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MODELLING OF LOGISTICS PROCESSES AND SYSTEMS

PART XIX

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Mirosław Chaberek[a)], Cezary Mańkowski[b)]

a) Department of Logistics, Faculty of Economics, University of Gdańsk
b) Department of Logistics, Faculty of Economics, University of Gdańsk

TELEOLOGICAL ASSUMPTIONS IN THE PROCESS OF IDENTIFICATION AND EVALUATION OF BEST LOGISTICS PRACTICES

Abstract

Problem of identification and evaluation of best logistics practices is not a new one, however it still causes a controversy on the methods of logistics practices assessment. Thus, the authors, based on the literature review, case study and their long experience at the area of logistics research decided to put under the readers critique their conception of teleological assumptions, based on 5R logistics aims (objectives, purposes) criteria, which can be used for the process of identification and evaluation of best logistics practices. The added value of this conception is expressed at a thesis (and developed at this paper) that the set of logistics aims can be understood, specified, or even parameterized, only in relation to the primary process (production, trade, service), which determines the right resource, the right quantity, the right location, the right time and the right cost (5R) towards its logistics support process.

Keywords: logistics, best practices

Introduction

The problem of identification and evaluation of best logistics practices is both of practical and theoretical meaning. Practical, because logistics managers should know and promote to their staff the most economical way of performing logistics works to save time money and other engaged resources. From theoretical point of view, the methodology for identification and evaluation of logistics best practices is also much needed, because the analysis of many cases allows building a set of models of the best logistics practices, which in turn can be implemented

into practice. There are some literature items, which touch the above mentioned problem, however the standard evaluation method have not been created yet, and there is still a place for conceptions at this research area.

Thus, the purpose of this article is to formulate a conception of identification and evaluation of best logistics practices based on theological criteria, especially 5R logistics aims. To meet this purpose, the literature study is used as a first research method, and for verification of the obtained theoretical results, the case study method at the form of an analysis of procedures and documents used by logistics operators and authors own experience are applied. Therefore, this methodology falls into the system research approach in logistics (Gammelgaard, 2004, p. 481). The final results are presented at two chapters. First one is focused on identification of managerial problems with the assessment of the logistics practices to find the best one, and the second chapter includes the authors' response to these problems. This proposition covers the teleological approach, which is based on 5R logistics aims (objectives) conception, for identification and evaluation of best logistics practices.

1. The problem of evaluation of best logistics practices

Every day a lot of logistics practices are performed. They are taking place at many areas of supply chains, for instance at procurement, transportation, warehousing or distribution. Some of them are routine, while the others are creative, some of them are relatively simply, while the others are rather complex, some of them are automated, while the others require staff to be carried out. However, despite logistics practices have been called in practice or at literature, each of them can be evaluated better or worse than the other one. What, then, is it that makes one practice better than another? Finding the answer to this question would enhance the theory of management science, especially in reference to logistics sub-discipline, with the knowledge on best logistics practices, which in turn could be applied to logistical practice to change bad or good practices for better.

From the theoretical and practical point of view, four main problems regarding the evaluation of best logistics practices can be formulated. First of them is of epistemology aspect, which regards the essence of best logistics practice, and which can be expressed at the questions: what is the best logistics practice? The second one concerns the ontology problem on the elements structure of the research object, and can be formulated as: what elements/components do the best practices consist of? The third one regards axiology question: what values do decide the logistics practice is the best? And last but not least, the fourth, methodological problem can be formulated as: what methods to use to identify the best logistics practice and evaluate it if it is still the best?

First, the literature review has been conducted to get answers to the above mentioned questions. The obtained results show that there is a lot of books and articles on logistics, which do not mention logistics best practices at all. There is also a large group of literature (Gattorna, 2009, pp. 134–138; Pagell, Wu, 2009, pp. 40–51), which includes a description of logistics practices, which are treated

by Authors as the best, but without a course of reasoning, which explains why they are called the best. Some of the literature titles include the expression of "best logistics practice" (Mejías et al., 2016; Zao et al., 2016), however, it does not explain the essence of the title category, neither what its main components are, nor why these and not the other assessment criteria were identified. It looks like the term "best logistics practice" have been treated as an ordinary and obvious logistics category, which does not require to be defined. There are only few literature items, which try to define the term and describe its attributes. A representative state of art at this area of research is reflected by the idea included at the following paragraph: "It is worth nothing that 'best' practices are both relative and transitory. They are neither 'best' in every way, nor 'best' for all time. They are the best practice within the specific context at that moment in time. Hence, the case studies do not attempt to provide universal best practices, but instead provide specific examples of best practice, which universally might be considered good, successful or improved approaches to the case in point. (...) Today, supply chains know no boundaries and learning from other people's successful practices form other companies, supply chains, industries and countries is hugely valuable" (Cetinkaya et al., 2011, p. 4). Even at this paragraph, there is no explicit definition of best logistics practice, what indicates on the problem with interpretation of the category. However, there are mentioned some attