in food industry worldwide. The main reason why companies are deciding to go through certification process is to become competitive. In order to maintain their certificates they are subjected to food safety audits on a regular basis – mostly yearly. Companies have to decide which food safety standard they will choose and this is depending where in supply chain they would like to start or where in the food supply chain they are situated. There are different certification schemes available to the companies. The key differences involve where the company is in the supply chain (primary producer, manufacturer, logistics/transport and so forth), its product sector (aquaculture, produce, meat, poultry etc.) and also the scope of its business (local versus international trade) (Figure 1).

Figure 1. Different schemes of food safety standard



Source: adapted from GFSR, 2015

Today in food supply chain network one can see various systems and standards that have been developed during last decade. Worldwide best known standards are Hazard analysis critical control point (HACCP) system, ISO 22000 standard and the British Retail Consortium (BRC) standard. Standard like HACCP is developed to manage potential risks for food safety while standards *like ISO 22000 and BRC normally include HACCP aspects and besides that provide a management system to incorporate food safety in an organization.* (Ackerman et al, 2010: 870)

Choosing a food safety standard is not easy to do. Choice depends on where the company is situated in relation to final buyer and consumer so there are four main "places" in the supply chain for which company can be certified according to the different standards such as primary food production and food safety on farms – SQF Code, CanadaGAP, Global G.A.P; food manufacturing – SQF Code, BRC Food Safety Standard, FSSC 22000, Global Aquaculture Alliance BAP, Global Red Meat Standard, International Food Standard, Synergy 22000; Standards for food packaging – BRC IOP Global Standard for Packing and Packaging Products, IFS PACsecure Standard and Standards for food labeling - Gluten Free Certification Program (Canada) and Food Allergen Labelling, Legislated by Governments. (Bliska and Kovalski, 2014; DNV 2015; GSFI, 2015)

Gawron and Theuvsen (2006) noticed that one of the most often mentioned complaints about food safety standards are huge bureaucratic efforts and work and therefore there is an open discussion if the certification according to one of the above mentioned standards is increasing competitiveness together with increasing safety in food supply chain or not. Henson (2008) in is work looked upon food standards that are currently present in the world food production and food supply chain and he divided standards into two main groups: public and private food standards. Majority of these private standards are created by different commercial and non-commercial entities. Extent, to which private standards are voluntary, significantly depends on level of power wielded by companies that are adopting standards (Brunsson and Jacobsson, 2000). Henson and Humphrey (2009) in their work found that in every group of standards (public and private) there are the ones that are mandatory and the ones that are voluntary for companies (Table 1).

Table 1. Forms of standards

	Public	Private
Mandatory	Regulations	Legally-mandated private standards
Voluntary	Public voluntary standards	Private voluntary standards

Source: adapted from Henson and Humphrey (2009)

Table 2. Private and public standards in the world

		Public		Private	
		Mandatory	Voluntary	Collective	B2B
Focus	National	National legislation	• Food Safety Enhancement Program • HACCP Advantage	• Dutch HACCP • BRC Global Standard • Assured Food Standard • Qualitat and Sicherheit • Integrale Keten Beheersing	• Nature's Choice (TESCO stores UK) • Field-to-Fork (Marks and Spencer UK) • Filiere Agriculture Raisonnee (Auchan Franche) • Filiere Qualite (Carrefour France) • Terre et Saveur (Casino)

	International	EU regulation	ISO 9000 ISO 22000	• International Food Standard • SQF 1000/2000/3000 • EUREPGAP	Wall-Mart Nestle

Source: adapted from Henson, (2008: 73)

Table 2 shows main world food standards according to the group they belong to. Henson (2008) has identified that standards are being developed not only because of safety in food supply chain but because of wider food quality attributes. Although one can see evolution of different private food quality and safety standards for governance of global supply chain of agricultural and food products, there are debates on how much impact on trade private standards have and also how strong is public regulation on national levels of such standards (Garcia Martinez and Pole, 2004).

In the following chapter we will describe International Food Standard (IFS) as one of the most developed and present private collective food quality and safety standards.

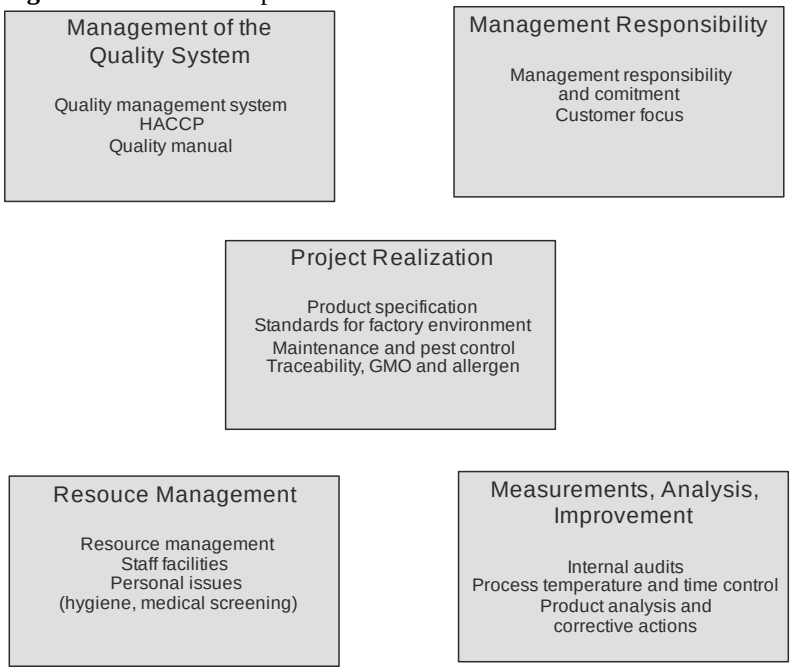
2.2. International food standard

International food standard (IFS) is a food safety standard which has uniform safety system that is used to qualify and select suppliers (DNV, 2015). It can be explained as one common audit standard, globally accepted by the food industry in order to continuously improve food safety for consumers. Standard helps supermarket chains in ensuring food safety of the product they are selling to their buyers and to monitor quality level of suppliers of their private labels. International Food Standard has been developed for the purposes of auditing suppliers who cooperate with networks of so called private label manufacturers. Growing concerns among biggest retailers and supermarket chains regarding food safety of the products they are selling was the main reason why was IFS developed by German and French food trade associations. Standard is intended for all suppliers during food supply chain network from agricultural stage to supermarket chains. The main aim of the IFS standard is to confirm whether the supplier is capable of delivering a safe product compliant with valid law regulations and norms. Standard helps in ensuring that the companies comply with quality and safety demands, and legal requirements. Smieciuch et al (2009) stated that lowering of the costs related to the behavior transparency of the supply chain is one of the essential aspects of IFS.

Furthermore, the IFS introduced uniform requirements and transparency in the supply chain (of raw materials and the final product). The IFS standard is based on the principles of a quality management system as well as the HACCP system and is supported by the expectations for prerequisite programs, which is the set of Good Manufacturing Practices (GMP), Good Hygienic Practices (GMP) and Good Laboratory Practices (GLP). The IFS also follows the guidelines of the Global Food Safety Initiative and meets criteria set by GFSI – organization that includes senior management of more than 400 retailers and supermarket chains operating on close to 200.000 store and manufacturers of all sizes (Bliska and Kowalski, 2014).

Structure of IFS is similar to the structure of ISO 9001 and it is base for the audits of the company (Figure 2). It consists of the main technical chapters are management of the quality system, management responsibility, resource management and product realization, measurement s, analyses and improvements

Figure 2. Technical chapters of IFS standard



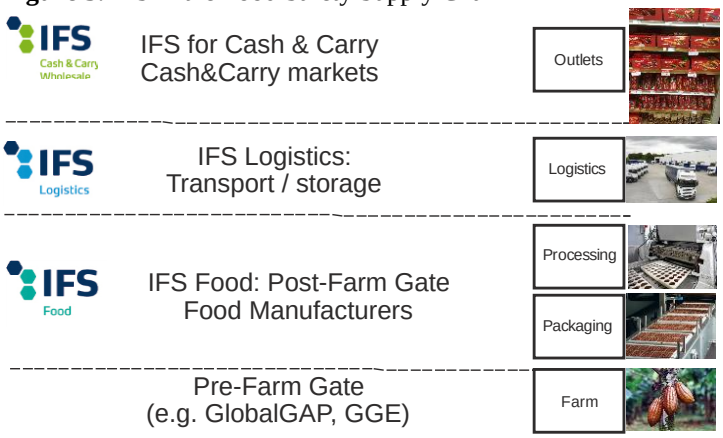
Source: adapted from Gawron J-C., Theuvsen, L., 2006: 5

IFS enable organization that is certified (DNV, 2015; Gawron and Theuvsen 2006) to:

- Have proof of commitment to the food safety in its supply chain and in case of need legal defense,
- Create management system that is capable for meeting food safety supply chain requirements and legal compliance that is applicable in countries where the products are sold and consumed,
- Have a tool for improving food safety supply chains and tools to observes and measure performance of current food supply chain network,
- Reduce product waste, product reworking and product recall – reduce costs of business.

Due to the need for certification of the whole food supply chain companies can be certified according to the different parts of the IFS for its different parts and roles in food safety supply chain (Figure 3.).

Figure 3. IFS in the Food Safety Supply Chain



Source: adapted from ANSICA, 2015

IFS Food was the first standard in the IFS standard family and now is the most widely used standard from IFS family. This is confirmed by more than 11.000 IFS Food audits which were conducted in over 96 countries in 2010 and that numbers are growing (IFS, 2011). IFS Logistics is developed for distribution, transportation, loading and unloading activities, storage and is intended for implementation in environments that are managing food and non-food products. It marks objective of industry and trade in creating transparency and trust in entire food supply chain. In order to optimize procedures of audits in cash & carry locations and wholesalers IFS Cash & Carry / Wholesale standard was developed. This two business types are important connectors between primary producers, converters and commercial clients. This business also need standard because they can process small amount of unpacked products alongside to their wide assortment of other products. Besides this three main IFS standards, companies can be certified for IFS PacSecure (packaging materials suppliers), IFS Broker, IFS HPC (Household and cosmetic products) depending on their role and place in food safety supply chain and also based on their business.

3. BENEFITS OF INTERNATIONAL FOOD STANDARD FOR CERTIFIED COMPANIES

Companies see calls for safety in food supply chain network as their opportunity for continuous innovations and competitiveness. Hofstede (2003) found, enabling logistics and process improvements along the supply chain and having important consequences to a liability as direct benefits of certification

IFS can be looked as a neutral instrument based on third party audits which can decrease costs and improve quality of final products at the same time (Buhlmann et al, 2004). Therefore standard has been largely accepted in the Western European retail sector (France and Germany) and is becoming a certification standard not only for private labels but also for manufacturer brands (Gawron and Theuvsen, 2006). As a

result of this more and more food producers are replacing ISO standard with IFS. Smieciuch et al (2009) stated that main benefits for companies having IFS are growth of efficiency, effectiveness in production, increasing trust in product safety and lastly transparency of behavior and better acceptance of customers.

Certification in accordance to IFS offers benefits to companies which mission includes excellence in quality, customer satisfaction and trying to have a competitive advantage in global marketplace.

Table 3. Key IFS benefits

Purchasing	Production	Marketing
Improved confidence in suppliers and products	Improved understanding between management and staff relating to standards and procedures	Improved business reputation as a supplier of high-quality product
Reduced time spent on supplier screening	Monitoring of compliance with food regulations	Ability to trade with customers insisting on independent inspection
Less time spent reworking or returning product outside specification	More effective use of resources	Use of the IFS logo and certificate to demonstrate compliance with the highest standards
Due diligence defence	Reduction in the need for customer inspections	
Expert witness	Due diligence defence	
Ability to reduce individual inspection costs by combining a variety of different inspections at the same time	Expert witness	
	Ability to reduce total inspection time by combining a variety of different inspections at the same time	

Source: adapted from SAI Global, 2015

Other authors (Garcia Martinez and Poole, 2004; Ackerman et al, 2010) stated additional benefits of IFS standard for companies – possibility to achieve higher level of food safety and quality, standard is clearly structured and precisely written and gives companies a fair chance for sustainable improvements in the processes. On the other side it is important to state some contras to the private standards among which is IFS. Jackson (2008) stated following contras – standard is a "trade barrier" – for a potential new competitors on the market, standard is not transparent and not science based, they present additional cost to suppliers and producers, customer is King and can ask everything they want from suppliers.

Probably the biggest benefit coming from IFS is that is accepted by major retailers like Metro Group, Edeka, Rewe Group, Aldi, Lidl, Auchan, Carrefour Group, Leclerc, Provera (Cora and Supermarchés Match), Système U, COOP, CONAD and others. This means that the company that has IFS certificate can produce private labels

and can be a partner to this retailers and this give company competitive advantage in relation to the companies that don't have this certificate. This competitive advantage is huge benefit in today's global and increasingly competitive marketplace for company that has it. Certificate also ensures retailers that the certified company has food safety supply chain settled and that his food safety can be trusted and that there is no need for additional audits from retailers themselves.

4. CROATIAN CHOCOLATE PRODUCER KANDIT D.O.O. AND FOOD SAFETY STANDARD

4.1. Company background

Kandit d.o.o. has been founded in 1905 as a sugar factory. In the 1920-ties company started with production of candies and confectionery. After the second world Kandit produced first chocolate. In 1960-ties Kandit became one of the leading manufacturers of confectionery products in former Yugoslavia. During last several years Kandit has invested in modernization of production and in 2009 started production of foamy products.

In 2011 Kandit became a member of Mepas group together with Saponia, Brodomerkur, Koestlin and Maraska. During 2012 Kandit has started building of new modern factory which was finished in June 2014 and soon afterward production has been completely moved to the new location. More than 20 million EUR has been invested in the new factory – building and equipment.

Company currently has around 350 employees and has recorded a growth in sales during Q1 2015 in relation to the same period of the previous year.

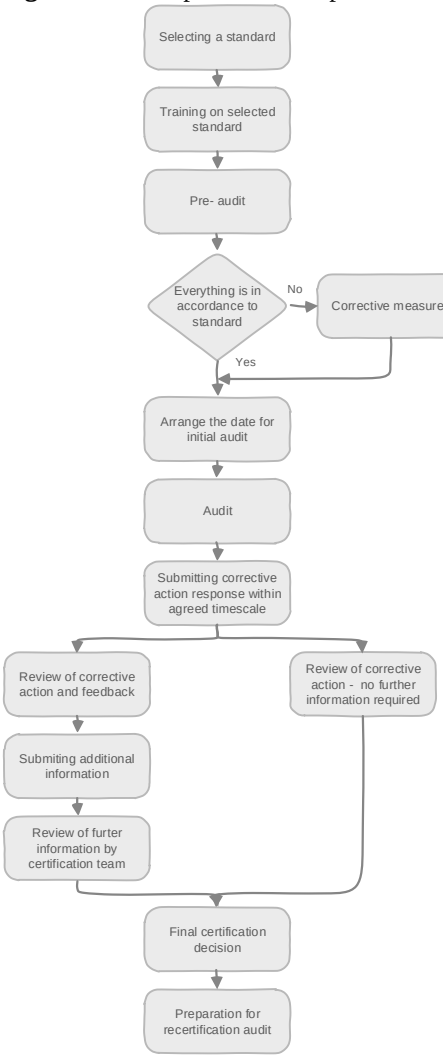
4.2. Implementation of IFS in Kandit

Kandit has started to produce private label products for several foreign companies including Lidl, Lela and Rewe group (Billa). Previously Kandit has passed certification for ISO 9000 (quality management) and HACCP (food security management) and has been recertified for both standards several times. Besides this two certificates Kandit hold Kosher and UTZ certificate. UTZ is largest program for sustainable farming of coffee and cocoa in the world. The UTZ Certified program covers good agricultural practices, farm management, social and living conditions, and the environment.

Until 2013 there were no additional demands from buyers except agreed price and quality. But due to the bigger competition on global market and increasing of concern for the food safety supply chain, buyers like Lidl and Lela started to demand additional quality and security demands. This was first done through additional food safety audits which were performed by buyers themselves. They suggested that Kandit should start certification process for IFS standard in order to remain their chocolates supplier and in order to be able to offer its products to the other retailers to whom Kandit wasn't able to sell without this standard.

Managing board of the Kandit founded certification team which started IFS implementation process in October 2014. (Figure 4) During certification process members of certification team and whole Kandit prepared and increased food safety supply chain in Kandit. This was done through investments in production (i.e. replacing wooden pallets with plastic ones, replacing wooden elements with plastic or metal ones, etc.). There were other investments as well especially in the field of workers education about their role in food safety supply chain – what to do and how to improve safety with their behavior. Implementation process has finished in January 2015 when Kandit successfully passed certification audit for IFS Food.

Figure 4. IFS implementation process in Kandit



Source: author, 2015

Figure 4 is showing process of IFS implementation in Kandit. Before starting management had to decide which standard to implement and next phase was creating certification team and education of team members about IFS. After education and preparation pre-audit was done in order to see what is in accordance with standard and what has to be improved. Next step was audit itself which has lasted for three days. At the end of every day members of certification team had a meeting with audit team members in order to check daily progress and if there are some slight improvements to be done – if there are big and huge faults company would not be certified and will have to wait at least six months before it applies for another audit. After the certification audit has passed audit team members informed members of the board that company has got the IFS certificate. For Kandit this meant open door for supplying big retailers with chocolate and for retailers that they will received Kandit's products via safe food supply chain.

4.3. IFS and transport requirements in Kandit's supply chain

In several departments in Kandit besides production there was additional activities implemented all in order to increase food safety in supply chain. One of those departments was transport and logistics in order to prepare transport demands of IFS and transport of the final products – chocolates. Safe transport should be an assurance for buyers and consumers that the products will be suitable for consumption when they reach final destination. Different food industries influence the transport in diverse ways. Food transport is influenced by weather conditions and therefore additional efforts should be implemented in accordance to IFS to ensure food safety in the supply chain. It is important to state the IFS in its quality demands have a section which deals with transport and logistics

Transport of the chocolates had to be improved in order to match following conditions: means of transportation have to be kept in food technical conditions, loading surface of vehicle should be adapted to transporting chocolates, temperature of transport should be 12-18°C, etc. As part of these efforts, Kandit has invested in improving transportation means and bought refrigerator truck in order to be better supplier for its customers. Additionally during the transport it is necessary to maintain quality by keeping constant temperature, maintain hygiene regarding biological contamination, and apply protection during transport and watching over refrigerator truck quality and status.

Special procedures were developed for critical situations in order to prevent chocolate transport failures. These situations can be divided in three groups: vehicle failure, road accident and damage to the chocolates during transport. Procedures describe way of how it should reacted in case of vehicle failure – how to protect chocolates, how to contact customer and how to eliminate possible damages to chocolates; in case of road accident – how to contact producer, how to contact buyer, how to organize replacement transportation in case that the original in not able to continue or to keep the chocolate safe. In case of product damage during transport procedure states following steps: driver informs customer service and logistic about damaged chocolate products; customer service department decides how to proceed – deliver goods to consignee or return to the Kandit warehouse; new set of sales

documents is created in relation to the updated status of transported chocolates. Procedures and actions are also in place in cases when the transport of chocolates is forwarded to external transportation company – in transport order it is mentioned that the transporter has to follow principles of IFS for transport of the chocolate. In this way chocolate producer have control over food safety in supply chain during transport from production site to the external warehouse or to the buyer of chocolates.

5. CONCLUSION

Safety in food supply chain is important in today's food production and process of bringing food from producer to the final users. Functionality of food safety in supply chain should and has to cover safety and quality assurance. Prevention of safety issues is of the most critical importance because just one problem which reaches final consumers can have significant health and financial consequences for the producer. Food safety in supply chain is focused more on prevention than reaction because it has lower costs and helps companies to be better and more competitive on global market.

International Food Standard is one of the available world food safety supply chain standards companies can choose in order to be certified and to have safe supply chain. This standard has several benefits for the companies that finish certification process but the most important one is the certified company can produce private labels for retailers which increase company's competitiveness in in today's global marketplace.

After being IFS certified Kandit gained advantage in relation to its competitors but it had to invest in getting standard in all supply chain starting from suppliers through transport and logistic until its buyers.

Influence of IFS on company food safety supply chain is significant and can be costly due to the necessary changes but in the same time it can save money and increase sales. Since there is not a lot of companies in Croatia that are IFS certified it will need some time and further research to prove how exactly IFS is influencing food supply chain of the certified companies.

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IV. DEVELOPMENT PERSPECTIVES OF SUPPLY CHAIN AND LOGISTICS

DIMENSIONS FOR DEVELOPING SUPPLY CHAIN INTEGRATION SCENARIOS

Lukasz Hadas
Poznan School of Logistics
Estkowskiego 6, 61-755 Poznan, Poland
Phone: +48 61 850 47 81; Fax: +48 61 850 47 89
E-mail: lukasz.hadas@wsl.com.pl

Piotr Cyplik
Poznan School of Logistics
Estkowskiego 6, 61-755 Poznan, Poland
Phone: +48 61 850 47 81; Fax: +48 61 850 47 89
E-mail: piotr.cyplik@wsl.com.pl

Michal Adamczak
Poznan School of Logistics
Estkowskiego 6, 61-755 Poznan, Poland
Phone: +48 61 850 47 81; Fax: +48 61 850 47 89
E-mail: michal.adamczak@wsl.com.pl

Roman Domanski
Poznan School of Logistics
Estkowskiego 6, 61-755 Poznan, Poland
Phone: +48 61 850 47 81; Fax: +48 61 850 47 89
E-mail: roman.domanski@wsl.com.pl

Scientific paper

Abstract

The paper focuses on the issues of supply chain integration. The integration process is considered from the perspective of possible directions of its implementation. The choice of integration directions and types of actions is limited by space defined by: specific integration factors, their aggregate measure as well as assessment measures applicable to supply chain operation. The space in question determines the dimensions for developing supply chain integration scenarios. The authors undertook to verify this claim based on the 19 factors they had previously identified, their 4 described integration advancement levels, the supply model they had developed as well as using a series of simulation experiments. By applying process modelling and simulation methods, they managed to represent characteristic features of supply chain operation at each integration level for all identified factors. Empirical data necessary to verify the initial thesis were obtained by subjecting such model of supply chain to simulated material planning and flow in the option of dynamic changes resulting from the application of scholastic demand distribution. In doing so statistical methods were used for the general option (complete supply chain

integration – all factors) and the specific option (for each factor individually). The authors found two issues to be particularly important – the correlation (established using binary methods) between supply chain performance and the integration level, or the lack of such correlation, but also regression power between these two variables.

Key words: SCM – Supply Chain Management, integration process

1. INTRODUCTION

Integration of supply chains is currently one of the key challenges for modern management in the global economy. Engaged in competition with one another, companies are looking for new conceptual ideas and methods of reducing operational costs and increasing their flexibility. Improved flexibility – in terms of the time needed to respond to current market needs and implementation of ambitious plans of product innovation – is impossible without progressive integration of supply chains. In recent decades supply processes have been evolving from little more than meeting of material demands to fostering close (oftentimes strategic) cooperation with suppliers. Cooperation between supply chain partners takes various forms; from framework contracts for supplies, to shared forecasting and planning, to concentration of reserves, to cooperation in design and launching production of new products, or of their key modules. The success of these practices offers tangible business advantages to each of partners, with the outcome being robust supply chains that are capable of competing globally. This fact gives rise to the widespread interest among management practitioners and the scientific world in the processes of supply chain integration.

This paper focuses on the aspect related to the formation of an adaptive scenario of supply chain integration. In the process of supply chain management, the leading company takes decisions on the directions of integration progress. Multidimensionality of the issue and the number of factors affecting the real level of integration force companies to carefully select the actions they should take. The choice of integration directions and types of actions is limited by space defined by: specific integration factors, their aggregate measure as well as assessment measures applicable to supply chain operation. The space in question determines the dimensions for developing supply chain integration scenarios. The authors, based on the studies on the multi-faceted conditions of supply chain integration, verified the assumptions presented above by simulation experiments performed using the created model.

2. DEVELOPMENT OF SUPPLY CHAIN INTEGRATION

In recent years, given the observable pressure on cutting costs of production activity along with reducing order implementation time, integration of processes has been a frequent topic of scientific papers, with particular attention being paid to planning processes (Daviaud, 2006, p. 33-34, Muzumdar & Fontanella, 2007, p. 35). In specialist literature, integration is often discussed in the context of supply chain management as an element required to secure high performance results. “The task of

cooperating supply chain links is to attain high efficiency [...] through integration and coordination of all actions" (Łupicka-Szudrowicz, 2004, p.49). The papers examine the impact of integration on supply chain performance. In their paper, Lummus, Vokurka and Krumwiede showed that a higher integration level in supply chains makes it possible to attain better cost indicators (Lummus et al., 2008, p. 56-63). Many authors have made an attempt to identify the factors that affect the integration level. The study by Wong and Boon-itt concentrates on institutional standards and uncertain environment. They proved that standards intensify integration processes and that the integration level goes up as environmental uncertainty increases (Wong, & Boon-itt, 2008, p. 400-410). Based on the studies presented in specialist literature, one may say that soft integration factors obviously dominate over hard integration factors, which makes it harder to assess the phenomena in question objectively. Numerous papers emphasise that attaining full integration requires exchange of information about supply, production plans, distribution of benefits, as well as shared planning and implementation of strategies related to a physical product flow. Integration of product flows is a particularly difficult task given the presence of numerous models of material flow planning. The abundance of models results from customers' changing needs and constant attempts at costs rationalisation in production businesses (Stachowiak, 2003, p. 68-71). Specialist literature offers a number of papers tackling the issue of material flow planning models. Chronologically, the oldest are the models which assume inventory formation to facilitate smooth flow of material through the production system. The need to minimise costs and emergence of IT tools supporting performance of MRP algorithms contributed to broad application of that model. The development of computer hardware and software made it possible for users of the MRPII model to balance production tasks with available capabilities, as well as to integrate the production area with other company functions, such as accounting, finances, HR or distribution (Pająk, 2007, p.226). Further attempts at lowering the costs of operational activity bore fruit of the JiT model (Just in Time). The aim of JiT is to reduce the inventory level by organising just in time deliveries in the conditions of rhythmic production (Payne, 1993, p.304). Further integration within the supply chain resulting in coordination and optimisation of actions within the chain is known in specialist literature as the Supply Chain Management (SCM) strategy (Douglas & Griffin, 1996, p.1). Another noteworthy observation is the fact that most examinations of the integration of chain participants refer primarily to forward flows, performed from the producer to the consumer. What is more, a supply chain is often treated fragmentarily, as a relation between two participants: supplier-purchaser. Backward supply chains become more significant in the context of the quality of life of future generations. A pro-integration tool is tax reliefs and low interest loans as they provide financial spurs that encourage changes in the current production profile by facilitating the use of secondary raw materials (Bieda, 2007, p.28.). What is necessary is the transformation of logistic areas with more weight placed on the environmental protection aspect. Therefore second-hand products regain their value that was lost in the course of their operation, and they are remarketed. Given how limited resources are, reuse of products is economically attractive (Kruczek & Żebrucki, 2009, p.22) while the area related to waste may be perceived as an infinite plane offering the possibility to create added value (Brdulak & Michniewska, 2009, p.16).

Supply chain integration is an evolutionary process, namely the integration of specific participants proceeds in stages. For this reason integration can be accessed through determining its current level. The creators and advocates of the supply chain management concept tend to agree that achieving full integration of partners requires covering a challenging, long and multi-stage road. Specialist literature, however, presents diverse views on specific procedures that can be followed to reach higher levels of cooperation. For this reason the authors wish to describe and organise various opinions on reaching top partnership levels as part of integrated supply chains. Generally speaking, there is a common agreement about the fact that the supply chain integration process should start with improving internal logistics of the company that assumes the role of a change leader. An intermediate integration level is the implementation of a test programme of supplier development. Crucial for attaining the top development level, understood as an integrated supply network, is building true partnership with preferred suppliers and key clients as well as application of shared IT systems based on online solutions (Witkowski, 2010, p.73-75).

In structuring the knowledge of supply chain integration of the forward and backward type, the authors carried out a detailed analysis of four reference models used in this area. They are:

- three tier model by A.T. Kearney,
- four tier model by Ch.C. Poirier,
- five tier Compass model,
- SCOR model.

Since the models differ from one another, a decision was made to compare them. Ten criteria were established according to which scores were awarded to each model. The objective of the criteria was to identify the model offering the most comprehensive scope of the analysis of integration as well as finding possible research gaps. The results of the performed analyses can be seen in Table 1.

Table 1. Analysis of supply chain integration models

	Model by A.T. Kearney	**Model by Ch.C. Poirier**	**Compass model**	**SCOR model**
Quantifiable values of integration factors	-	-	-	-
Taking into account backward flows	-	-	-	+
Planning	+	+	+	+
Information flow	+	+	**(+)**	+
Material flow	+	+	**(+)**	+
Financial flow	+	+	**(+)**	+
Equity relations in the supply chain	-	+	-	-
IT in the supply chain	+	+	+	-
Competences of staff	+	**(+)**	-	-

	Model by A.T. Kearney	Model by Ch.C. Poirier	Compass model	SCOR model
Activities controlling in supply chain	+	(+)	(+)	+

Where:
+ The model meets the criterion
(+) The model partially meets the criterion
– The model does not meet the criterion
Source: Hentschel, B., et al., 2015, p.120

An analysis of the summary presented in Table 1 suggests that no integration model presents quantifiable integration factors. The models presented in specialist literature are based on quantitative descriptions and lists used to verify specific statuses within supply chains. Moreover, only one model recognises the occurrence of reverse flows in supply chains.

To sum up, the methods of assessing supply chain integration levels put forth in specialist literature usually depend to a large extent on identified integration stages, with integration itself being divided into internal and external. The internal integration stage is mostly characterised by attempts to reduce costs, while the external integration stage – by maximising profits and market share (value increase). To each integration stage a set of specific characteristics is assigned being subject to measurement and assessment. The main drawback of the solutions in question is inaccuracy of proposed characteristics, resulting in ambiguity of notions and subjectivity of awarded scores.

3. CATEGORIES OF SUPPLY CHAIN INTEGRATION

As part of the authors' research on multi-aspect conditions affecting supply chain integration, a grading system for integration levels was developed as well. The assessment of supply chain integration level is based on the analysis of the integration level for each identified factor. By using this solution it is possible to comprehensively analyse supply chain integration levels. For each of the 19 identified integration levels 4 levels were described – assessment grades (see more: Hadas et al., 2014a, p.59-78). Each of the levels (A, B, C, D with A being the top one) has a defined performance characteristic which facilitates performance assessment within a supply chain (by being assigned to a specific level). The authors, when describing specific integration levels, focused on:

- integration symptoms,
- symptoms of absent integration,

which made it possible to make assessments based on a typical operation characteristic of a given chain obtained, e.g., during interviews with managerial staff. Table 2 presents 19 categories of integration operations, without their detailed description.

Table 2. Categories of supply chain integration

1. Sales support	5. Transport operations	9. Financing of supply chain operation	13. Recycling cooperation	17. Characteristics of secondary raw material availability
2. R&D	6. Unified packaging	10 Inventory management in supply chains	14. Response to internal supply chain disruptions	18. Ability to accept returns from the market and information flow on secondary raw materials
3. Investments	7. Information flow integration	11. Information quality, accuracy and standards	15. Reduction of material losses	19. Monitoring of the performance of supply chain links
4. Demand forecasting	8. Material flow optimisation	12. Leading cooperation areas	16 Supply provision and secondary raw materials storage	----

Source: Hadas et al., 2014b, p.6

Moreover, based on the aforementioned factors, the authors developed the methodology of determining the integration index for a given supply chain. The methodology of determining the integration index for a given supply chain assumes that full integration of all links within a supply chain is not possible due to (Hadas et al., 2014a, p.59-78):

- its natural dynamics (variability over time),
- assumed strategies of performing specific functions (e.g. short term agreements concerning distribution and sales, or purchases compliant with the "multisourcing strategy", a prerequisite of which is an extensive supplier base with poorly developed cooperation).

Furthermore, as it was assumed in the course of work on the assessment model, integration – rather than being a goal in itself – is a tool that can improve company's operating indicators. For the abovementioned reasons it is necessary to (Hadas et al., 2014a, p.59-78):

- asses the level of supply chain integration for a selected group of key entities (links)
- relate the selection of key links to the rank of a supply item (category) and the chosen strategy used in selecting the number of supply sources for an individual supply item,

- the adopted measure of link significance assessment should include the ranks (managerial decision) and value (measurable in currency units) of supply value stream,
- assessment of integration level should not affect company's sourcing strategy, but be a result of it; it should provide information to support activity at the tactical and operating level.

The supply chain integration model developed at later stages of work, as well as its representation in the application performing process simulations, was meant to facilitate verification of the accuracy of integration level characteristics assumed for selected (quantifiable) integration factors.

4. SUPPLY CHAIN MODEL AND ITS REPRESENTATION IN THE SIMULATION APPLICATION

The authors of this paper created their own supply chain model, based on forward flows (primary raw materials) and backward flows (waste, secondary raw materials).

The model implies a 5-level structure of the supply chain. It includes (see Figure 1):

- suppliers of primary raw materials – e.g. entities offering raw materials,
- intermediaries involved in the trading of secondary raw materials – e.g. entities collecting and offering secondary raw materials, waste stock exchange,
- manufacturer – an entity producing finished goods and their components both from primary and secondary raw materials,
- distributors – entities responsible for the storage of finished goods and supplying them to the sales network,
- sales networks – entities which supply the goods directly to the final customer.

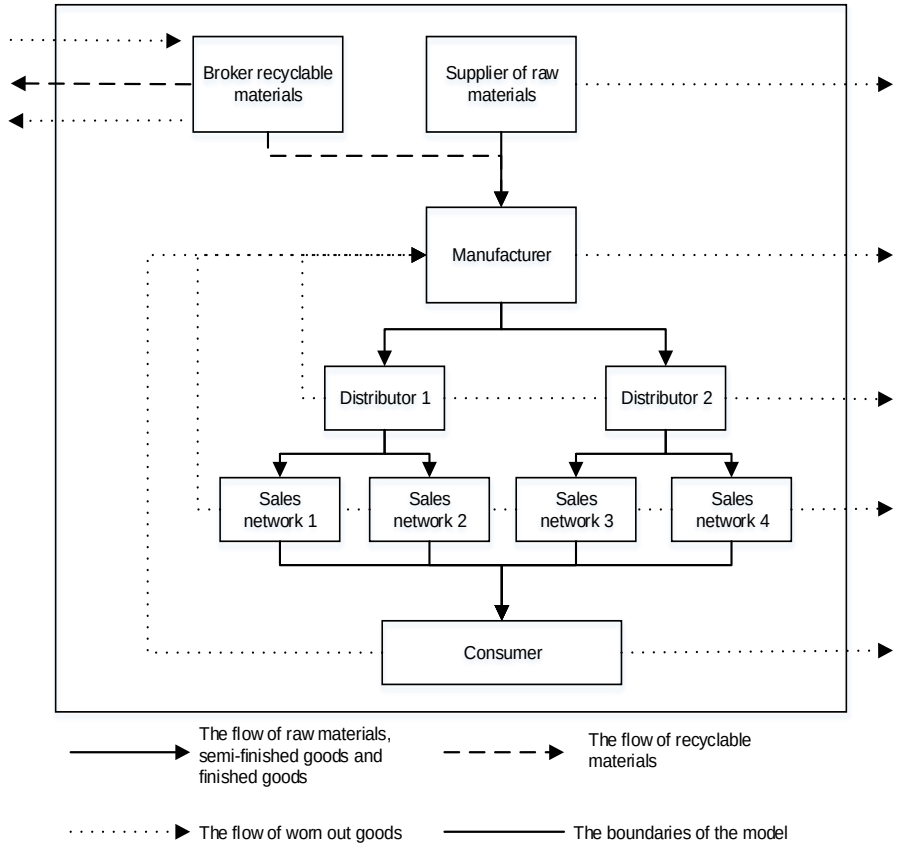
Main input and output data for the model include:

- forecast demand,
- estimated costs,
- actual demand,
- waste stock exchange bids.

Main controlling parameters in the model:

- the prices of raw materials, the prices of finished goods,
- stock maintenance and replenishment costs,
- transport costs,
- material flow times,
- properties of raw materials,
- cash flow times,
- profit margins,
- minimum levels of customer service,
- maximum production capacity and potentials of the partners in the supply chains.

Figure 1. Structure of the supply chain mod



Source: own study

Three metrics have been identified for the purposes of assessing the supply chain within the developed model:

- service level – the ratio of the number of delivered items to the number of items ordered by these customers,
- profitability – a ratio of the achieved material flow as controlled by the profit plan to the generated profit,
- cash flow – identified with an average amount of cash available to the company in the months under inspection.

The presented metrics enable the evaluation of the streams flowing in the supply chain: material stream and financial stream (the perspective of costs and cash).

A model thus developed makes it possible to analyse the impact of selected integration factors and their levels on supply chain performance.

5. SUPPLY CHAIN INTEGRATION MODELLING – SELECTED SIMULATION RESULTS

5.1. Supply chain results for change of the total index of integration level

Before the results of supply chain can be analysed, one should introduce the assessment method in the condition of having six functioning (selected for simulation experiments) integration factors, each of which may assume 4 states (A, B, C, D). The following factors and levels of their integration were analysed:

- Availability of secondary raw materials,
- Integration of planning processes,
- Inventory management,
- Transport operations,
- Unified packaging,
- Material flow optimisation.

For the purpose of a synthetic analysis, one indicator was created as a source of information about the state of supply chain integration. The indicator was formed as a total of numbers representing the levels of integration of each of the selected factors. The following values were adopted for transcription: level A = 4 points , B- = 3 points, C =2 points, and D = 1 point. The aggregate result of integration level assumes 19 various states (from 6 to 24 points - the highest level of integration for all the six factors).

In the next step was done, a number of statistical analysis (Table 3) to verify the dependence between levels of integration and performance of the supply chain (cash flow, profitability, Service level (OTIF – On Time In Full delivery)

Table 3. Summary results of statistical analyses carried out to verify the total integration level

Integration level / **Performance of the supply chain**	**Changes in the total index of integration level** (based on the calculation of selected factors; the results are in ascending order)
Correlation analysis	Between levels of integration and performance of the supply chain
Cash flow	Correlation exists
Profitability	Correlation exists
Service level (OTIF)	Correlation exists
Analysis of regression (for integration level change)	
Cash flow	Large impact (ascending direction)
Profitability	Large impact (ascending direction)
Service level (OTIF)	Large impact (ascending direction)
Analysis of variance significance (ANOVA)	
Cash flow	Significant
Profitability	Significant

Service level (OTIF)	Significant
Analysis of change dynamics (average % of change between integration levels)	For four levels: A, B, C and D for all 6 factors under analysis
Cash flow	14.58%
Profitability	5.30%
Service level (OTIF)	3.41%

Source: Own study

The obtained results confirm that the assessment model of integration level, i.e. a model of characteristics of particular levels for given factors, is correlated with supply chain performance. This means that as the integration level increases, the supply chain performance under analysis changes; moreover – most significantly – these correlations are statistically important.

5.2. A summary analysis of the results of integration level verification carried out for selected factors

On the basis of the results obtained during the previous phase of work, three key factors were qualified for the purpose of detailed analyses of the assessment of impact exerted by a single factor on supply chain performance:

- Secondary raw material availability,
- Integration of planning processes,
- Inventory management.

These are three critical factors that exert the greatest impact on supply chain performance.

The analysis contains an assessment of impact exerted by particular integration factors attributable to various integration levels. The results for the remaining factors are presented in Table 4. The summary of results for each of the factors under analysis demonstrates the correlations and regression power related to specific changes of integration levels and their impact on supply chain performance. Statistical significance of variances was also analysed along with change dynamics with respect to: cash flow, profitability and service level (OTIF). The presented list of results provides an answer to the basic questions concerning verification of correctness of adopted integration levels for each of the factors under analysis.

Finding a correlation between an integration level and supply chain performance is something very much desired. No correlation between the performance and changes in integration levels means that the division (differentiation) into these levels in not important (and hence pointless). In this way one may verify the adopted characteristics of integration levels. The analysis of variance significance helps in drawing conclusions in statistical assessment. Moreover, the analysis of regression and change dynamics allows one to determine the strength of impact exerted by changes in a given integration level on supply chain performance. Thus presented set of results is a valuable material for reaching conclusions.

Table 4. Summary results of statistical analyses carried out to verify integration levels for selected factors

Factor	Secondary raw material availability	Integration of planning processes	Inventory management
Analysis of correlations (between integration level change)			
Cash flow	Correlation exists	Correlation exists	Correlation exists
Profitability	Correlation exists	Correlation exists	Correlation exists
Service level	Correlation exists	Correlation exists	Correlation exists
Analysis of regression (for integration level change)			
Cash flow	Very low change dynamics (very small impact)	Large impact	Very large impact
Profitability	Very large impact	Small impact	Very large impact
Service level	Small impact	Very large impact	Average impact
Analysis of variance significance (ANOVA)			
Cash flow	Significant	Significant	Significant
Profitability	Significant	Significant	Significant
Service level	Significant	Significant	Significant
Analysis of change dynamics (average % of change between integration levels)			
Cash flow	Small significance (1.84%)	Significance (7.42%)	Large significance (25.37%)
Profitability	Significance (3.75%)	Small significance (1.37%)	Significance (3.18%)
Service level	Insignificant (0.72%)	Significance (5.01%)	Significance (6.92%)

Source: Own study

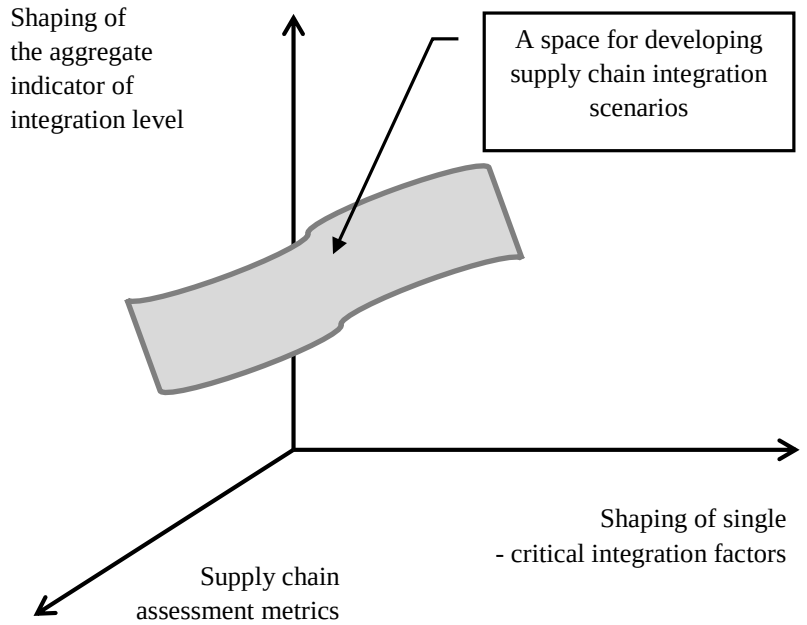
The analysis of correlation and variance significance is of basic character, namely it verifies the validity of one's reasoning. Conversely, the analysis of regression and change dynamics goes much deeper and may be used to build a scenario of supply chain integration.

6. DIMENSIONS FOR DEVELOPING SUPPLY CHAIN INTEGRATION SCENARIOS

When formulating general correlations in the studied area, one may conclude there are three dimensions when it comes to the development of integration scenarios for forward and reverse supply chains (namely choosing integration directions) (Figure 3):

- the first dimension is shaping of single - critical integration factors,
- the second dimension is shaping of the aggregate indicator of integration level,
- the third dimension are supply chain assessment metrics.

Figure 3. Dimensions for developing supply chain integration scenarios



Source: Own study

The dimensions of the supply chain management system form the space for developing a scenario of improving the integration level. The first dimension (X axis) refers to the shaping of single integration factors. The plane is therefore oriented to searching for leading (critical) factors affecting the integration process. Therefore it is in that direction that the plane should be explored. The authors of papers, based on distinguished integration factors, developed supply chain model and a series of simulation experiments, highlighted the abovementioned factors: „inventory management", "integration of planning processes", "availability of secondary raw materials". As regards the process of supply chain management (and the process of

increasing its integration level) one should look for critical factors that affect supply chain performance the most. The critical factors presented herein are definitely not all the items in their catalogue (set). Nevertheless, the factors verified herein (through a series of experiments) may be a natural axis of integrating activities. This fact is confirmed by the results of simulation experiments, especially in the context of adopted assessment metrics of supply chain functioning. The potential development of the measurement system of supply chain performance will surely be accompanied by extending focus of managers' activity on other factors.

Another dimension of integration (Y axis) refers to the shaping of the total level of supply chain integration as a complex assessment of all the 19 factors and their levels. The analyses performed with respect to four levels of supply chain integration showed that an increase of the level entails better assessment metric values (chapter 5.1.). Selected assessment metrics show positive tendencies (increase in metric value reflects better functioning of supply chain), so one may conclude that supply chain integration is a way to improve its competitive edge.

The scenario of improving the integration level will be developed on the basis of the assumption that the increase in the integration level of all factors is conducive to better supply chain performance and attaining a synergy effect. The synergy effect, so sought after by managers, is possible to achieve when interaction of particular factors is ensured. In practice, various configurations of integration levels for each factor are possible. The synergy effect most certainly will not exist in each configuration. What is more, the so-called negative feedback may occur, which will affect supply chain performance in an adverse way. In order for this plane to be used in the development of an integration scenario it needs to be adapted so that the negative phenomenon could be avoided. The key issue here is the analysis of logical cohesion between particular solutions used at a given integration level for each of the factors. It is obvious that apart from contradictory solutions, which should not be difficult to eliminate, there are a number of configurations that can be used to create solutions the efficiency of which is hard to predict. The authors – in the assessment model of the aggregate integration level indicator – assumed that the aggregate assessment depends on the weakest link. The only parameter that may be influenced (through making a choice) during assessment is the width of integration understood as a percentage share of partners in the supply chain subject to assessment (degree of coverage of supply chain). Such freedom to choose the degree of supply chain coverage with the integration process is a consequence of the need to take into account various strategies of sourcing in everyday management. For example, the implementation of multi-sourcing strategy, which may be optimum for many product items, does not assume progressing integration but rather large flexibility and no dependence on suppliers. On the other hand, the assumption that the result of integration level assessment depends on the weakest results (for factors with the lowest integration levels) means that attempts should be made to achieve a balanced integration increase. Neglecting the selected factors may lead to unfavourable configurations in which the level of one factor is blatantly different than the level of another. In such configurations "bottle necks" may occur as well as the negative feedback mentioned earlier. As it has already been pointed out, this fact needs to be considered by managers developing an adaptive integration scenario. More

importantly, not only the starting configuration of integration level should be analysed, but also the target condition as well (in a given cycle of change project management). In the process of implementing work-intensive and long-term changes, the intermediate states are equally important, as they create the "road map" for the implementation. The negative supply chain performance in the intermediary phase is a threat to partners in the chain. Therefore the threats should be limited by proper – flexible management of change project.

The third dimension of integration (Z axis) refers to the impact of particular actions on the assessment metrics of supply chain operation. As a result of the performed analyses, certain generalizations were made with respect to particular supply chain assessment metrics:

- cash flow grows fastest with low values of integration aggregate measure,
- profitability increases in a linear way as the chain integration level goes up,
- the level of customer service grows fastest once a certain level of integration is exceeded making use of the synergy effect.

On the one hand, the general statements identified herein allow one to formulate forecasts of the impact that potential actions may have on the improvement of: profitability, customer service level or cash flow; depending on the integration level at which the factors under analysis are. Such knowledge is particularly important for managers who need to bring about an "immediate" improvement of the selected assessment metrics. From such perspective, one may say that this dimension has the largest impact on shaping the adaptive integration scenario. On the other hand, the nature of this plane is auxiliary when compared to the two other as it is used to verify efficiency of actions taken on the basis of the two dimensions presented above.

7. CONCLUSIONS

Dynamic development of supply chain integration scenarios against quickly changing external conditions allows one to attain the assumed competitive position.

What is crucial to make it happen, however, is the knowledge of basic dependencies affecting the formation of economic phenomena in such entities. Integration factors and opportunities for shaping thereof are subject to strong internal and market conditions in which the "leading" companies operate, i.e. the entities which have the causative power to build stable supply chains and initiate the process of their integration. The presented papers show that the development of supply chain integration scenario is affected by both actions leading to an increase in its aggregate indicator and the impact on critical factors, as well as those directly contributing to improving the assessment metrics of its functioning.

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CROATIAN COMPETITIVENESS WITHIN EUROPEAN LOGISTICS SPACE

Drago Pupavac
Polytechnic of Rijeka
Vukovarska 58, Rijeka, Croatia
Phone: +385 51 353 737; Fax: +385 51 673 529
E-mail: drago.pupavac@veleri.hr

Filip Golubović
University of Split, Faculty of Maritime Studies
Zrinsko-Frankopanska 38, Split, Republic of Croatia
Phone: +385 21 380 762; Fax: +385 21 380 759
E-mail: filgol87@pfst.hr

Scientific paper

Abstract

World trade between countries is operated within a network of increasingly global logistics operators. But the ease with which traders can use this network to connect with international markets, by large depends on country-specific factors such as trade procedures, transport and telecommunications infrastructure, and the domestic market for support services. The Logistics Performance Index (LPI) and its component indicators provide a unique global point of reference to better understand these key dimensions of logistics performance. The first worldwide LPI was developed by the World Bank to provide a better assessment about how respective countries rank in the managerial and physical effectiveness of their logistics. At the global level in 2010 Croatia ranks 74th, behind developed EU countries, but also behind EU Balkan countries Bulgaria, Romania and Greece. The initial hypothesis of this study is that improving LPI to acceptable levels (LPI > 3.5) would significantly improve trade expansion, ability to attract foreign direct investments, and economic growth. Research results are based on primary and secondary research methods. Findings of this study should provide a realistic way to improve national competitiveness in European and global logistics market.

Keywords: Logistics Performance Index, competitiveness, logistics market

1. INTRODUCTION

Logistics encompasses an array of essential activities — from transport, warehousing, cargo consolidation, and border clearance to in-country distribution and payment systems — involving a variety of public and private agents. A competitive network of global logistics is the backbone of international trade. Unfortunately, many

developing countries have not yet benefited from the productivity gains of logistics modernization and internationalization implemented over the last 20 years by advanced economies.

Improving logistics performance has become an important development policy objective in recent years because logistics have a major impact on economic activity. Data on 2007 and 2012 LPIs indicates that, for countries at the same level of per capita income, those with the best logistics performance experience additional growth: 1 increase in gross domestic product and 2 increase in trade (www.worldbank.org, 2012). These findings are especially relevant today, as developing countries need to invest in better trade logistics to boost recovery from the current economic crisis and emerge in a stronger and more competitive position. When observing competitiveness on a global level, it is clear that Croatia cannot be considered competitive. Croatia is one of lowest ranging competitive countries in the European Union (*The Global Competitiveness Report* 2012–20013). Accordingly, this research will explore the interdependence between Logistics Performance Index (LPI) and Global Competitiveness Index (GCI). To achieve the intended goal, statistical methods of regression and correlation analysis were used.

2. THEORETICAL BACKGROUND AND RESERCH PROBLEM

Logistics is a business process that involves the management and movement of goods and services from the point of origin to the point of consumption. It is a core part of SCM and includes various services such as freight forwarding, multimodal transport by means of air, sea, road and rail. It also provides customs brokerage, warehousing and storage, tracking, and tracing of freight goods services. The logistics industry is more important to the European economy and its citizens than it seems to be to the general public. The share of the logistics industry in Europe is close to 14% of GDP (Freight Transport Logistics Action Plan" – 2007). In 2006 the total turnover of the logistics sector grew to €800- €900 billion. Approximately 40% of the total turnover is accumulated by logistics service corporations, while the other 60% is made by internal activities of companies from other economic sectors (Zelenika, R.& Pupavac, D., 2008). In addition to this, there is a significant shift towards the outsourcing of logistics activities. The development and provision of advanced logistics services varies from country to country. In developing countries, the market for these services is usually small, which can be a major deterrent for companies wishing to establish a market presence. About half of the logistics industry is concentrated in only three countries: Germany, the United Kingdom and France (cf. figure 1).

Figure 1. European logistics location and clusters

Source: Rebitzer, W.D. The European Logistics Market, www.clt.org.me [accessed on the 12/06/2008]

Core economies benefit more from the effects of European integration than peripheral economies. Germany in particular is continuing to position itself as a logistics platform in the heart of Europe. Here an evident issue is imposed: how can peripheral economies, such as Croatian, reap greater benefits from the integration of the European logistics market? The answer to this could be found by exploring the factors which determine the efficiency of transport and logistics system of a particular country.

The first worldwide Logistics Performance Index (LPI) was developed to provide a better assessment of countries' ranking in managerial and physical effectiveness of their logistics. On a global level, a gradual convergence of the LPI is observed. Mostly, it is the outcome of diffusion of transport infrastructures and services, a process favored by the growing presence of global freight carriers, such as maritime shipping companies, global terminal operators, air freight and even third party logistics providers. The LPI is a composite index based on proxy measures for transport and information infrastructure, supply chain management (SCM) and trade facilitation capabilities, which are calculated based on a world survey of international freight forwarders and express carriers. The LPI is based on six underlying factors of logistics performance [4]: (1) efficiency of the clearance process by customs and other border agencies; (2) quality of transport and information technology infrastructure for logistics; (3) ease and affordability of arranging international shipments; (4) competence and quality of logistics services; (5) ability to track and trace international shipments; and (6) timeliness of shipments in reaching destination. LPI values range from 1 (worst) to 5 (best) and show that building the capacity to connect firms, suppliers and consumers is key in a world where predictability and reliability are

becoming even more important than costs. A value of less than 3.0 reflects an array of problems within a nation's freight distribution system causing undue delays and additional costs. For instance, a difference of one point in the LPI is related to two to four additional days of port - hinterland access and a 25% higher physical inspection rate at customs (people.hofstra.edu). High-income OECD countries lead in logistics performances, but developing countries are showing gradual and continuous improvements. They benefit from economies of scale and scope, innovation and technological change in logistics services. On average, the LPI is a good proxy for involvement of each country in global value chains and the friction of freight flows and there is a significant concordance with the location of the world largest container ports. According to the LPI, Germany and Singapore, major global transport and logistics hubs, rank first (Connecting to Compete 2010). At the other extreme are low-income countries, particularly those landlocked in Africa and Central Asia. All developed countries turned out to be top performers. There are also significant differences among developing countries with similar incomes. China, for instance, ranks 27th, while countries in higher income groups, such as several oil producers, tend to perform below what would be expected from their income levels. Developing countries with higher trade performances performed better than those with similar incomes.

The logistics market in Croatia and throughout the Southern and Eastern Europe remains underdeveloped. Croatia currently suffers from high unemployment that has driven down salaries which are now among the lowest in Europe. Negative economic trends and the reduction in real income and purchasing power had a negative effect on the Croatian transport sector. Decrease in passenger transportation in all forms of transport is a continuation of the negative trend started in 2009. In 2012, there is 36.3% less passengers carried compared to 2008. In addition to passengers, in 2012 there was also a decrease in the amount of goods carried (33%) compared to 2008. The amount of transported goods has decreased in all types of transportation. The biggest drop of 40.9% was registered in road transport. The strategic location of Croatia, EU membership and being a maritime entry route for cargo from the Far East to the North Adriatic Ports, creates opportunities for development in this sector. The development of the railway network to strengthen the existing high quality motorway network could help Croatia become both an entry and exit point for goods coming in and out of the EU. The government is focusing on improving the rail network to enable the Port of Rijeka and the neighbouring ports in Koper, Venice and Trieste to be more competitive to the established ports in northern Europe, such as Le Havre and Hamburg. There is €3 billion of planned investments in the Rijeka rail route, 85% of which could be drawn from EU fundings (www.aik-invest.hr).

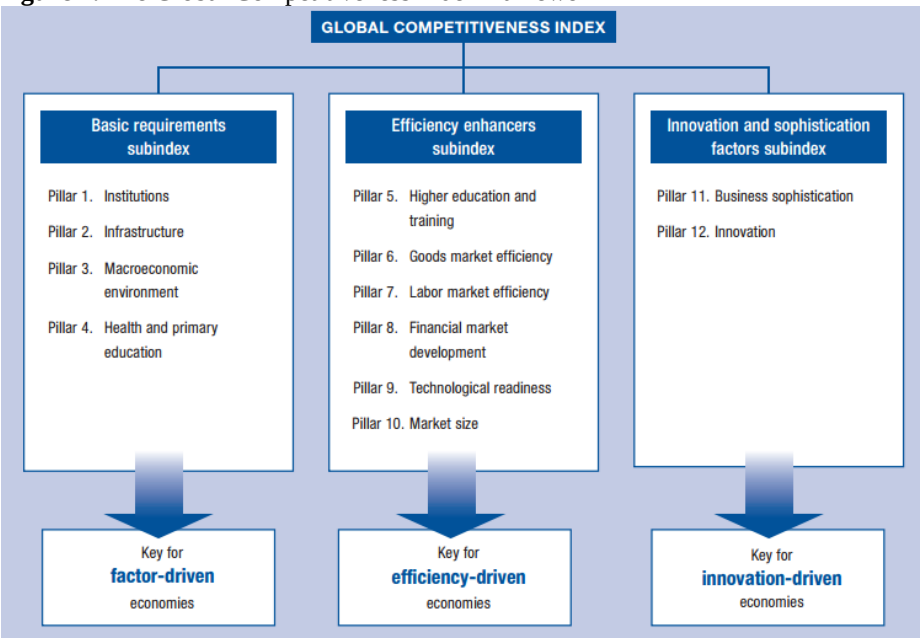
3. DATA AND RESEARCH METHODOLOGY

Data is obtained from the Logistics Performance Index surveys conducted by the World Bank in partnership with academic and international institutions and private companies and individuals engaged in international logistics. Round of surveys in 2009 covered more than 5,000 country assessments by nearly 1,000 international

freight forwarders. Respondents evaluate eight markets on six core dimensions on a scale from 1 (worst) to 5 (best). The markets are chosen based on the most important export and import markets of the respondent's country, random selection, and, for landlocked countries, neighboring countries that connect them with international markets. Scores for the six areas are averaged across all respondents and aggregated to a single score using principal components analysis.

Second source of data is *The Global Competitiveness Report* 2012–20013. The GCI includes an average of many different components, each measuring a different aspect of competitiveness. These components are grouped into 12 pillars of competitiveness (see Figure 2).

Figure 2. The Global Competitiveness Index framework



Source: *The Global Competitiveness Report* 2014–20015, [accessed on the 19/05/2015]

Croatia, and another 20 states are in transition from stage 2 to stage 3, from efficiency-driven economies to innovation-driven economies. The importance of pillar 2 is described as follows (*The Global Competitiveness Report* 2014–20015): Extensive and efficient infrastructure is critical for ensuring the effective functioning of the economy, as it is an important factor in determining the location of economic activity and the kinds of activities or sectors that can develop in a particular instance. Well-developed infrastructure reduces the effect of distance between regions, integrating the national market and connecting it at low cost to markets in other countries and regions. In addition, the quality and extensiveness of infrastructure networks significantly impact economic growth and reduce income inequalities and poverty in a variety of ways. A well-developed transport and communications infrastructure network is a prerequisite for the access of less-developed communities

to core economic activities and services. Effective modes of transport—including quality roads, railroads, ports, and air transport—enable entrepreneurs to get their goods and services to market in a secure and timely manner and facilitate the movement of workers to the most suitable jobs. Economies also depend on electricity supplies that are free of interruptions and shortages so that businesses and factories can work unimpeded. Finally, a solid and extensive telecommunications network allows for a rapid and free flow of information, which increases overall economic efficiency by helping to ensure that businesses can communicate and decisions are made by economic actors taking into account all available relevant information.

This study applied scientific methods common in laboratory work (analysis, synthesis, description, explanation, comparison, induction, deduction), and the main findings are based on statistical methods of regression and correlation analysis. The numerical calculations are performed using *Statistica* software.

4. RESEARCH RESULTS

International trade operates through a network of increasingly global logistics operators who deal with a number of functions in the international supply chains: maritime shipping, air freight, land transport, warehousing, and third party logistics. Globalization has made the demand for logistics services more sophisticated, pushing for integration and diversification of services to help operate uninterrupted supply chains. Countries eager to improve trade logistics may need to reform and modernize border management institutions, change transport regulation policy, and, in some cases, invest significantly in trade-related infrastructure. The key issue — highlighted by the 2007 LPI — is that a trade supply chain is as strong as its weakest link. Determining where the weakest links are and addressing them through targeted development interventions has therefore become a major element of the trade facilitation and logistics agenda. Until recently, policy-makers and private sector stakeholders have not had the data they needed to identify trade constraints or create constituencies for reform. The LPI fills that gap.

Singapore receive the highest ratings in the 2007 and 2012 LPI with scores over 4.13, while Somalia ranks last with a score of 1.34 (see Table 1)

Table 1. LPI ranking and scores selected states, 2007-2012

Economy	**Rank**		**Score**			**% of highest performer**		
	2010	**2012**	**2007**	**2010**	**2012**	**2007**	**2010**	**2012**
Germany	1	4	4,1	4,11	4,03	97,62	100	97,58
Singapore	2	1	4,2	4,09	4,13	100	99,2	100
Sweden	3	12	4,1	4,08	3,85	97,62	98,8	93,22
Netherlands	4	5	4,2	4,07	4,02	100	98,5	97,34

United Kingdom	8	10	4	3,95	3,9	95,24	94,9	94,43
Finland	12	3	3,8	3,89	4,05	90,48	92,6	98,06
France	17	12	3,8	3,84	3,85	90,48	91,3	93,22
Italy	22	22	3,6	3,64	3,67	85,71	84,9	88,86
Spain	25	19	3,5	3,63	3,7	83,33	84,3	89,59
Hungary	52	39	3,1	2,99	3,17	73,81	63,8	76,76
Greece	54	69	3,4	2,96	2,83	80,95	62,8	68,52
Slovenia	57	34	3,1	2,87	3,29	73,81	60,2	79,66
Romania	59	53	2,9	2,84	3	69,05	59,1	72,64
Bulgaria	63	36	2,9	2,83	3,21	69,05	58,8	77,72
Macedonia, FYR	73	100	2,4	2,77	2,56	57,14	56,9	61,99
Croatia	74	42	2,71	2,77	3,16	64,52	56,8	76,51
Serbia	83	75	2,3	2,69	2,8	54,76	54,1	67,8
Bosnia and Herzegovina	87	55	2,5	2,66	2,99	59,52	53,4	72,4
Albania	119	78	2,1	2,46	2,77	50	46,8	67,07
Montenegro	121	121	2,4	2,43	2,45	57,14	45,9	59,32
Somalia	155	162	2,2	1,34	1,34	52,38	10,9	32,45

Source: Author prepared according to: Connecting to Compete 2007,2010, 2012, www.worldbank.org [accessed on the 19/05/2015]

Data from Table 1 show that Croatia ranked 74th in 2010 and apart from the EU countries ranking better than Croatia, Balkan countries with EU membership ranked better as well (Bulgaria, Romania and Greece). In just two years, Croatian progress is evident and significant – it is listed as 42nd, with the LPI above 3. To find out what were the improvements and which should be made in the future for an even better standing, it is necessary to explore the factors which form the LPI (see Table 2).

Table 2. Factors of logistics perfomance for Croatia 2007-2012.

Factors of logistics performance	**2007**	**2010**	**2012**	**2012/2007**
Efficiency of customs clearance process	2,36	2,62	3,06	+0,7
Quality of trade and transport-related infrastructure	2,5	2,36	3,35	+0,85
Ease of arranging competitively priced shipments	2,69	2,97	2,95	+0,26
Competence and quality of logistics services	2,83	2,53	2,92	+0,09
Frequency with which shipments reach consignee within scheduled or expected time	3,45	3,22	3,54	+0,09

Ability to track and trace consignments	2,46	2,82	3,2	+0,74
LPI: Overall	2,71	2,77	3,16	+0,45

Source: Prepared by the author according to http://www.worldbank.org/lpi [access May 19, 2015]

Data from Table 2 show that the greatest improvements were made in the quality of trade and transport-related infrastructure (+0.85), ability to track and trace consignments (+0.74) and efficiency of customs clearance process (+0.7). Unfortunately, this positive trend was broken, so that in 2014 Croatia was ranked as 55th (LPI=3.05), again behind Slovenia, Greece, Romania and Bulgaria [2014]. The afore mentioned confirms that stagnation in a competitive environment actually means a quick loss of competitiveness. In the following, this research will explore the interdependence of GCI and LPI in order to examine positive or negative correlation. Research results are based on the data from table 3.

Table 3. GCI and LPI score of chosen countries

Country	**Score GCI**	**Score LPI**
Germany	5,48	4,03
Singapore	5,67	4,13
Sweden	5,53	3,85
Netherlands	5,50	4,02
United Kingdom	5,45	3,90
Finland	5,55	4,05
France	5,11	3,85
Italy	4,46	3,67
Spain	4,60	3,70
Hungary	4,30	3,17
Greece	3,86	2,83
Slovenia	4,34	3,29
Romania	4,07	3,00
Bulgaria	4,27	3,21
Macedonia, FYR	4,04	2,56
Croatia	4,04	3,16
Serbia	3,87	2,80
Bosnia and Herzegovina	3,93	2,99
Albania	3,91	2,77

Montenegro	4,14	2,45
Somalia	2,50	1,34

Source: Prepared by the author according to *The Global Competitiveness Report* 2012–20013 & Connecting to Compete from 2012.

Data from Table 4 shows the statistically strong and positive correlation between the GCI and LPI.

Table 4. Correlations of GCI and LPI

	Correlations (Spreadsheet1) Marked correlations are significant at p < ,05(N=21 (Casewise deletion of missing data)			
Variable	Means	Std.Dev.	GCI	LPI
GCI	4,50571⁴	0,80975(	1,00000(	0,94315⁹
LPI	3,27476²	0,69446¹	0,94315⁹	1,00000(

Source: Author's calculations

Data in Table 4 confirm the statistically firm correlation between the GCI and LPI (r=0,943). After conducting correlation analysis, a one-dimensional model of linear regression was chosen in the following form:

$$Y = a + bX + u \qquad (1)$$

Where:
X – independent variable,
Y – dependent variable,
u – deviation from the functional relation,
a, b – parameters.

The LPI was selected as an independent variable, while the parameters were evaluated based on statistical data from Table 3. In assessing the value of parameters in function (1) the method of regression analysis was applied, while the numerical computation was performed by *Statistica* software (cf. Table 5).

Table 5. Results of regression analysis

	Regression Summary for Dependent Variable: GCI (LPI.sta R= ,94315947 R2= ,88954979 Adjusted R2= ,88373662 F(1,19)=153,02 p<,00000 Std.Error of estimate: ,27610					
N=21	Beta	Std.Err. of Beta	B	Std.Err. of B	t(19)	p-level
Intercept			0,904341	0,297301	3,04184	0,00670⁹
LPI	0,94315⁹	0,07624⁴	1,09973(	0,08890²	12,3702(	0,00000(

Source: Author's calculations

Regression analysis of the correlation between GCI and the LPI gives the following model of simple linear regression:

$$\mathbf{AP = 0{,}904341 + 1{,}099736\ LPI} \quad (2)$$

Results of regression analysis (cf. Table 4) indicate that there is a statistically significant correlation between GCI and the LPI ($R=0{,}943$; $F(1,19)=153{,}02$; $p<0{,}01$). Correlation between the GCI and the LPI is positive, indicating that the increase in GCI is linked with an increase in LPI. An increase in LPI of 1 leads to an increase in GCI of about 1,0997 in the first year ($B=1{,}099$; $SE=0{,}0889$; $p<0{,}01$). An increase in GCI with 88,37 % of variance can be explained by LPI. If Croatia would raise its LPI in the long term for one index point (from 3,05 to 4,05), it would be ranked among the most competitive countries in the world with the GCI of 5,36. In the short term, it is definitely possible to raise the LPI for 0,5 index points, which would result with the GCI of 4,8 which would put Croatia on a very good 34th place. This would mean a shift of 45 places compared to 2014.

5. CONCLUSION

Increased freight flows have been a fundamental component of contemporary changes in economic systems on a global, regional and local scale. These changes are not merely quantitative with more freight in circulation, but also structural and operational. The application of logistics enables a greater efficiency of movement with an appropriate choice of modes, terminals, routes and scheduling. Countries eager to improve trade logistics may need to reform and modernize border management institutions, change transport regulation policy, and, in some cases, invest significantly in trade-related infrastructure. Logistics advancement will provide the competitive advantage leading to customer service excellence and profits increase.

The perception of individual countries in the setting and management of supply chains can be assessed, as is done by application of the Logistic Performance Index. The LPI is a **composite index** based on proxy measures for transport and information infrastructure, supply chain management (SCM) and trade facilitation capabilities, which are calculated based on a world survey of international freight forwarders and express carriers. LPI values range from 1 (worst) to 5 (best). A value of less than 3.0 reflects an array of problems within a national freight distribution system. In 2012, Croatia raised its LPI above 3 thanks to improvements made in the quality of trade and transport-related infrastructure (+0,85), ability to track and trace consignments (+0,74) and efficiency of customs clearance process (+0,7). This success lasted until 2014, when Croatia dropped to a 55th place in the world ranking.

This study confirmed the statistically significant correlation between the GCI and the LPI. This correlation is strong and positive, suggesting that an increase in LPI leads to an increase in GCI. Accordingly, it can be concluded that if Croatia improves its competitiveness in the European logistics market, it would directly and significantly contribute to an improvement of its competitiveness in the global market.

With the LPI above 3,5, Croatia would be among the highly competitive national economies of the world.

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"smartBOX" - A BUSINESS CONCEPT TOWARDS THE PHYSICAL INTERNET

Hans-Christian Graf
University of Applied Sciences Upper Austria
Wehrgrabengasse 1-3, 4400 Steyr, Austria
Phone: +43 50804/33218
E-mail: hans-christian.graf@fh-steyr.at

Kapplmüller Harald
University of Applied Sciences Upper Austria
Wehrgrabengasse 1-3, 4400 Steyr, Austria
Phone: +43 50804/33259
E-mail: harald.kapplmueller@fh-steyr.at

Professional paper

Abstract

The overall transport volume of parcels and small logistics units strongly increases due to the rising popularity of online trading and supply concepts such as just-in-time delivery. Today's distribution services are inflexible in terms of customer needs and carried out by competing service providers in an uncoordinated manner, leading to inefficient and multiple deliveries and result in a lack of cube optimization. Therefore researchers propose a fully integrated system for autonomous and self-optimized cargo transport which effects reduction of traffic density. At the core of this prototype system which is currently being developed in Austria, is a concept labelled "public freight traffic". This concept will enable private persons to ship their private parcels or luggage. In order to tackle the challenges of small freight mobility especially in urban areas, the project team develops new mechanisms of autonomous traffic optimization together with intelligent business models for cross-sector transport and logistics services. The developments include the design of intelligent containers (so-called "smart boxes") as well as technologies for the branch-wide transport-related information flow. The goal of the project "smartBOX" is to increase overall quality of life and to save resources by creating an intelligent and integrated approach. In order to reach these goals, various system components need to be developed:

- The technical design of the smartBOX as reusable container
- Design of a standardized pooling system including tracking and tracing technology and a business model for intelligent order control and cost splitting. (Providing distance-related transportation rates, covering service provider expenses and ensuring compatibility with current systems.)
- Design of vandalism-proof pick up and drop off terminals to be implemented at public hot spots as well as housing complexes.

- Development of a comprehensive, intermodal transport concept to enable autonomous and bundled transports.

The smartBOX project team therefore investigates the challenges, technical and economic opportunities and the feasibility of an intelligent and integrated system for freight mobility. The findings will serve as a basis for future implementations.

Key words: physical internet, freight mobility, reusable container, intelligent container, small freight mobility, collaborative business models

1. INTRODUCTION

Both, people in rural and urban areas suffer increasingly under the negative effects of the ever-increasing freight traffic implying congestion, traffic fatalities and injuries and a not tolerable rise of environmental impacts. But freight transport is a basic pillar of the European economy and trade. Freight transports deliver goods across Europe rather fast, efficiently, flexibly and cheaply. – Nevertheless there are big needs for further improvements concerning economic and environmental efficiency. The logistics sector is of crucial importance for the European economy and contributes almost 14% to the European gross domestic product (GDP). But logistics processes constantly face big challenges to meet actual megatrends like:

- constant growth in the mail order sector (E-commerce)
- effects of demographic change and advancing urbanization
- impacts driven by automation and industrial initiatives like „Industry 4.0".

These ongoing megatrends ask for sustainable reduction of emissions and higher efficiency especially in the distribution logistics. The logistics branch has to advance along those recent and future trends and changes to contribute to a sustainable competitiveness in Europe.

Based on long term considerations the concept of the "Physical Internet" (PI) meets those demands even facing a growing flow of goods and is currently investigated by different strategic R&D projects from North-American and European initiatives. Modular and standardized loading- and transport devices (like the smartBOX, which are able to communicate among each other and with the logistics infrastructure) and shared assets (e.g. inter-company commonly used nodes and edges in transportation networks) as well as new services and business models play a key role in order to efficiently use the available resources. However, the road from current technical and organizational basic conditions and predominated standards in the logistic branch towards new ideals will be long term and step by step.

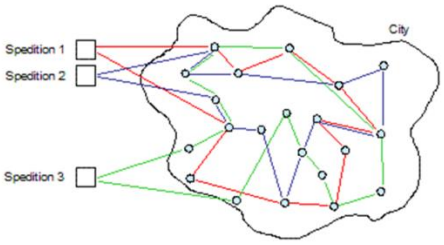
The project "smartBOX" therefore investigates on the basis of a prototype for small goods possible impacts, changes, prospects and risks in a future distribution logistics according to the PI-vision. Therefore, criteria and guidelines regarding aspects of technical and information systems as well as processes are evolved in order to develop a neutral and open business model in the area of distribution logistics for small goods.

For operationalization purposes of the project the broadly diversified aims of the PI are reduced to three main core areas: Optimization of the volume and weight usage,

common usage of resources and the therefore required data and business models. All that is aimed to find possibilities of better bundling and reduction of traffic.

Based on practical analysis of existing market volumes and actual systems general process models, functionalities, logistic services and cost structures for a future PI-realizations are derived. In this context the project "smartBOX" particularly focuses on identifying practicable gaps between proposed visions and the current situation, defining short- and long term measures to adopt the current distribution logistics to assessing prospects and risks. The project "smartBOX" will moreover identify further unsettled research questions. Practical aim is to find a system for greater efficiency in transport and storage, environmental sustainability and traffic reduction.

Figure 1. Competing delivery services presently block the cities



Source: Presentation of automated internet-shopping terminals, Bol 2014

Due to increasing individualization of trade and urgency control in industry the often tried bundling effects of existing logistics service providers are lost, transport fill rates drop and traffic volume increases especially in the last mile. In parallel, deliveries are carried out by competing service providers in an uncoordinated manner so that there are multiple deliveries and a lack of consolidation and concentration effects. Currently, so-called cross-channel transports, which could pool available transport capacities of public, commercial and individual vehicles, are not used. Moreover the lack of standardized pool systems of reusable transport containers (similar to the Euro-pallet pool) induce packaging needs and increased waste, including the associated negative environmental performance, both in the individual and in the commercial sector.

At the same time, the rapid increase in internet-based deliveries also gives rise to additional transport. Anyway, in most cases the personal presence of the receiver is currently required for delivery services. If no one is present on time of delivery, up to two additional delivery attempts occur and/or the way to a pick-up point is required for end-customers. In this case the persons have to take over the last mile of freight transport. In doing so the car is the choice of vehicle mostly. Thus, studies of the mobility behaviour of individual persons have revealed that the mobility of travellers is often urged by the need of the carriage of baggage in the direction of the automobile for ease of handling and comfort.

With a future integrated system for autonomous cargo transport it should be possible to reduce traffic density and simultaneously to promote passenger traffic by developing a system for public freight traffic. Passengers will be getting rid of their luggage or parcels as well as passenger traffic and freight mobility are going to be installed at once. Therefore the project "smartBOX" aims to revolutionize the growing transport needs in the field of freight mobility while increasing scarcity of resources by designing an intelligent and holistic approach. By means of holistic approaches future requirements using new media and information and communication technologies (ICT) will be investigated in the framework of the project "smartBOX".

In the field of ITS ("Intelligent Transportation Systems") numerous approaches from the logistics industry are already available to individually control reusable transport containers (such as ISO containers, industry-specific delivery units, ...). Often these are traceble via radio-frequency identification (RFID) systems. With individual identification each transport unit leaves a digital trail that can be completely traced and documented to the origin of the consignment over several modes of transport. Traceability provides the basis to guarantee reliable transport quality and to continually optimize. Thus, for example, the Unit Load Device (ULD) of Lufthansa and British Airways are completely chipped to load baggage, cargo and mail targeted at wide-body aircraft and on single-aisle aircraft, to control the empties and to target supply of maintenance. This allows the bundling of large quantities of goods to large units, which has the effect that fewer units need to be loaded and ground handling companies can save personnel, time and effort. Also in the field of temperature-controlled logistics, intelligent devices for permanent indoor climate monitoring are now state of the art.

What does not exist so far is the widely use in the end-customer-delivery because cost pressure and competition are particularly high here. However, we observe a drastic drop in prices for electronic components for years that motivate the project team for a technology transfer in small good containers. Logistics and parcel services or railway cargo companies are currently working with (for competitive reasons often incompatible) bar codes for packet identification. A standardized RFID-use should overcome companies' barriers.

2. METHODOLOGY

The project "smartBOX" will provide concepts regarding different system components: (1) Conception of a standardized dual-use container with an intelligent control system and user security access (= the "smartBOX"). This reusable transport container is the central element of the project. (2) Development of a pool system in order to provide availability, exploitation and control of the smartBOX regarding B2B as well as private passenger traffic by using electronic track & tracing methods and web-based communication technologies. (3) Conception of extensively used vandalism proof pick up and dropping terminals in public areas as well as housing complexes (including an adaption for freight transfer in the B2B sector.) (4) Conception of an encroached, intermodal transport system which will realize and bundle transport requirements in order to prevent multiple trips. (5) Conception of IT-

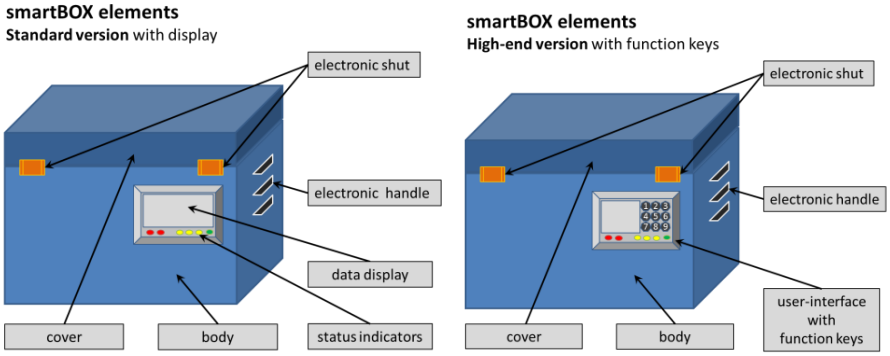
functionality by considering transparency and data privacy for decentralized autonomous subsystems. (6) Conception of business models to provide favourable and distance-related transportation rates, cover service-provider expenses and combine with presently used systems.

3. RESULTS

3.1. Description of the Technical Elements of smartBOX

The central element of the project vision is based on a lightweight, yet sturdy and for all users easily available reusable transport container. Therefore the smartBOX has to be safe, robust, vandalism-proof and to be opened only by authorized persons. The smartBOXes are supposed to be without usage and acceptance barriers in all user groups (so also especially for disabled and elderly persons) and easily obtainable in fixed terminals or by an app on popular mobile devices. Further it should be standardized, thus dimensionally accurate, but available in different standard sizes and modular stackable. It is also important that the smartBOX is a reusable container, which is recyclable and preferable produced in large quantities ecologically.

Figure 2. Technical elements of smartBOX



Source: Functional smartBOX drafts with and without input keys, Logistikum Steyr 2014

The clear identification is ensured electronically by using a RFID chip and optically by a readable number. Another quality of smartBOX is intelligence. Therefore the current transport data and container history have to be saved self-sufficient and could be shown to entitled users on a film screen. An active communication at fixed terminals, with readers in vehicles and in handling stations is also intended. In variant the smartBOX is also directly programmable and trackable via GPS chip. Therefore two initial variants are designed, which are shown in Figure 2.

A summarized criteria catalog lists the demands in detail as follows:

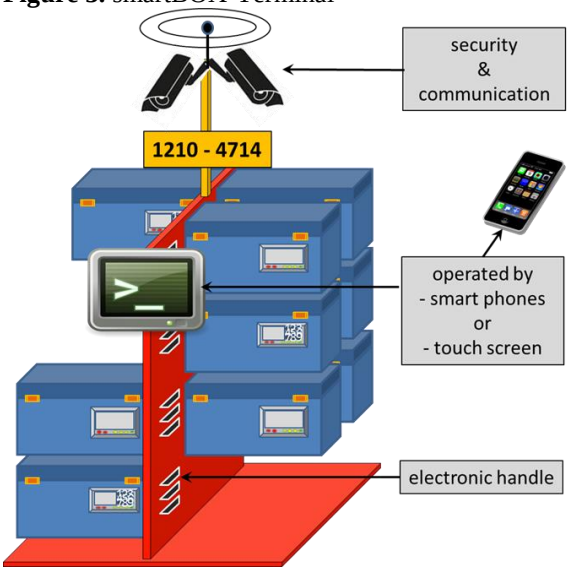
- Safe and stable
    - lightweight, yet sturdy and robust

    - vandal-proof and to be opened only by authorized persons
- Standardized
    - dimensionally accurate, but available in different standard sizes
    - modular stackable
- Ecological
    - preferable produced in large quantities ecologically
    - reusable (packaging is omitted)
    - recyclable
- Individualised
    - electronic identification via RFID
    - optical identification through readable numbers
- Intelligent
    - stores autonomously current transport data and the box history
    - visualisation of stored information on a display (e.g. sender, destination, lead time)
    - active communication with terminals and readers in vehicles
- User-friendly
    - easy to handle
    - without usage and acceptance barrier in all user groups
    - especially for disabled and elderly persons
    - easily obtainable in fixed terminal or by app on popular mobile devices (e.g. Smartphones, Tablets).
    - trackable via GPS

3.2. The Public Feed and Pick-up Terminals

The feed and pick-up terminals are intended for commercial and private use and taking over following tasks: (1) pick-up location for received consignments (mailbox function for packages) (2) buffer storage for empty transport containers and (3) feeding station for outgoing consignments. Furthermore the terminals must be protected against access and have to be easy to use. Therefore contact latches that can be solved electronically only by authorized users are foreseen. Through the terminal each registered user can receive and send consignments (luggage or packages). The terminals are labelled with unique identification numbers (e.g. consisting of the zip code and a serial number) for clear separation. In open spaces, the stations are under video surveillance or housed in rooms with an access code (similar to the garbage room of a residential settlement).

Figure 3. smartBOX-Terminal



Source: smartBOX Terminal draft, Logistikum Steyr 2014

3.3 Process and Transport Model

In contrast to the usual business practice of competing parcel services leading to multiple deliveries to the same destination, the smartBOX system should allow bundling effects and therefore result in measurable reduction in traffic. From today's perspective two traffic models are possible which will be analysed and developed in more detail in later phases of the project.

3.3.1 Model of autonomous Self-guidance

Whenever (commissioned and timed) delivery traffic enters a target area, the pick-up needs at the smartBOX terminals are visualized for the driver (or his dispatcher). If he has free hold capacity in his vehicle, he can autonomously decide to collect a smartBOX and pass it to the next dispensing hub for further intermodal transport. Over there the best provider will be determined for further transport. Thus, the competition of existing service structures remains but the expensive collection and distribution is neutralized.

Traffic-reducing advantage results from the possibility of delivering vehicles (which must perform deliveries in the target area) to automatically recognize the pick-up needs. These try to fulfil them in a traffic neutral fashion.

3.3.2 Model of central traffic control

In this case the vehicles participating in the system are coordinated and charged for collection from a central location. The benefits result from predictable service

times and mathematically optimizing filling levels (e.g. through "Capacitated Vehicle Routing Solution" or models of the "Vehicle Routing Problems with Time Windows - VRPTW") and to enter into better ways to prioritization and emergencies.

The necessary commercial competition in both business models could take place through area-wise announcements for cross-channel logistics by service areas. Special priority should be given to environmentally friendly means of transport like cargo bikes and electrical vehicles. The system smartBOX could even act as driver for the exclusive delivery using ecological vehicles over the last mile.

3.4 Container pool

From the current perspective the responsibility for the provision and for the maintenance of the smartBOX transport container have still to be defined in the framework of the research project. Ideally an international provider of transport container pools should take this task. Existing pool solutions in food and automotive industries can serve as a role mode, whereby the offsetting of a "circulation charge" should be taken into account as a cost element in the transmission fees.

3.5 Business model and Payment

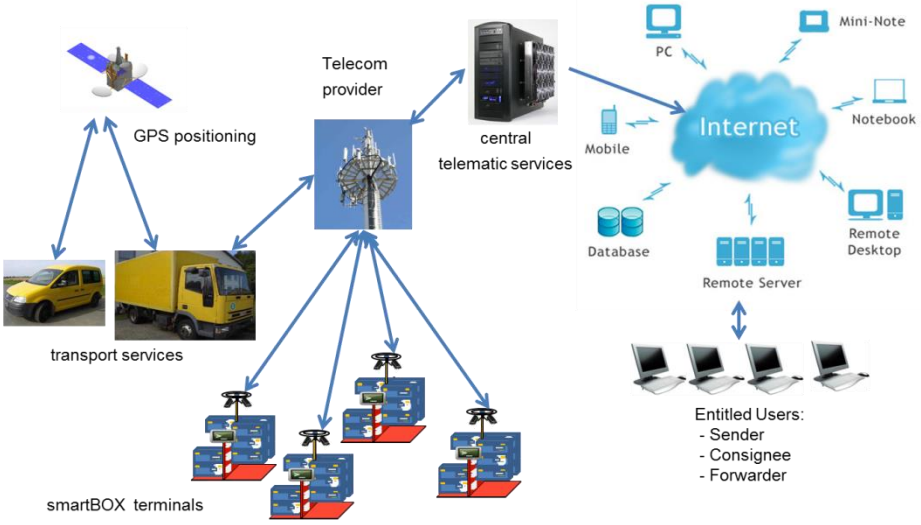
The use of data chips in the smartBOX transport containers enable dynamic tracking & tracing of all transport objects for all system stakeholders (transmitter, receiver, transport service, pool operators ...). This will result in a business model which calculates variable and individual transport prices on the basis of actual costs. Thus costly peripheral areas of central layers are economical to operate on the part of operators. It is expected to also improve the modal split between road and rail in favour of rail. To analyse and to conceive this is also subject of this project. Currently only Internet-based forms of payment are scheduled.

3.6 SmartBOX Information and Communication Technology and the Data Model

The design of the ICT (information and communication technology) infrastructure and the data model are very important in the service concept. On the one hand, the transparency and the real-time availability of information and on the other hand the necessary data protection are decisive for the product's competitiveness or acceptance in this system.

Moreover there are the challenges of decentralized data storage on the RFID chips of the smartBOX container, but also the necessary central information. For example, transmitter data (address, authorized data ...), recipient data (address, authorized data ...), container data (ID, track & trace, maintenance, availability ...) and service history (production date, maintenance data ...) have to be managed on the SmartBOX – Chip.

Figure 4: Information and communication structure in the system smartBOX



Source: Smartphones as enabler of Supply Chain Event Management, Posen 2014

The importance of ICT in the system smartBOX is clear primarily by the mass volume of the expected amounts of data and the interactive data streams, which have to be processed in real time.

4. CONCLUSION

The smartBOX system enables a demand-oriented, cross-regional bundling of the small goods transport by different, currently competing service providers with the aim of reducing traffic and increasing the comfort for industrial, commercial and residential customers. Widespread and public available reusable transport units reduce packaging needs. Joint system performance and responsibility (liability) replace company-specific business models. The Internet of Things with concepts of decentralized data storage and autonomous optimization strategies enables a public small goods transport. This has the effects that, the mobility of travellers improve for reasons of easy handling and greater travel comfort and made independently of cars.

From consumer's point of view the greatest innovation is to receive or send small articles at or from home, without having to be physically present for the acquisition or the transfer. Beyond this the way to a collecting or delivery point is omitted.

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POLICY FRAMEWORK FOR BUSINESS CONCEPTS AND MODELS OF URBAN/CITY LOGISTICS OF A DEVELOPING ECONOMY

Adebambo Olayinka Somuyiwa
Associate Professor of Transport Management
Department of Transport Management
Faculty of Management Sciences
Ladoke Akintola University of Technology
P.M.B. 4000
Ogbomoso, Oyo State, Nigeria
Phone: +23 48 033 570 837
E-mail: iseoluwa89@yahoo.com

Scientific paper

Abstract

Urban logistics is indispensable to the economy as it moves not only the goods and passenger but also the concomitant effects of pollution, traffic congestion and noise are major issues of concern. These kinds of condition not only affect the quality of life in urban areas, but also the future city development. Sequel to these, the paper sought to analyse the effect of traffic congestion, noise pollution and other negative externalities on city/urban logistics. This is with a view to determining significantly effect of traffic congestion and other negative externalities on city/urban logistics through business performance. Data for this paper were both primary and secondary, that were collected from various respective agencies. Mostly the primary data were number of vehicles along designated routes; industrial areas, information on negative externalities (Noise, Odour, etc), which were analysed using parametric statistical techniques. Findings revealed that major routes were used by vehicles/motorists as a result of growth and diffusion pattern of industries of different types. Correlation results of these negative externalities indicated range of correlation values of between 0.3 to 0.74, Analysis further showed differential in ranking of industrial areas, based on certain factors identified and discussed, to serve as pointer to where attention should be focused in proposing business concepts/models for urban/city logistics. The paper recommended sustainable transport environment and city development in an holistic manner within the concepts of People, System and Organisation (PSO), with emphasis on internal consistency and complementarity with other policy areas in the economy and the environment.

Key words: Framework, Business, Models, City and Developing

1. INTRODUCTION

The objective of business logistics is to deliver goods/products at reasonable time and satisfy consumer's requirements. In urban contexts, city logistics have been developed for more than fifteen years, providing solutions and methods to support public authorities as well as other stakeholders in urban freight transport planning and management (Taniguchi et al. 2001). Nowadays, two definitions of city/urban logistics are retained. The first is that of Taniguchi et al. (2001) who define city logistics as ''the process for totally optimizing the logistics and transport activities by private companies in urban areas while considering the traffic environment, the traffic congestion and energy consumption within the framework of a market economy''. The second, more related to the vision of Ambrosini and Routhier (2004) and Anderson et al. (2005), is not related to the notion of optimization but to organization. In this sense, we can define urban logistics as the pluri-disciplinary field that aims to understand, study and analyze the different organizations, logistics schemes, stakeholders and planning actions related to the improvement of the different goods, transport systems in an urban zone and link them in a synergic way to decrease the main nuisances related to it. Different stakeholders are seen in urban logistics, having different aims and thereby constituting difficulties for collaborative actions. Public stakeholders (politicians, city planners, public transport managers, regional or national technical services) are on a collective welfare vision and aim to reduce the main nuisance attributed to freight transport, i.e., congestion, pollution, global warming and noise without penalizing urban areas and also while creating employment when possible. Private stakeholders (shippers, transport and logistics operators, retailers, wholesalers, craftsmen, real state stakeholders, tertiary activities, etc.) are on an economic efficiency vision and aim to reduce costs and/or increase service quality, of course with an eye on the environment but not as a primordial criterion.

The main findings of this report show that the most suitable logistic solution is defined not only by the business characteristics, but also by the delivery, product and city area features (logistic profile), as well as the policies adopted/to be adopted for the city. It is the combination of these three pillars that constitute the backbone of the decision making for best urban logistics solutions (TURBLOG, 2011). As Ogden (1992) states the "explicit consideration of urban goods movements has the potential to contribute in a useful and positive way to achieving both the goals of urban transport and some of the broader goals of urban policy and planning". Though, the movement of goods and passengers is indispensable to the economy of the city; the concomitant effects of pollution, traffic congestion and noise are major issues of concern.

According to Marcario (2007), there are factors to consider in urban modeling logistics (agent needs, characteristics of the urban area and characteristics of the products/type of delivery).Even though urban areas and freight movement activities are different around the world, they all have in common that they are complex and difficult to understand (Dablanc, 2011).For the characterization of the city area it is necessary to identify the features that can represent any possible constraints, but also give a picture of the actual state of the art in terms of logistic conditions, such as

commercial density and homogeneity, logistic accessibility, or if there are any restrictions applied. The product characteristics are the ones that can determine the type of vehicle to be used or if there are any restrictions, such as easiness of handling and special conditions; and finally the agents' needs or delivery profiles (for example, frequency and urgency of deliveries).However, building a model that will work for all operational urban logistics may be difficult and unrealizable. First, in order to present a broad variety of urban logistics practices around the world, both in developed countries as well as in less developed countries. Each city is also different with regard to its characteristics (for instance size, important economic sectors, transport infrastructure and traditions). Sequel to these, the paper sought to analyse the effect of traffic congestion, noise pollution and other negative externalities on city/urban logistics.

2. MATERIALS AND METHODS

Policy framework for business concepts and models within the context of Urban/City logistics is of academic interest and theoretical importance, especially in developing economy. This is predicated on the fact that most research work have being on freight and passengers movement in both quantitative and qualitative terms, with no emphasis on the aspect that can effectively and efficiently harness the existing situation within the ambit of business concepts towards environmental friendliness and general sustainable city development. Sequel to this, the paper attempts to propose robust policy framework for business concepts in a megacity of a developing economy with the aim to harnessing city development strategies. Data for this paper were both primary and secondary, that were collected from various respective agencies. Mostly, the primary data were number of vehicles along designated and chosen routes, industrial areas, information on negative externalities and others. All these were analysed using parametric statistical techniques that involved Pearson Product Moment Correlation (PPMCC), multiple regression and analysis of Variance (ANOVA).

3. STUDY AREA

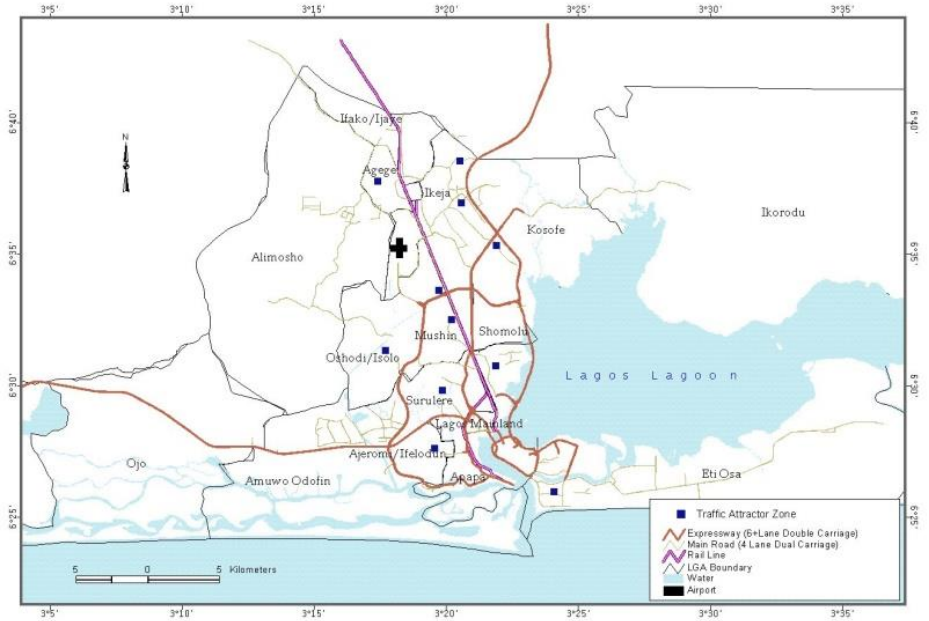
Lagos metropolis is located in southwestern Nigeria. The boundaries of the area is the territory within latitudes 6°23 N and 6°41°N and longitude 3°9°E and 3'28E. Metropolitan Lagos, however, constitute less than 2.5% of Nigeria's total land area of 923,768km²; meanwhile, Lagos accommodates over 6% of Nigeria's total population of 1991 National Census. The metropolitan area accounted for the seventeen out of the twenty local government areas in Lagos State (Fig 1).

Basically the state lies on low lands, with about 17,500 hectares of built-up area of which residential areas occupy the single largest proportion of 8, 739 hectares (51.9%), Commercial 821 hectares (4..8 %), Industrial, 1,444 hectares (8.4%), Institutional and special use 2,366 hectares (13.7%) open spaces 453 (2.6%) and Transportation 3,205 (18.6%) (Olayiwola, et al, 2005). It is interesting to note that

the population characteristics of the state are heterogeneous with most parts of the nation being represented. Again, despite the relocation of the Federal Capital to Abuja, Lagos State remains, undoubtedly, the economic nerve centre of the country. It harbours almost all the headquarters of the multinational companies in the country.

Lagos, occupies a pre-eminent position based on all urban indicators, most especially demography. It should be noted that all other cities are relatively small in terms of commercial, industrial and trading activities in comparison to Lagos. Demographically, the density of Lagos is much higher than other cities in Nigeria. According to Taiwo, (2005), while Nigeria's population density is 100 persons per square kilometre (psk) that of Lagos is about 2,400 persons/ km² with annual population growth rate of between 5.0 to 5.5%.

Figure 1. Metropolitan Lagos



Source: Encarta, (2013)

In terms of transportation, Lagos area is naturally endowed with navigable creeks, lagoons and water body that are suitable for urban transit services. It also has rail line that links the commercial southern part of the city with the dormitory settlement of the North. As a result, Lagos has the potential of benefiting from a seamless transportation system. Ironically, road transport dominates more than 90 percent of all intra -urban movement (Oni, 2004). According to Taiwo (2005) there are about 2,600 km of roads in Lagos. These roads are frequently congested with over 1 million vehicles on a daily basis. Lagos has about the highest national vehicular density of over 222 vehicles/km against country average of 11/km. The major identified corridors with predominant heavy vehicular traffic are Lagos- Abeokuta road, the Lagos-Badagry road axis and the Ikorodu road.

3.1. Industrial structure of Lagos metropolis

Lagos is the most advanced and Industrialized metropolitan in the country and sub Saharan Africa. Its people enjoy a very high standard of living. Basic commodity oriented industries play a key role in the Lagos economy, making Lagos a strong market for high value processed consumer goods. Transportation, communication and trade are in the suburb of the state. Farming is concentrated in the suburb of the state. The leading commodities produced in these parts of the country are vegetables, daily products and grain, while other substantial proportion are brought from other parts of the country because of the availability of market. The economy of Lagos is heavily oriented towards international trade and is open to foreign investments (Somuyiwa, 2012).

The Lagos industry as well as the economy as a whole is undergoing a rapid restructing process during the past decade following a relatively suitable political climate. The business sector is traditionally based on raw material industries such as paper and pulp, iron and other metals. However, the main competitive factor of the country today is knowledge and the flexible uses of knowledge, even the supply of indigenous raw materials are still important elements of the industry. This is witnessed by the city's very fast expansion in the telecommunication industry. There are many industrial companies in Lagos. These are shown in table 2.1 with their relative percentage share of industrial grouping.

Table 1. Composition of Industrial group in Lagos metropolis

Industrial group	Composition (%)
Engineering	14.2
Forest products	6.3
Chemical	34.4
Food	35.7
Others	9.4

Sources: Manufacturing Association of Nigeria (2011); Lagos Chambers of Commerce and Industry (2011; Somuyiwa,A.O (2012)

4. LITERATURE REVIEW AND CONCEPTUAL DISCOURSE

4.1. Concepts of business logistics

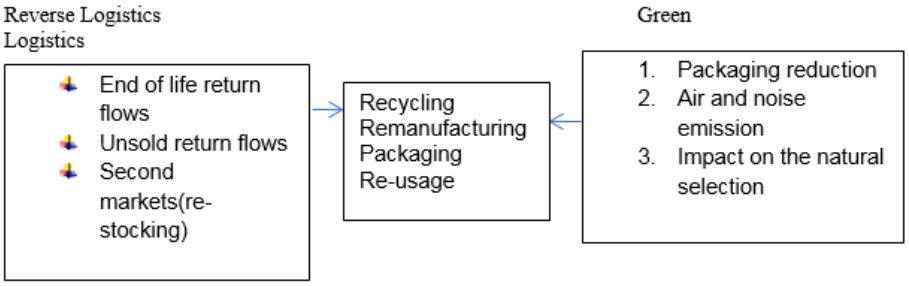
In this field, there are several concepts like the eco-conceptionand eco-design (Michelini & Razzoli 2004; Ademe, 2006), the reverse distribution (Carter & Ellram 1998) and the reverse logistics (Rogers & Tibben–Lembke, 1999). Eco-conception and eco-design (related to product design, building and infrastructures with environmental respect targets) are similar concepts that have become popular in the 1990s decade (Michelini & Razzoli, 2004; Le Pochat et al. 2007). Eco-designing products and eco-conceiving infrastructures for logistics purposes encourage a global approach designed to prevent or minimize impacts emerging throughout the whole

life cycle of products and infrastructures concerning all types of environmental impacts.

In GrSCM, another important concept is that of reverse logistics, defined by Lambert and Riopel (2003) as the environmentally efficient practices of recycling, reusing and reducing amounts of material used. Dekker et al. (2004) refer to it as the logistics process that concerns the integration of used and obsolete products back into the supply chain as valuable resources. According to Rogers and Tibben- Lembke (2001), it is important to distinguish the green logistics and the reverse logistics concepts because they do not follow the same schemas, although several common points can be found (see Fig. 1. The vision of Green logistics involve eleven domains, i.e. (1) energy and (2) materials conservation,(3) efficient land-use, (4) traffic and congestion reduction, (5) air, (7) water (8) visual, (9) smell and (10) acoustic pollution reduction and waste management, for both (10) conventional and (11) hazardous materials.

Another ‘‘global vision’’ of reverse logistics is that of Lambert and Riopel (2003), who proposed a combination of reverse distribution, green logistics and reverse logistics measures and approaches and where the definition of each component does not exactly meet that of Rogers and Tibben-Lembke (2001).

Figure 2. Connections between reverse logistics and green logistics



Source: according to Rogers & Tibben-Lembke (2001)

4.2. Business models for urban logistics

Diversity in the available definitions poses substantive challenges for delimiting the nature and components of a model and determining what constitutes a good model. It also leads to confusion in terminology, as business model, strategy, business concept, revenue model, and economic model are often used interchangeably. Moreover, the business model has been referred to as architecture, design, pattern, plan, method, assumption, and statement (Morris at al., 2003).

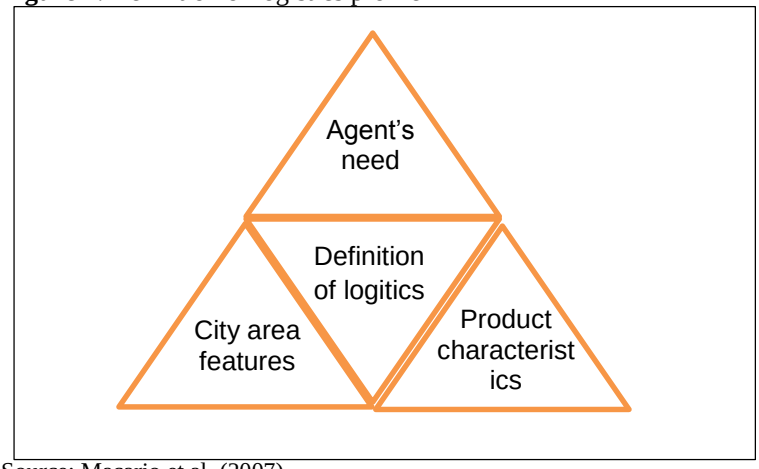
Quantification of the consequences of City Logistics initiatives is necessary for their evaluation and planning. Predicting the impacts of City Logistics initiatives for evaluation purposes requires modelling to be undertaken. Models should describe the behaviour of the key stakeholders involved in urban freight transport. They should also incorporate the activities of freight carriers including transporting and loading/unloading goods at depots or customers.

Models must also describe the traffic flow on urban roads for freight vehicles as well as passenger cars. Models are also required to quantify the changes in costs of logistics activities, traffic congestion, emissions of hazardous gases, and noise levels etc. after implementing City Logistics initiatives.

At the moment, models are limited in their ability to quantitatively predict all the impacts of City Logistics measures. This is because urban goods movement is a very complex system with many stakeholders. Existing mathematical modelling approaches that have developed are currently not sufficient for fully describing entire urban transport systems. In particular, the interaction between stakeholders is not well represented in existing models. Another difficulty encountered when modelling City Logistics comes from the fact that City Logistics involves the economic activities of private companies and vehicle flows on road networks. It is quite difficult to deal with both aspects of logistics activities in a single model. In addition, model calibration and validation is not easy in real situations, because of the lack of appropriate data describing current goods movement patterns. Osterwalder & Yves Pigneur (2010) itemized the followings to be considered before the construction of the model:

- the products and/or services to be provided,
- the means by which such products/services will be provided,
- the mechanisms by which opportunities could be exploited,
- the different actors / agents, roles and relationships,
- the financial flows, investments and incentives.

Figure 2. Definition of logistics profile



Source: Macario et al. (2007)

There are four key stakeholders in city logistics: 1) shippers (2) Freight carrier (3) Residents (consumers) (4) Administrators .Shippers are the customers of freight carriers who either send goods to other companies or persons or receive goods from them. Shippers generally tend to maximise their levels of service, which includes the cost, the time for picking up or delivering, and the reliability of transport as well as trailing information. The reliability of delivering goods has become more important

for Just-In-Time transport systems. There are two types of reliability; (a) delivery without any damage to the goods, (b) delivery without any delay with respect to designated time at customers.

Freight carriers typically attempt to minimise the costs associated with collecting and delivering goods to customers to maximise their profits. There is much pressure to provide higher levels of service to customers at a lower total cost. This is especially important when carriers are requested to arrive at customers within a designated time period. However, freight carriers often face difficulty in operating their vehicles on urban roads due to traffic congestion. This has led to the inefficient use of trucks, where smaller loads are being transported and trucks often have to wait near the location of customers when they arrive earlier than the designated time (Somuyiwa & Dosunmu 2008).

Residents are the people who live, work and shop in the city. They do not welcome large trucks coming into local streets, never the less these vehicles carry commodities that are necessary for them. They would like to minimize traffic congestion, noise, air pollution and traffic accidents near their residential and retail areas. Within the commercial zones of urban areas, retailers want to receive their commodities at a convenient time for them. However, this sometimes conflicts with residents who desire quiet and safe conditions on local roads. City administrators attempt to enhance the economic development of the city and increase employment opportunities. They also aim to alleviate traffic congestion, improve the environment and increase road safety within the city. They should be neutral and should play a major role in resolving any conflicts among the other key stakeholders who are involved in urban freight transport. Therefore, it is the administrators who should co-ordinate and facilitate City Logistics initiatives (Somuyiwa, 2012 and 2014).

There are three general types of network models necessary for predicting the effects of City Logistics initiatives, (a) supply models, (b) demand models and (c) impact models. Supply models predict the level of service of the freight system based on network characteristics and demand. Demand models predict the demand for urban goods movement based on industry and resident characteristics as well as the level of service. Impact models predict the financial, energy, social, environmental and economic impacts of City Logistics schemes based on the predicted demand and level of service. There are computer based models and manual models.

4.3. The need for business model

Furthermore, urban freight is strongly interrelated with many other aspects of the urban system: urban passenger system, land use, regional development, socio-economic environment, employment, etc. Thus, it is necessary, when considering urban freight planning, to devote some effort towards understanding its integration within urban mobility planning. As pointed out by Macário and Caiado (2005), acting on urban logistics domains implies intervening in different aspects of urban mobility management, particularly institutional, regulatory, social, infrastructural and technological, therefore requiring the joint and coordinated action of the different stakeholders in the urban logistics arena. Understanding the relationships between the agents of the logistics activities and the major elements that influence the urban

logistics is very important to know the functioning of the urban system and define the most feasible "logistic business".

Osterwalder (2004) developed a model that was successfully applied in large corporations. According to TURBLOG,2011: The logic within this methodology is to describe the business model through nine building blocks that show how an organization creates, delivers, and captures value. Infrastructure Management: how the company efficiently performs infrastructural or logistical issues, with whom and as what type of network enterprise;

Product: what business the company is in, the products and the value propositions offered to the market;

Customer Interface: who the company´s target customers are, how it delivers their products and services, and how it builds a strong relationships with them;

Financial Aspects: what is the revenue model, the cost structure and the business models' sustainability.

Another important structure of business model can reflect the characteristics itemized below:

- Determination of whom the organization create value
- Factors that can add value by the organization to customer-efficiency, customization, reliability, price, cost reduction and accessibility.
- The channel of reaching the customers-Direct sales, whole sales and the informal channels.
- Personal relationships
- Technology and Innovation
- Cost Associated with Logistics Business Models
- Fixed costs, Variable costs and sunk costs.

4.4. Government policies in urban logistics models

The government has roles to play in urban logistics in terms of policy regulation and enforcement. Enforcement and promotion, e.g. law and regulations enforcement; Traffic management (vehicle), e.g. vehicle size/type and time window restrictions for vehicle emissions movement standards, subsidies for low emission vehicle, fuel taxes; Access conditions, e.g. loading and unloading duration, time and access restrictions; Land use management, e.g. zoning for logistic activities, land use pricing/subsidies; Public infrastructure, e.g. new infrastructure for freight, truck routes (Somuyiwa 2012 and 2014).The policies targeted to urban logistics that a city can adopt are;

Environmental impacts

Reduce pollution;
Reduce the freight vehicles trips (- km);
Reduce noise;

Social impacts

Improve the quality of life;
Reduce accidents;
Reduce congestion;
Improve working conditions.

Rationalizing the urban supply with the ambition to reduce the negative consequences of the multiplication of movements (Taniguchi et al. 2001).
• Maintain the commercial activity and craftsmanship in cities, guaranteeing satisfying conditions for their supplying (Dufour et al., 2007).
• Set in coherence the regulation on deliveries inside the urban transport perimeter (Dablanc, 1998).
Take into account the needs in surface necessary to sustain the activities of urban logistics.
• Lead a reflection on the existing and future infrastructures in the perspective of a multimodal offer. The goal is to mix transports and logistics activities of all kinds of shops (hypermarket, supermarket, convenience store). To cope with this many various needs supply chains are reset, taking into account three dimensioning factors:
• The delivered volume: if a hypermarket needs the deliveries of ten articulated vehicles a day, a small shop will only need ten palettes, and sometimes not even every day
• The delivery frequency: the suppression of storage on the selling spot imposes a just-in-time organization, increasing the number of deliveries and thus the time spent by vehicles in the city.
• The location of the shops in the delivery route: their position relatively to efficient transport infrastructures, the accessibility will impact the delivery time.

4.5. Areas of considerations to excel in business logistics

There were indications from extant research that 'business partnerships were successful because they were implemented through strategic alliances between the companies and the municipality. Of all the logistics activities of production, distribution and supporting activities, distribution is the strongest followed by production and lastly supporting service (TURBLOG, 2011).

Moreover, some business concepts were only effectively implemented because they were sustained by public administration policies, which provided availability of warehouse spaces or accessibilities and, in some cases, financial incentives, resulting in partnerships with the municipality or other government administrations. In order to meet the municipality environmental requirements and restrictions, and also looking forward towards improving the service performance, some companies developed joint ventures to develop these new services.

Some business models combine more than one activity such as the Beijing case study regarding the Tobacco Logistics Centre, which performs a uniform storage, centralised sorting and graded distribution of tobacco for the whole city (Somuyiwa, 2012 and 2014).

Some hauliers operating in a UK pallet network noted that they make their deliveries within a specific postcode area where freight comes in overnight and has a short turn-around time to ensure next day delivery within the specific time window to deliver that freight.
Product charateristics: Size, weight, holding conditions, special conditions, fragility and perishability. Vehicle routing and scheduling problems (VRP) involve an optimisation process of assigning customers to trucks and determining the visiting

order of customers and routes of vehicles. The basic information needed for the VRP is the location of customers, road network conditions, travel times, traffic regulations, etc.

- Company and logistics relationships
- Urgency of deliveries
- Frequency of deliveries
- Vehicle weight and size
- Route planning in delivery.

4.6. Factors that inhibit business concepts and models for logistics

Other important factors that hinder their work are economic and political structures, for example local authority civil servants are responsible for the planning procedures, but it is the political representatives that are responsible for the decision making. Furthermore, historical reasons and cultural traditions could have great influence on the planning procedures. Often urban deliveries are made to premises that have undergone a change of use, for example a small high street convenience store may occupy premises that were constructed some 50 years ago for use as a hairdressers, and therefore delivery access to the store is limited since it had never previously been required from the outset. Others are: indiscriminate parking, collision problem, right of way, carriage of passengers along the road, ceremonies & blocking the road, government's inability to provide bridges, fill potholes/rehabilitate it, incompetent drivers, incessant break down of vehicle as a result of poor maintenance.

5. ANALYSIS AND DISCUSSION

This section presents and discusses results and various analytical tools used as previously mentioned in the methodology section. These techniques include descriptive statistics, correlation coefficient multiple regression and paired t-test order ranking for the Industrial areas. Similarly those routes that were mentioned in the methodology section were used to count the number of vehicles, which was later used as surrogate for transport infrastructure that is dominant factor in the Logistics activities of any city. In furtherance to this, counting along the major routes revealed that, Ikorodu road, Third mainland, Lekki-Epe axis, Eko Bridge, Western Avenue and Agege motor road are often being used by these vehicles in that order; as shown in table 4. 1

Table 4.1. 12 hours traffic count on selected roads in metropolitan Lagos

Roads	Nos. of vehicles in both direction (12 hours traffic counts)	Nos. of vehicles in both direction p/hour	Average volume/capacity v/c ratio

1.	Third Mainland Bridge	356,175	31,355	9.9.1
2.	Carter Bridge	97,982	8,212	1.9:1
3	Eko Bridge	297,360	24,254	5.2:1
4.	Western Avenue	254,670	22,112	4.3:1
5.	Murtala Mohammed Way	76,512	6,234	2.5:1
6.	Herbert Macaulay Way	101,345	13,112	3.5:1
7.	Ojuelegba – Mushin	94,355	8,012	1.6:1
8.	Ikorodu Road.	398,248	32,231	4.8:1
9.	Lekki-Epe Axis	321,346	28,654	5.8.1
10.	Agege Motor Road	165,123	21,231	3.7:1

Sources: LAMATA (2013)
Author's field survey (2015)

Interestingly, the pattern observed is due to the connection between these route and some of the industrial areas. For instance, Third mainland, Ikorodu road and Western avenue are connected to Apapa and other CBD Zones. While Western Avenue and Agege motor road are linked to Ikeja. Consequently, they are been used to facilitate logistics activities. Similarly, Agege motor road is often links adjourning state (Ogun State) which has been enjoying limp frogging advantage of diffusion of industrial pattern from Lagos metropolis like that of Lekki axis. In this case, the route equally enjoys the proposed developmental economic programmes like Free Trade zone, Export processing zone and Lekki port.

Similarly, in line with the cardinal thrust of this paper; to evaluate major environmental concerns of negative externalities, Pearson Product Moment Correlation Coefficient (PPMCC) was adopted and the result indicated a moderately low and high but positive values that devoid multicolinearity and autocorrelation as revealed by Durbin-Watson statistics that showed 1.721.This in turn confirmed that these variables are reliable and suitable for correlation analysis with number of vehicles as dependent and negative externalities as independent variables. The major environmental concerns of negative externalities as identified by Hospitals and medical centers around and along the sampled route are highlighted in table 4.2.

Table 4.2. Variable list description of major environmental concerns of negative externalities.

Variables	Description
NOISE	Noise
POLLUT	Pollution
ODOUR	Odour
ACCIN	Accidents/Injury
HEANA	Headache/Nausea
CHIDIS	Children Diseases
PSYDIS	Psychological Disturbance
SKIRR	Skin Irritation
NOVEH	Number of Vehicles
LUNGP	Lungs Problem
EARPR	Ear Related Problems

Source: Author's Field Work (2015).

It is interesting to note that number of vehicles (NOVEH) is a surrogate for transport infrastructure and tangentially for negative externalities, consequently, is dependent variable. The rationale is predicated on the fact that, the more road is accessible the more is prone to all aforementioned environmental factors. Table 4.3 reveals the descriptive statistics for variables of the major environmental concerns.

Table 4.3. Descriptive statistics for variable of the major environmental concerns of negative externalities.

S/No	Variables	Mean	Standard Deviation
1	Noise	41.62	13.64
2.	Pollution	30.22	11.10
3.	Odour	28.31	10.14
4.	Accidents/Injury	9.17	6.75
5.	Headaches/Nausea	21.05	7.31
6.	Children Diseases	4.33	2.17
7.	Psychological Disturbance	17.19	5.16
8.	Skin Irritation	2.75	1.05
9.	Lungs Problem	4.12	2.34
10.	Ear related Problems	3.11	0.16

Source: Computer Analysis based on Author's Field Survey (2015)

Based on this table, Noise has highest value at mean and standard deviation, which indicates that, is the most prominent environmental factor that affects the inhabitants. This is followed by pollution, while skin irritation with 2.75 and 1.05 as mean and standard deviation respectively brought up the rear. In table 4.4 however, the correlation co-efficient between NOVEH (Number of vehicles) and noise is very high (0.721). This shows that there is high and positive linear relationship between these variables. It implies that the more the higher the number of vehicles the more the noise.

Table 4.4. Correlation co-efficients between the dependent and independent variables

	NOISE	POLLU	ODOUR	ACCIN	HEANA	CHIDIS	PSYDU	SKIRR	LUNGP	EARPR	NOVEH
NOISE	1.000	0.614	0.210	0.132	0.542	-0.142	0.572	-0.012	0.316	0.415	0.721
POLLUT		1.000	0.614	0.240	0.536	0.561	0.591	0.325	0.432	0.534	0.641
ODOUR			1.000	0.322	0.432	0.548	0.356	-0.213	0.446	0.613	0.118
ACCIN				1.000	-0.227	-0.124	0.233	-0.341	0.581	0.732	0.216
HEANA					1.000	0.611	0.536	0.014	0.593	0.578	0.561
CHIDIS						1.000	0.021	0.121	0.711	0.732	0.484
PSYDIS							1.000	0.318	0.536	0.711	0.532
SKIRR								1.000	0.562	0.581	0.351
LUNGP									1.000	0.334	0.431
EARPR										1,000	0.362

NOVEH											1.000

Source: Computer Analysis based on Author's Field Work (2015)

However, there is a very low relationship between, Odour and NOVEH (0.118), this implies that the stench from the area might not be due to the numbers of vehicles that ply the routes, which is related to congestion, but to some other factors which can be relative low sanitation and industrial activities in those areas. Similarly, there is negative relationship among few variables that include ODOUR and SHIIRR (-0.213); NOISE and SKIRR (-0.012); ACCIN and SKIRR (-0.341). Apart from the fact that these values are low, they only expressed direction of their relationship. In the same token, table 4.5 equally reveals regression coefficients.

Table 4.5. Regression analysis model for the negative externalities along the sampled routes

R	R^2	Adjusted R^2	Std Error of the Estimate	F. Ratio	Sig.	Durbin Watson
.0856	.733	.721	1.9431	142.21	0.00	1.548

Source: Computer Analysis based on Author's Field Work (2015)

The result of multiple regressions showed .733 that implies 73.3% of the level of explanation of all those externalities. Therein Durbin Watson statistics was computed to ensure that there was no violation of the assumption underlying the use of regression analysis as regards the existence of auto-correlation among the independent variables, before conducting the regression analysis. The result showed 1.679, which is close to acceptable standard of 2.0. This indicates that there is no auto-correlation problem in the model. Hence the explanatory variables are fit to predict the pattern of negative externalities in those sampled routes and industrial areas.

Moreover, for effective planning process, paired t-test was adopted for ranking of these industrial zones, such that it will be easier to know what, where and how Business logistics model and concept can be adopted. This is revealed in Table 4.6

Table 4.6. Ranking of industrial zones according to paired t-test

Industrial Group	**Apapa**	**Ikeja**	**Marina**	**Victoria Island**	**Lekki Axis**	**Ikoyi**	**Agege Areas**
Food	1	1	2	2	2	2	1
Engineering	1	2	2	2	1	2	2
Chemical	1	1	1	1	1	1	1
Forest product	3	2	3	3	1	3	2

Others	2	1	3	3	1	2	1

'I' indicates the highest mean flow, and "4" is the lower
Source: Based on author's field survey, (2009)

Table 4.6 shows that Lekki axis industrial zone has the highest rank; followed by Agege, Ikeja and Apapa and other industrial zones take the rear. The implication of this is that all routes leading to Lekki axis, Agege and Ikeja areas should be well catered for and planned for urgently such that congestion would be minimized and Business concepts and models for city logistics would be enhanced. Similarly, there must be integration of existing resources to solve the difficulties caused by the impact of increasing population and other logistics activities within these areas.

6. CONCLUSION, PLANNING AND POLICY IMPLICATION AND RECOMMENDATION

The paper opines that Business concepts for Urban and City logistics should revolve around sustainable transport environment and city development, with provision of infrastructure within the framework of strategic management planning and societal marketing concepts that incorporate People, System and Organisation (PSO) on one hand, and on the other hand, ensuring these infrastructure do not only perform human welfares functions by meeting respective users requirements and satisfaction, but also profitable for the organizations that provide them, such that those facilities will give both high immediate satisfaction and high long run benefits. For instance, water transport infrastructure that is underdeveloped and utilized should be developed and improved upon. This will ease the burden on road transport, consequently reduce pollution, congestion and other negative externalities on one hand and enhace movement and other logistics activities in the city. Furthermore, sustainable transport systems policy measures be introduced within the ambit of Transport Demand Management (TDM) that must be developed so as to ensure internal consistency on one hand, and consistency with other policy areas, as well as sustainability in the economy and the environment. Hence, government should develop and guide implementation of transport strategies through 4ps- Politics, Planning, Policy and Public service, which will all ensure steadily improving standards and targets in quality, pollution reduction and safety.

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DEVELOPMENT OF IT INFRASTRUCTURE TO OPTIMIZE LOGISTICS OPERATIONS IN THE SEGMENT OF COLD CHAIN

Dominika Crnjac Milić
Faculty of Electrical Engineering, J.J. Strossmayer University of Osijek,
Kneza Trpimira 2B, 31000 Osijek, Croatia
Phone: +385 (0)31 224 600; Fax: +385 (0)31 224 605
E-mail: dominika.crnjac@etfos.hr

Ivana Hartmann Tolić
Faculty of Electrical Engineering, J.J. Strossmayer University of Osijek,
Kneza Trpimira 2B, 31000 Osijek, Croatia
Phone: +385 (0)31 224 600; Fax: +385 (0)31 224 605
E-mail: ivana.hartmann@etfos.hr

Martina Martinović
RALU logistika d.o.o.
Radnička cesta 47, 10000 Zagreb, Croatia
GSM: +385 (0)98 984 2430
E-mail: crnjac.martina@gmail.com

Scientific paper

Abstract

An important segment in the development of good business is the development of information technology, which is especially pronounced in the area of logistics operations. This paper analyses trends in the application of information technology in storage and transportation of food products that require refrigeration or freezing in order not to lose their nutritional properties and maintain their quality.

The market of frozen products has been on the rise in recent years, although in Southeastern Europe the consumption per capita is lower than in Western Europe. It is expected that the consumption of these products will significantly increase in the next few years as a result of the changing lifestyle (less time, consumption of a variety of foods from all over the world throughout the year, etc.).

Because of technology advancements and logistics strategies, the cold storage of perishable items has become an important stage in the distribution between manufacturers/processors and retail locations. Fresh and deep frozen production continues to increase to meet worldwide demand, and technology has created a wider range of usage for that kind of products and the ability to transport products.

The hypothesis of this paper is that further research and development of information technology solutions would, beside existing ideas, provide faster and more efficient distribution and storage of food products which require special

conditions, and it would ensure the profitability of the companies and their stronger business position in the global market.

Key words: optimization, logistics operations, cold chain, IT infrastructure

1. INTRODUCTION

The goal of most managers to make all costs variable is impossible to fulfil, but the right decisions at the right time make most outstanding ones able to get closer to achieving that goal. Certain business activities are increasingly being outsourced, because when something is outsourced and you arrange a job with an expert for that particular operation, then the service is delivered on the money-for-service principle (Lacković, 2014, p. 111).

From the cost reduction aspect, i.e., less service and lower costs up to the level no service - no cost, lead to the desire to make most of the business related costs variable.

Logistics costs account for a significant share of the total costs of the company, in manufacturing and retail. Retailers and manufacturers have recognized the importance of logistics costs in the total costs of the company. Because of the cost size, companies are forced to find a more efficient solution for their logistics operations taking into account not only the cost but also quality of service. Retailers are creating their own storage capacities, and forcing manufacturers to move logistics operations on their centralized storages. As a consequence, reduces the number of the deliveries which manufacturers need to distribute and their own distribution network becomes inefficient and unprofitable.

Looking at the issues in terms of logistics, the more goods produced/sold, the higher costs and vice versa, so the long-term use of outsourcing logistics services significantly reduces the costs of one's own employees, depreciation, energy and the like, waiting to get turnover to its previous value.

All effects of business cycle fluctuations are transferred to the service providing company that must combine its services with services offered by a number of different clients to compensate fluctuations and make their business profitable. If to this we add savings referring to investing one's own capital in storage facilities, vehicles, computer equipment and systems, quality management systems, employee training and development, it is more than obvious that this is most frequently worth outsourcing.

On the other hand, companies that offer outsourcing of logistics operations have great responsibility when it comes to the goods, which are often very sensitive to changes in the storage and shipping conditions.

For companies that are engaged in this activity, except for investments in facilities and vehicles, it is important to invest in internal processes to ensure safety of food and other goods throughout the logistics chain.

At the present time, it is important to constantly harmonize the internal procedures with the European processes and standards, and to have these procedures supported by IT.

There is a necessity for the use of state-of-the-art IT to support daily operations, and at the same time to record all data in order to ensure full traceability. This ensures the quality of logistics services so that in case of any non-conformity of goods the companies could quickly withdraw products from the market and provide data for possible changes in procedures and working methods that lead to the aforementioned non-compliance, which is particularly important during transport, storage and distribution of food that require the fulfilment of the highest standards of safety.

Cold-chain, on which research of this paper was focused, is a special form of logistics and a complex cryogenic system, which compose by a number of links, the overall processes from the procurement, processing, distribution, retail to consumption are all under lower temperature. It is outlined a specific supply chain system, with perishable food purchased or fished from the origin places, the procedures of processing, storing, transporting, distributing and marketing are under required low temperature to ensure the safety, reduce losses and prevent pollution (QingYing & Zhimin, 2011).

According to the basic functions of logistics, cold-chain operations can be divided into the following four areas: supplement (producing, processing, purchasing, checking and accepting), storage (storing, loading, handling and sorting), transportation (transport, loading, handling and distribution) and consumption (transport, storing, sorting) (Yanyan & Yu Yin, 2009).

In order to build confidence and trust with their clients and enhance their prestige in the market, it is more difficult for companies engaged in logistics operations to hold the "IFS Logistics" certification (international standard for transportation, storage and distribution), which has as a prerequisite ISO 9001 and HACCP certifications brought together under the umbrella of the "IFS Logistics" which defines in detail food safety by specifications of each particular product and clearly defined procedures.

The paper analyses trends in the application of information technology and logistics in general, but particular attention is focused on the segment of cold chain, i.e., storage and transportation of food products that require refrigeration or freezing.

The complexity and responsibility of this work is accompanied by a large role played by money and time with constant questioning when to invest and in what.

"RALU Logistics", the leading independent regional logistics Croatian company in the field of cold chain, is a company mentioned in this paper as a positive example worthy of attention that has recognized the market needs for a reliable provider of logistics services in the field of refrigerated and deep frozen products, is constantly investing in the most modern solutions using IT infrastructure offered in the market.

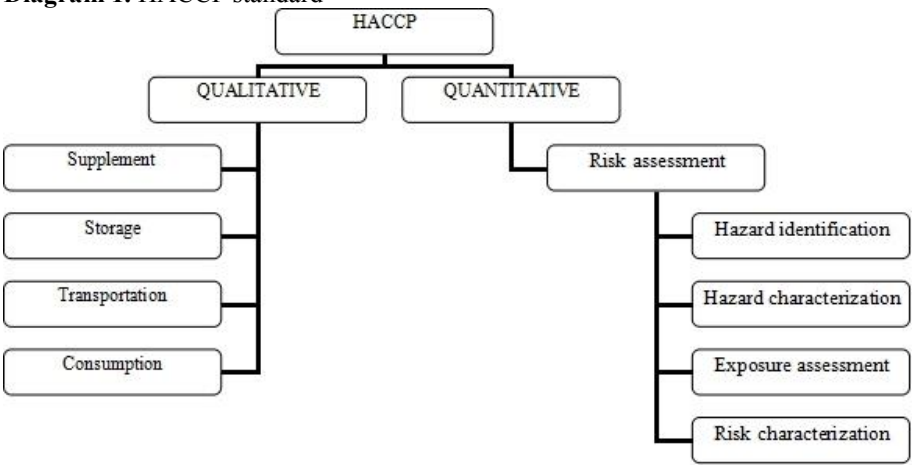
2. IT INFRASTRUCTURE

2.1 IT infrastructure in logistics

Companies utilize IT infrastructures in order to ensure food quality and conform with the HACCP (Hazard Analysis and Critical Control Point) standards during transport, which makes IT infrastructures an important factor of business quality and significant instrument of business success ensurance. HACCP standard is a tool for

the analysis of the cold chain processes, assessment of potential risks for each operation link, and identification of critical control points. It gives the appropriate risk weights, so as to ensure the safety, quality and reliability of the cold chain (QingYing & Zhimin, 2011). From the biological, chemical and physical perspective, it combines qualitative and quantitative analysis methods to identify risks and assess the weight of each risk, so as to determine the critical control points and establish internal relations between hazards and risks.

Diagram 1. HACCP standard



Source: Authors

The paper gives an analysis of IT infrastructures currently present in the labor market in the logistics operations segment, particularly cold chain. IT infrastructures in the area of logistics are commonly used in wired or wireless monitoring the transport of goods, and RFID (radio frequency identification). These IT infrastructures include monitoring vehicle location, monitoring the temperature of cooling chamber vehicles, determining the origin of goods transported and the like.

Most often tracking vehicles use the GPS (Global Positioning System) that transmits information about the position of the vehicle, the parameters of the vehicle, driving time and the like. Using GPS vehicle tracking technology makes available to the client the parameters of temperature and geographical location of their goods.

GPS technology was integrated with RFID technology in order to develop the technology to gather complete data. The main disadvantages of GPS technology are limited area coverage, dependence on the battery and human intervention.

RFID technology is increasingly superseding the bar code technology and is used in all aspects of life – access control (RFID cards, bracelets, pendants – for example records of employees' working time), cashless payment (bank cards, coffee makers, museum admissions, transport, etc.), identification equipment, vehicles, industrial applications (the label is usually on the product). In synergy with other technologies (GPS and wireless) it is commonly used in transport, logistics, production and control.

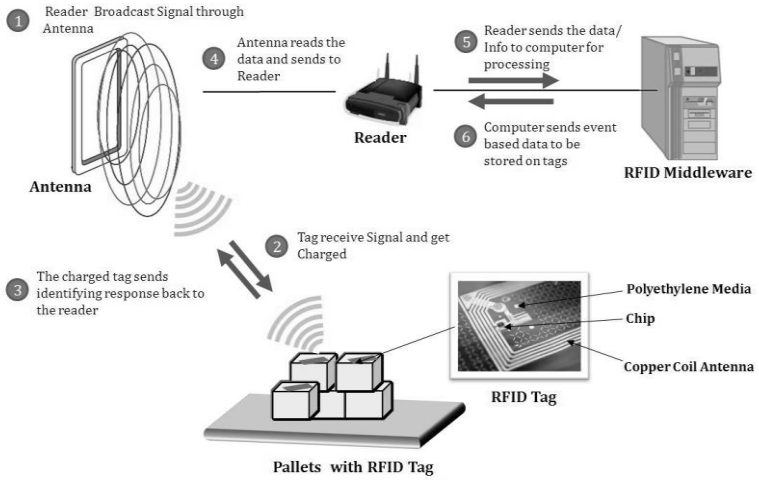
The basic principle of the RFID technology usage is the reading of the essential characteristics of the product / property / animals which are stored on the RFID tag.

RFID readers read and / or write data after transmitting radio waves stored in the memory chips in the RFID tag (Cej et al., 2012, p.152). RFID tags are placed on a product or integrated into an object and they contain all the necessary data which are read without contact (e.g. contactless payment of bills in stores using bank cards). RFID tags can be divided into three main types with respect to the source of energy used to power them:

a) active tags - use a battery to power the tag transmitter and receiver to broadcast their own signals to readers within the life of batteries;
b) semi-passive tags - contain built-in batteries to power the chip's circuitry, resist interference and circumvent a lack of power from the reader signal due to long distance. They are different from active tags in that they only transmit data at the time a response is received;
c) passive tags - derive their power from the field generated by the reader without having an active transmitter to transfer the information stored.

The principle of communication between a RFID tag and its reader and the processing of data on the computer is shown in Figure 1.

Figure 1. The working principle of RFID technology



Source: Infinium Solutionz Pvt. Ltd. [available at: http://122.182.4.125/infiniumwebsite/Tech_RFID.aspx, accessed June 14, 2015]

The frequency range determines the characteristics of the system, i.e. the range of reading and reading speed data, which is shown in Table 1. From the table it can be concluded that for transport and logistics based on an RFID system the best solution would be the ultra high frequency (UHF) RFID with (active) transponder because of the communication range of ten meters, which can be upgraded for an additional range of up to a hundred meters, while the battery life is up to ten years. It is possible to embed various sensors into active RFID transponders, such as temperature sensors necessary for monitoring of perishable goods, humidity, vibration, light and radiation sensors (CARNet CERT & LS&S, 2007).

Table 1. Comparison of RFID Frequency Band and Their Respective Applications

Frequency	Maximal range and type of RFID tag	Cost of Tags	Data speed	Applications
Low Frequency (LF) 125 – 134 KHz	<0.5m (passive)	High	Low	Animal identification, access control, identification of objects with high percentage of water
High Frequency (HF) 13.56 MHz	up to 1 m (passive)	Medium to Low	Low to moderate	Smart cards, payments, access and passage control
Ultra High Frequency (UHF) 433, 868-928 MHz	3-6m (passive) up to 10m (active)	Low	Moderate to high	Logistics and supply chain, baggage tracking, warehouse and logistics applications, remote locking of vehicles
Microwave (SHF) 2.4/5.8 GHz	10m-15m (passive) 20-40m (active)	High	high	For systems which require long distance for operation: identification of vehicles (tolls and tunnels, parking lots, garages), airline baggage

Source: The Hong Kong Polytechnic University, Overview of RFID Technology, [available at: http://www.rfid.ise.polyu.edu.hk/en/RFID_ov.html#2, accessed June 14, 2015]

2.2 IT infrastructure in cold chain logistics

Temperature monitoring during transport of goods in cold storages has been for years an important part in the cold supply chain in order to optimize logistics costs. One of the first monitoring temperature technologies in logistics was the use of chart recorders shown in Figure 2. The technical disadvantage of this device is that the data are written onto paper and manually interpreted. That is the limitation of applicability to a large number of data that needs to be processed in real time.

Figure 2. Chart recorder

Source: Ashford Instrumentation Ltd [available at: http://www.ashfordinstrumentation.com, accessed July 7, 2015]

Later widespread devices for temperature monitoring during transport of goods were digital or analog electronic devices (named "data loggers") with an integrated sensor for measuring and tracking temperature data over time - one such device is shown in Figure 3 (Dada & Thiesse, 2008, p. 142). The disadvantage of such devices is difficult access to measured data because the device must be connected, e.g. via serial cable.

Figure 3. Temperature logger

Source: Global Sensors [available at: http://www.global-sensors.com/TemperatureAndHumidityLoggers.htm, accessed July 1, 2015]

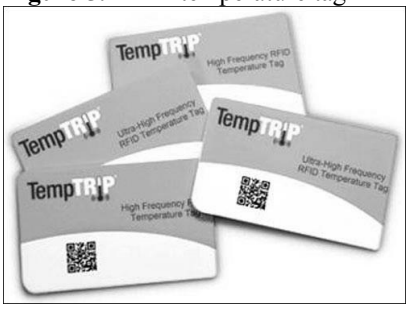
There are concepts which are different from the above mentioned devices: inexpensive labels based on chemical, physical or microbiological reactions that show an easily-measurable time and temperature dependent change (TTI – Time-Temperature Indicators) (Figure 4). The color shift on the TTI label can easily be read and understood and does not require an additional reader device (Dada & Thiesse, 2008, p. 143). Main disadvantages of these devices are: they do not have digital information, they require manual examination and they do not allow for remote monitoring.

Figure 4. Time-Temperature Indicator

Source: Freshpoint [available at: http://www.freshpoint-tti.com, accessed July 7, 2015]

The best choice in recent years have been RFID-based sensor tags (Figure 5) which allow for fully automatic data collection in real time. Temperature sensors are integrated with RFID, they continuously record temperature readings and store them in the tag's memory and at any point in the process these readings can be accessed by an RF reader and forwarded to an organization's information system (Dada & Thiesse, 2008, p. 143). Radio frequency identification in recent years has been increasingly used in logistics and supply chain management.

Figure 5. RFID temperature tag



Source: TempTrip [available at: http://temptrip.com/, accessed July 7, 2015]

Monitoring in the supply chain has now evolved. Very promising technologies in several fields (environmental monitoring, cold chain control, traceability, etc.) are Wireless Sensor Technologies (WST). WST appertains to Wireless Sensor Networks (WSN) and RFID based sensor devices. WSN contains wireless sensor nodes that have a microprocessor for data processing, storage capabilities, radio chip for wireless communication with which to communicate with a gateway unit which can communicate with other computers via other networks (LAN, WLAN, CAN or WWAN). Integration of WSN and RFID provides a significant improvement on monitoring. This integration, with software agents and intermodal containers, facilitates the development of the "intelligent container" system.

Nowadays, cloud computing as a new business model has a profound impact on the entire information technology across the industry. At the same time, cold chain logistics increasingly demands fresh and frozen food, along with customers' rigorous requirements. Cloud computing in cold chain logistics helps to achieve the highest

quality IT services with minimal investment. In this environment cold chain logistics can provide: database controlled, real-time monitoring, data calculation, logbook recording, query, report generation, etc.

2.3 Recent IT applications in transport

In recent years, development of sensor networks used in logistics has focused on the development of an intelligent transport system labeled "intelligent container" system. Much international research is focused especially on the management and control of transport of perishable goods. Some of the IT applications are summarized in Table 2.

Table 2. Summary of IT applications in transport

Category	Subject	References
RFID	Pineapple supply chain	Amador et al., 2009.
WSN	Real-time monitoring of fruit logistics	Ruiz-Garcia et al., 2008.
RFID & WSN	Raw Brazilian sugar supply chain	Fray da Silva et al., 2015.
RFID & WSN	Aquaculture supply chain	Parreño-Marchante et al., 2014.

Source: Authors

3. A REPRESENTATIVE EXAMPLE OF A LOGISTICS COMPANY IN CROATIA

The "RALU Logistics" company has specialized in accordance with recognized potential, and created the image of a reliable logistics partner that could provide a high-quality and complete logistics service operating according to EU standards.

To effectively manage partner requests referring to specified requirements (e.g., a certain delivery at a specific time with least possible costs) it is necessary to establish an efficient and optimal logistics system (Segetlija, 2013, p.19). It is known that for the provision of such network it is necessary to manage two main functions: logistics planning and logistics controlling (Frazelle, 2002, p.125).

The role of logistics planning is to ensure the overall efficiency of the logistics system to ensure a competitive position. It is in this part that independent logistics companies exploit synergy of many clients from their portfolio in order to distribute the cost of distribution to a greater amount of goods.

Successful logistics service providers pay particular attention to the development of logistics controlling in order to control the effectiveness of logistics services provided within the anticipated financial framework.

In order to better control costs, it is necessary to continuously report on the results of the logistics operations, such as measuring the efficiency of existing logistics capacity. For this purpose, "RALU Logistics" carries out weekly monitoring of KPI (i.e., Key Performance Indicators) values in order to evaluate its own effectiveness.

This company has defined its mission, and it seeks to execute the mission every day. It provides timely and efficient services to its clients trying to achieve at the same time a satisfactory level of profitability for the company.

In order to reach this goal, performance parameters are to be measured continuously, such as capacity utilization of trucks, storage capacity utilization, efficiency in warehouse workers, profit per mile and the like.

In a market of increasingly demanding clients and increasing competition among 3PL providers[1], "RALU Logistics" is developing in the direction of meeting the various demands of clients, expansion of service offerings, and narrow specialization in the logistics activity. In addition to standard logistics operations, transportation, storage and distribution, they also offer product repackaging services, product labelling services, reverse logistics services (Goetschalckx & Fleischmann, 2005, p.102), logistics services in certain regions, customs and excise storage as well as the implementation of the highest quality standards in all operations (IFS[2], ISO 9001, HACCP).

Being aware of the sensitivity of the products entrusted to them by their clients (i.e., refrigerated and deep frozen products) and the flow of goods, "RALU logistics" has implemented state-of-the-art equipment and information technology in order to ensure quality of service, because only satisfied and happy customers guarantee a successful and sustainable market position.

The vision of this company is to become the leading independent provider of the integrated logistics service "from factory to shelf" in the cold chain segment in Southeast Europe, which includes international transportation and all possible forms of warehouse operations.

Without proper and high-quality infrastructure it is impossible to deal with logistics; hence the construction of the RALU LDC (i.e., the logistics and distribution center) in Rugvica along with investments in transportation and vehicles represents a solid foundation for the expected success of the activity the company is involved in. The construction of the LDC in Rugvica created the conditions for developing fully operational logistics business in the region.

The new RALU center consists of two main facilities, i.e., a warehouse – a cold storage facility and a transportation support facility. The entire warehouse with chambers, just like all handling zones and additional service zones, are under temperature-controlled conditions, which might, depending on the needs, go to -25ºC. The transportation support facility, except for the service itself, includes an internal fuel pump, automatic truck wash and a rest area for drivers.

The LDC occupies an area of 117,000 m^2 so that sufficient space is reserved for the future rapid increase in capacity. In Croatia, "RALU Logistics" employs more than 200 employees, and together with companies in Serbia and Hungary it has more than 300 employees. The new LDC in Croatia created the conditions to increase the number of employees in the next few years.

By the construction of the new logistics and distribution center the company has

[1] 3PL is an English abbreviation for Third-Party Logistics and it implies logistics activities carried out by a third party. It is identified with logistics outsourcing. Many global companies today are advertised as 3PL companies.
[2] International Food Standard.

become the leader in the field of both storage capacity and manipulation of frozen and refrigerated products.

In addition to investments in the logistics and distribution center in Rugvica worth HRK150 million, the company also invested in the fleet of vehicles, which was complemented by 90 refrigerator trucks manufactured by a renowned German manufacturer.

Investments in new trucks are extremely important, because over 70% of company's turnover in the field of transport is booked from clients from the EU. Although RALU has been operating for the last 25 years, this company is still relatively unknown in Europe; hence it has to prove its quality by providing superior levels of service, much more than logistics and transport companies in Western Europe that affirmed their positions long time ago. They are aware of the fact that this is feasible only with trucks of the highest level of quality that, in addition to lower costs (fuel consumption, tolls, maintenance), ensure the accuracy and reliability of the provision of services. Projections for the future have indicated that it is necessary to take into account the conditions in which companies operate in most EU countries, e.g., less polluting trucks (Euro 6), which RALU Logistics has also recently purchased, pay a lower toll rate and lower environmental taxes. In Croatia, this issue has not been regulated yet by law, but it is likely to be harmonized with relevant EU legislation.

This company recognizes the importance of ongoing investments for the purpose of achieving competitiveness.

For these reasons, "RALU Logistics" renewed most of their fleet after only four years, which is far above the average in the region, or at the level of the best EU companies. The company has always had refrigerator trucks of the best quality providing optimal solutions to distribution. Refrigerator trucks, for example, are equipped with sophisticated and modern equipment for communication and monitoring of the operating parameters of vehicles, as well as condition and temperature of goods in real time, and the GPS tracking system is constantly in contact with the dispatching unit.

By the implementation of the new SAP[3] information system, one of the leading business management information systems in the world, in all parts of business operations (from accounting and finance to warehouse operations), as well as the continued education of employees, "RALU Logistics" increasingly ensures that they have their client's trust. The company has implemented RFID based WMS (warehouse management software), and route planning software, they offer the possibility of electronic data interchange (EDI) with retail facilities for receiving orders.

In order to facilitate the deep frozen mode of operation, the company implemented a pick-to-voice system, and it is planned to offer all services referring to sales planning and forecasting of necessary supplies on the basis of historical data, taking into account all the specific days affecting the sale (end of school year, public holidays, etc.). In this way, "RALU Logistics" will offer to their clients a complete logistics solution – starting with inventory planning to delivery of products on retail store shelves.

[3] Systems, Applications & Products, the renowned German company which produces software.

As an independent supplier of integrated logistics services, this company differs from its competition because it is focused only on superior level of logistics services. Its clients are chain stores and manufacturers for whom the price is not the only and the most important element, but they pay attention to reliability, guarantee cold chain integrity and traceability, and maintain the highest level of product safety.

As an independent logistics company, "RALU Logistics" can simultaneously provide logistics services to clients who may also be market competitors and offer them the opportunity to be focused on their core businesses.

As a logistics specialist, through its own synergy "RALU Logistics" can offer optimal logistics services aware that any form of business competition increases with the growth of focus on their own core business. Increasing knowledge of the business world that no one can be perfect in all elements of business operation and outsourcing impose the necessity of the existence of companies such as "RALU Logistics".

This company aims to be the first choice of those who will outsource cold chain logistics from their core business activity, so their investment and development focus exclusively on processes and equipment essential to logistics operations of that form.

It also differs from its competition by the level of systems implemented to maintain the quality of goods and the cold chain integrity. As forerunners in Croatia, they have implemented the IFS (International Food Standard) in logistics, and they strive toward a leadership position in the area of quality assurance and food safety as well.

Offering a complete service with its own equipment that enables taking delivery of the goods anywhere in Europe makes that company different from others.

Due to the environment the company operates in, it is slow to reach the intended results. The process of economic integration of the Republic of Croatia into the EU is taking place more slowly than expected because foreign companies have belatedly recognized and used a good geostrategic position of Croatia in terms of logistics.

On the other hand, the crisis and the decline in the purchasing power have slightly slowed down the plans to develop toward the east, and since Europe has opened to us, we have opened to the competition in transportation. The result is a drop in the prices dictated by companies from countries with a lower standard of living and lower labor and business costs, which joined the EU before Croatia and thus managed to adapt well (e.g., Lithuania, Romania, Bulgaria). These companies are now our competitors.

Eastern Europe countries have also recognized transportation as an important part of the export-oriented industry and the development of this industry is thus encouraged by various measures.

Regardless of everything, since Croatia joined the EU the share of transport "RALU Logistics" has done for its clients is constantly increasing, and the long-term sustainability of transport is evident in the further development of specialized transportation within the EU and by using their own vehicles in the provision of integrated logistics services.

4. THE SITUATION IN CROATIA AND COMPETITIVE COMPANIES AND LOGISTICS OPERATIONS IN THE SEGMENT OF COLD CHAIN

Currently, there are small shifts in the development of the logistics market in Croatia. We believe it is important to point out that without growth and investment in manufacturing and export and with no increase in consumption, there no serious progress will be registered in this economic activity.

Investments of "RALU Logistics" in the construction of the logistics and distribution center in Rugvica is one of the few major investments in logistics in the Croatian territory, but many analyses have shown that in terms of logistics Croatia lags behind trends in developed markets in many respects, e.g., only 30 per cent of logistics is outsourced, while 70 per cent still remains in house. From producers to small traders, everybody does everything, but it is clear that this trend will have to change. There must be specialization and outsourcing, because companies are becoming less competitive and they spend their capital on ancillary activities. This gives hope that the logistics services market will wake up quickly and change the image in the market.

Table 3: The analysis of competition in the provision of logistics services in the cold chain segment in the Republic of Croatia

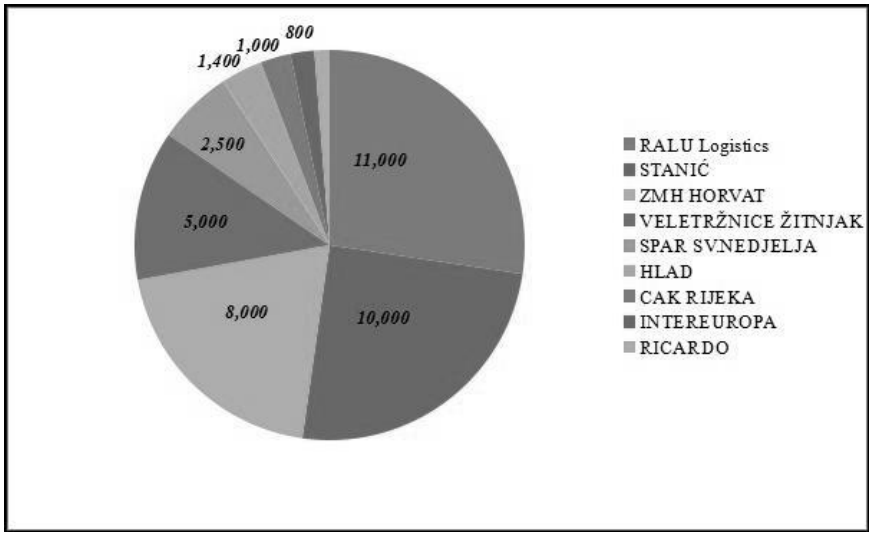
	Warehousing	**Distribution**	**No of refrigerator trucks**
RALU Logistics	11,000 PP[4]	national	180
Competitor	**Warehousing**	**Distribution**	**No of refrigerator trucks**
LOGISTICS COMPANIES			
Stanić	10,000 PP	national	100
ZMH Horvat	8,000 PP	national	outsourcing
Veletržnice Žitnjak	5,000 PP	n/a	
Spar sv. Nedjelja	2,500 PP	n/a	
HLAD	1,400 PP	n/a	
CAK Rijeka	1,000 PP	national	outsourcing
Intereuropa	800 PP	not refrigerated	
Ricardo	500 PP	Slavonia	15
MANUFACTURERS			
Dukat	9,000 PP	national	50+outsourcing (100)
LEDO	4,000 PP	national	150

[4] PP stands for pallet positions.

	Warehousing	Distribution	No of refrigerator trucks
PIK Vrbovec + Zvijezda	3,000 PP	national	140
Mlinar	1,000 PP	only for their own use	
Pan pek	1,000 PP	only for their own use	
Private carriers		used by Vindija, Gavrilović, Meggle	
TOTAL	**58,700 PP**		

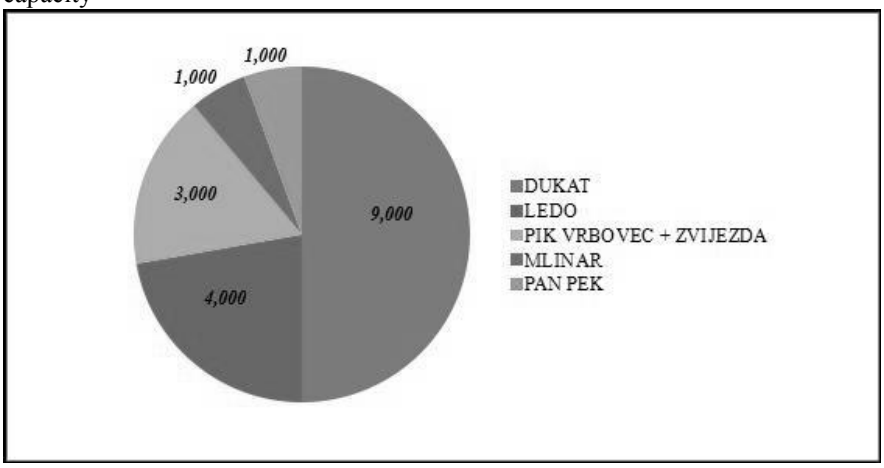
Source: RALU Logistics

Chart 1. Logistics companies - the number of pallet positions of refrigerated storage capacity



Source: RALU Logistics

Chart 2. Manufacturers - the number of pallet positions of refrigerated storage capacity



Source: RALU Logistics

5. CONCLUSION

The paper provides specific measures improved in the use of IT technology to make the turnover rate of cold chain. This interdisciplinary paper gives a detailed analysis of the necessary IT infrastructure well-known in the market. Its usefulness in certain segments of logistics operations has been demonstrated, and by using an example of a leader in Southeast Europe in the segment of cold chain, we tried not only to provide guidelines for the future development of companies in this business segment, but also to open space for new research in this direction in order to optimize work in this sector as much as possible by means of synergy of IT and economic knowledge.

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UNIVERSITY/INDUSTRY PARTNERSHIP PROJECTS – BY THE CREATIVE WAY TO PRACTICAL KNOWLEDGE: THE GOALS AND BENEFITS OF THE LOGISTICS PROJECT

Darja Kukovič
University of Maribor
Faculty of logistics
Mariborska cesta 7, 3000 Celje
Phone: +386 3 428 53 62
Fax: +386 3 428 53 38
E-mail: Darja.Kukovic1@um.si

Tone Lerher
University of Maribor
Faculty of logistics
Mariborska cesta 7, 3000 Celje
Phone: +386 3 428 53 09
Fax: +386 3 428 53 38
E-mail: Tone.Lerher@um.si

Borut Jereb
University of Maribor
Faculty of logistics
Mariborska cesta 7, 3000 Celje
Phone: +386 3 428 53 62
Fax: +386 3 428 53 38
E-mail: Borut.Jereb@um.si

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Abstract

Global competitive environment encourages cooperation between industry and the higher education institutions to get mutual benefits, but recently the focus is also on participation of students in these partnerships. The paper represents good practice of industry/university cooperation with participating students through the presentation of the logistics work-study project. The key benefits of the project are recognized in students' upgraded or acquired competencies, new scientific instrumentation and methodology for faculty and technological know-how, as well as in increasing absorptive capacity of company for scientific and technological problem-solving, in networks and social interactions. Thus potential partners should establish long-term partnerships as well as they should search for appropriate calls and funds to apply for these kinds of projects. Although the faculty and the company have established long-term partnership, students was not able to establish such partnership, because funds and consequently duration of the project were limited. Therefore companies should also provide financial funds to invest in their potential employees, especially when it

comes to a public company with less stimulating working environment and predominantly older workforce.

Key words: logistics work-study project, higher education/industry cooperation, students engagement, case study, performanece discussions.

1. INTRODUCTION: COOPERATION BETWEEN HIGHER EDUCATION INSTITUTIONS AND INDUSTRY

An increased youth unemployment was estimated to have reached five million across the European Union in August 2014. This situation has prompted many governments, the European Commission and the OECD to emphasise the need for closer links between higher education institutuions and industry to stress innovation policies and graduate employability. Universities are placing more focus on developing the practical and entrepreneurial skills of their students, and on promoting innovation and stakeholder partnerships. They are also engaging more within their local communities, with employers, business, and industry while also extending their reach internationally. The percentage of institutions which consider that cooperation with industry is highly important is 53 % in 2015 and is expected to grow to around 70 % in few years (Sursock, 2015, p. 23-54).

Labour markets increasingly rely on higher skill levels and transversal competences, therfore higher education institutions should equip students with the advanced knowledge, skills and competences they need throughout their professional lives. Universities shoud raise initial qualifications as well as maintain and renewe skilled workforce through close cooperation between governments, higher education institutions, social partners and students, which will allow institutions to be more responsive to employers' needs and employers to better understand the educational perspective. The European Universities' Charter on Lifelong Learning developed by the European University Association provides a useful input for defining strong partnerships between public authorities, higher education institutions, students, employers and employees. Learning outcomes can be recognized in the knowledge, skills and competences, which can be acquired through formal, non formal, or informal learning paths. Lifelong learning is also supported by adequate organisational structures and funding, as well as it is encouraged by national policies (EHEA, 2009, p. 3).

To foster innovation and creativity in society, higher education should be based at all levels on state of the art research and development. The potential of higher education programmes, including those based on applied science, is recognized to catalyze the innovative society, therefore also the number of people with research competences should increase. Also, doctoral programmes should be complemented by interdisciplinary and multidisciplinary programmes to provide high quality disciplinary research (EHEA, 2009, p. 4). Advanced degree levels, M.Sc. and Ph.D., should also be responsive to industrial requirements (Altbach, Reisberg & Rumbley, 2009, p. 158). Highly skilled graduates are the indeed key inputs for successful industrial development in a given society (Puuka & Marmolejo, 2008). In Slovenia,

employers usually demand paractical/working experience from new emloyees, wherein logistics is not excluded.

IBM, a worldwide leading catalyst for so caled service science, thus strives to develop a new discipline that (IBM, 2012):

"… *integrates aspects of established fields like computer science, operations research, engineering, management sciences, business strategy, social and cognitive sciences, and legal sciences.*"

Because of the interdisciplinarity, multidisciplinarity and applied nature, logistics actually represents an area, which responds very strongly to these requirements.

1.1 Benefits of cooperation

Since 1980s, the competitive environment has forced companies to introduce new technologies and innovations to shorten product and technological life-cycles. Therefore companies has started to accumulate knowledge and skills through the introduction of R&D. These activities take place at the vertikal or horizontal channels, where vertical spillovers, associated with suppliers and customers, usually have more significant effect on R&D then horizontal spillovers, which are associated with universities and research institutes (Faria et al., 2010, p. 1082-1083). Companies' innovation cooperation strategy is based on the type of external partenrs who might also be the universities, which mainly provide knowledge to aid defining trajectories that are new to the firm (Bercovitz & Feldman, 2007, p. 931). The knowledge, which is produced in this kind of cooperation, improves an existing life-cycles in companies, as it allows to better deploy their existing capabilities. Companies also obtain benefits from the cooperation with universities, as it might also be the way of sharing costs by complementing other R&D and innovation activities, such as own R&D, cooperation with other partners as well as the search for publicly available knowledge (Faria et al., 2010, p. 1084).

The pressure on universities to cooperate with industry is still an issue in Europe, where each region searches its own way to involve universities into regional development (Azagra-Caro, 2006, p. 38). For the university, this kind of cooperation creates knowledge that provides new findings and potential scientific breakthroughs (Bercovitz & Feldman, 2007, p. 933). These benefits are also well illustrated with the following words (Altbach et al., 2009, p. 154):

"… *Technological innovation is advanced by having a two-way flow of information – not only of science from universities to industry but of technological know-how from industry to universities*."

An emerging literature describes specific student participation in so caled "*co-op education programs*" or work-study programs, which are regarded as innovative in three different ways (Bramwell & Wolfe, 2008, p.1175-1185): First, it helps companies to identify new recruites; second, students help companies acquire new skills and knowledge from the university; and third, the cooperative students and programs provide mutual flows of knowledge and know-how across the university and local companies. In these work-study programs student groups work on specific

problems identified in local companies, community and government organizations (Puuka & Marmolejo, 2008).

Cooperation between higher education institutions and industry is more likely to occur with large firms and with firms that receive public funding for innovation, since these firms have more resources to invest in research that does not have an immediate market orientation (Faria et al., 2010, p. 1084).

In Europe, one survey reported that the number of start-ups increased by 10 percent annually between 2004 and 2007 and that European universities have been more efficiently generating these operations based on funds invested in research than US universities (Altbach et al., 2009, p. 155).

Research and development institutions (R&D), especially higher education institutions, should exploit all the given channels of knowledge transfers, that are recognized especially by networks, continuing professional development, consultancy, collaborative research, contract research, licensing, spin-outs, and finally, teaching (EC, 2009, p. 5). Recommended core performance indicators for the transfer of knowledge of public research organizations are: research agreements, invention disclosures, patent applications, patent grants, licences executed, licence income earned, spin-offs established (EC, 2009, p. i).

1.2 Assumptions and limitations of cooperation

Absorptive capacity of companies has been widely used concept to analyze innovation processes and the effect of organizational learning on the creation of sustainable competitive advantage, which has a cumulative character in the sense that its development in the present will permit its more efficient accumulation in the future. It involves three basic capacities in relation to new knowledge: recognition of its value; its assimilation; and its application for commercial ends (Vega-Jurado et al., 2007, p. 2). R&D activities have short-term and long-term effects on absorptive capacity, where the first are directly linked to R&D investment and have a positive influence on all types of absorptive capacity, while the second have a cumulative effect, which contributes to the acquisition of solid experience in a given technological trajectory and is particularly relevant for the absorption of scientific knowledge, which requires greater capacities for the acquisition and exploitation then the industrial knowledge. Thus, the company's internal knowledge, gained through education of personnel or R&D activities, is a key factor in the absorption of external knowledge from scientific sources (Vega-Jurado et al., 2007, p. 19).

Companies invest in university based research projects when they are more likely to be considered part of an ongoing relationship when the firm is pursuing an internal innovation strategy more heavily weighted toward exploration (rather then exploitation) and when a greater share of the research conducted at universities is exploratory (Bercovitz & Feldman, 2007, p. 944-945).

In this paper, an example of good practice of university/industry cooperation is presented to highlight the benefits of funding the projects, where students are directly connected with company. First, the funding and aims of the project are introduced, as well as the company itself. Next, goals as well as benefits are presented through project team tasks and achieved students' competencies.

2. THE PROJECT: THE METHOD OF INTRODUCTION OF SMART METERS FOR READING THE ACTUAL CONSUMPTION OF DRINKING WATER

The Public Fund of the Republic of Slovenia for human resources development and scholarships, which operates within the Slovenian Ministry of Education, Science and Sport, has tendered project with financial assistance from the European Social Fund, named "By the creative way to practical knowledge", to which Faculty of Logistics has also applied its ideas. The faculty has acquired 12 projects, and the presented project is only one of them.

2.1 Introduction and Rationale

The project has started in March 2015 with a run-time of 5 months. Its main goal was to optimize working processes in public service company, located in the city of Maribor. Genarally, services tend to have markedly weaker direct links with universities than do manufacturers (Tether & Tajar, 2008, p. 1093), thus the aim to connect with this company seemed rationale in order to improve this statistics and also in order to introduce innovative solutions to a public service company that does not have an immediate market orientation.

In this project students from the Faculty of logistics (FL UM) and the Faculty of mechanical engerneering (FS UM) of the University of Maribor have participated to offer their knowledge, as well as innovative and smart solutions that was implemented in business processes of the company. With this kind of participation, students have got deeper insight into a real working environment, where they upgraded their working experience and skills, as well as professional competencies (Final report of the project, 2015).

Project team was made from (Application form of the project, 2014):

- 10 students – 5 from FL UM and 5 from FS UM,
- 2 teaching menthors – one from both faculties (FL UM and FS UM);
- 2 working menthors – one from the company (Maribor waterworks), who was responsible for the professional guidance, and the other from the social organization (youth center CMLC), who was responsible for promoting the project; and
- 1 coordinator from FL UM.

Maribor waterworks is a company, which supplies drinking water for 200,000 inhabitants of seventeen municipalities and has registered 45,000 water connections (Erker & Rataj, 2015). One of the key processes in the company is the reading of water meters, that requires smart solutions, as small number of workers must read the large number of water connections. This problem can be solved by intelligent use of modern information technologies, while solutions can also have a direct impact on solving the problem of water losses (Mariborski vodovod, 2015).

On the market there are different meters for reading the state of drinking water consumption, which differ in performance and price. Therefore students of mechanical engeneering made cost-benefit analysis of smart meters according to different needs, which depend mainly on the type of consumer. They had also

participated the process of replacing/installing, repairing and warehousing the meters to optimize these processes and to make their improved workflows with key critical points and finally to make new operational instructions for installation of smart meters. On the other hand, students of logistics were looking for solutions to optimize the working routes that are required to replace/install meters as well as to read the monthly state of water consumption. They were forced to investigate the specific needs and requirements of these processes, and to explore relevant and affordable software. Therefore they made the decision model, which determines working routes via the interactive map (Application form of the project, 2014; Final report of the project, 2015).

Under the mentorship of youth center, students got instructions on how to promote the project and present its results, which should meet the public interest. They had also prepared all the promotional materials, which was made to use on the selected promotional events (Application form of the project, 2014).

2.2 Goals and structure of the project

The primary objective of the project was the interdisciplinary problem solving of students from various fields in the real environment, i.e. concrete problem of selected company. Innovative approaches were needed to overcome the scarcity of resources (technological, financial). These activities had the indirect impact on the students' specific working as well as generic competences (Application form of the project, 2014).

The company Maribor waterworks wanted to reach the correct and professional attitude to its customers. By the achievment of "win-win" situation between all participants in the business process each customers would pay monthly cost of the actual consumption. The achievement of this goal would also help to detect inadmissible spending deviations, which would allow the identification of sites of water losses. Management of water losses would thus be the next project of the company, which could also be planned together with students and higher education institutions (Application form of the project, 2014).

The goal of higher education institution, ie. FL UM, was to participate and coordinate this project to get new coordinating and managerial competencies as well as more close contact with industry (Application form of the project, 2014). For this reason FL UM and Maribor waterworks signed contract on mutual cooperation even before the project had started.

The goals and structure of the project can most clearly be seen via structured tasks of all the participants of project team, presented in Table 1.

Table 1. Tasks of project team

Member	Status	Tasks
Student 1	Master degree programme: System logistics	- to ensure the relevant theoretical foundations of the project in the field of logistics, - to record the process of reading the status of drinking water, - to make the decision model, - to promote the project, and - to communicate with the public
Student 2 and Student 3	University degree programme: System logistics	- to record the process of reading the status of drinking water, - to study the software, - to transform theory into practice, - to create the applications, and - to create the promotional materials
Student 4 and Student 5	Professional degree programme: Economic and technical logistics	- to record the process of reading the status of drinking water, - to transform theory into practice, - to create the interactive map
Student 6	Master degree programme:	- to ensure the relevant theoretical foundations of the project in the field of mechanical engineering, - to record the processes of replacing/installing, repairing and warehousing the meters, - to make the plan for pilot implementation of new operational instructions, - to promote the project, and - to communicate with the public

Student 7	University degree programme: Mechanical Engineering	- to record the processes of replacing, repairing and warehousing the meters, - to study the functioning of smart meters, - to transform theory into practice, - to professionally support the creation of applications, and - to create the promotional materials
Student 8	University degree programme: Mechatronics	- to record the process of installation of smart meters (the type of meters and the method of reading the meters), - to transform theory into practice, - programming the meters, - professionally support the creation of applications, and - to create the promotional materials
Student 9	Professional degree programme: Mechanical Engineering	- to record the processes of replacing, repairing and warehousing the meters, - to transform theory into practice, and - to make the operating instructions for the installation and maintenance of smart meters
Student 10	Professional degree programme: Mechatronics	- to record the process of installation of smart meters (the type of meters and the method of reading the meters), - to transform theory into practice, - to make the operating instructions for the installation and maintenance of smart meters

Educational mentor 1 and Educational mentor 2	Teachnig Professors at University of Maribor: Faculty of logistics and Faculty of mechanical engeneering	- to give advices on the theoretical foundations, methods and procedures
Working mentor 1	IT manager of the company	- to familiarize students with the key processes and responsible persons in the company, - to organize visits of students - to give advices on the possibilities of implementation of practical solutions, - to communicate with top management of the company
Working mentor 2	Project manager of Youth center CMLC	- to familiarize students with the lifelong learning competencies, - to give advices for the promotion of the project (the funders and contractors – participants of the project team), and - to assist the process of creation of promotional materials - to assist the organization of the promotional activities
Coordinator	Technical assistent of Faculty of logistics	- the management of the projest, and - the coordination of project team

Source: Adapted from Application form of the project (2014) and Final report of the project (2015).

2.3 Impact and benefits of the project

An innovative approach and the cooperation of two quite different professional areas, logistics and technical engineering, gave smart solutions in the project. Innovative approach and the introduction of modern information technologies was needed to overcome the problem of limited resources of the public company.

Mutual cooperation with FL UM and Maribor waterworks results in synergistic effects; a company gains technological innovation, while the faculty gains technological "know-how". With this project FL UM and Maribor waterworks had justified the contract on mutual cooperation, as they both got what they were expected.

FL UM also got new coordinating and managerial competencies as well as references on project work, case studies for teaching process, and quality materials for publications. Both, working as well as teaching menthors also gained new experiences as well as opportunities for new partenerships between all entities (students, industry, higher education institution, social organization). Established partnerships accelerated the motivation of students as potential offsprings of the company as well as intergenerational solidarity (Final report of the project, 2015).

Students upgraded or acquired planned and adventitious competencies represented in Table 2. These competencies will allow professional, responsible and confident behavior in their future work and study. Students made several working reports and a Final working report from which project team members can draw solutions for the implementation even after the project's run-time.

Table 2. Achieved or improved competences of students

Student	Generic competences, skills and knowledge	Specific working competencies
Student 1	- communication skills (internally and externally), - - responsibility and development of critical reflection, - project work, - teamwork (interdisciplinary), - creative and innovative integration of theory and practice - results orientation - problem solving	- coherent management of the basic knowledge, - decision-making in the dynamics of logistics systems and logistics processes, - effective problem solving in the field of logistics systems by using the modern scientific methods and procedures (modeling) - understanding and the use of methods of critical analysis and development of theories, and - the ability to applicate theories in solving specific problems - leadership

Student 2 and Student 3		- the use of knowledge in a concrete working environment, - the ability of intensive and continuous use of information and communication technologies and information management systems, - the ability to integrate knowledge from different areas and its installation into concrete applications in the company with a strong logistics function - the ability to analyze, assess and evaluate working processes as well as to update them
Student 4 and Student 5		- the use of knowledge in a concrete working environment, - smart use of software and applications, - the ability to analyze, assess and evaluate working processes as well as to update them
Student 6		- coherent management of the basic knowledge, - the efficient use of resources and the integration of the findings of different studies, - professional criticism, - to make decision on research methods and procedures, - to make decision on the scientific analysis and synthesis, - to choose the appropriate solutions and to assess their implications - leadership

Student 7		- the use and development of methods and tools for modeling, simulation and optimization of processes and devices, - the development and use of modern technologies, - automation of work - the ability to analyze, assess and evaluate working processes as well as to update them, - the organization and management of business processes
Student 8		- the use of modern information and communication technology, - programming of modern mechatronic systems and devices, - the ability to analyze, assess and evaluate working processes as well as to update them
Student 9		- independent and creative problem solving (less complex and medium complex problems), - the introduction of modern technologies, - the ability to analyze, assess and evaluate working processes as well as to update them, - the use and management of modern systems and devices
Student 10		- the ability to analyze, assess and evaluate working processes as well as to update them, - the organizing of simple working processes, - the use and maintenance of modern mechatronic systems and devices

Source: Adapted from Application form of the project (2014) and Final report of the project (2015).

The youth center CMLC gave instructions on promotion activities, where students had learned to communicate with the public and for this reason prepared

different promotional materials: flyer, poster (Figure 1), press releases, publications on websites and social networks, etc. They are also planning to attend promotional events such as Green Celje, International Trade Fair in Celje, and Student Arena in Ljubljana. Students, FL UM, CMLC and the company itself had continuously informed the public via websites about the progress of the project. In the context of project dissemination the impact and benefits of the project are indeed presented in this article to reach interested academic audience.

Figure 1. The promotion poster of the project

Source: Report on promotional activities of the project, 2015.

3. CONCLUSION

Company Maribor waterworks is a public company who had started the project of introducing smart meters, but was faced with lack of transparency in the key processes, such as replacing/installing, repairing and warehousing smart meters, as well as reading the status of drinking water consumption, which for this reason needed to be optimized.

FL UM applied the project and provided project team to solve the problem. All partners of project team gained some benefits from the partnership and work. These benefits are mostly recognized in students' competencies, which reflect in useful knowledge and gained skills. Otherwise, benefits of the project can also be racognized in new scientific instrumentation and methodology, and technological know-how for

faculties, as well as in increasing absorptive capacity of company for scientific and technological problem-solving, as well as in networks and social interactions.

The traditional academic disciplinary structures are often inappropriate for the engagement with the industry, as practical issues are usually interdisciplinary. The ongoing global economic crisis may encourage even stronger expectations in this area (Altbach, Reisberg & Rumbley, 2009, p.163). Logistics science, as an intedisciplinary and multidisciplinary dicsipline, might indeed be recognized as a quite good answer to these issues, as R&D in the field of logistics – namely higher education institutuions – will exploit the given channels of knowledge transfers. However, horizontal channels seems to be important especially for the universities and students, who gain more benefits than industry itself.

The norm of "open innovation" has led research-oriented companies to cooperate with universities. This aspect was reflected in the continued upward trend in industry-funded academic research in OECD countries, although recently government research financial funding increases (Altbach et al., 2009, 157). Financial funding is also possible through diverse sources of funds, that are provided by EU policies. Thus, higher education institutions and the industry should search for appropriate calls to apply for these kind of projects. In the case of work-study projects students' motivation should also be considered – either they get paid, or they establish long-term partnerships with companies. Although the faculty and the company have established long-term partnership, financial funds were provided for five months only, thus students were not able to establish long-term partnership with Maribor waterworks. For this reason, the company should provide their own financial funds to prolong this project to better meet its potential employees, especially because it is a public company, which usually provide less stimulating working environment due to the deficit of public funds, and often therein older workforce is predominant.

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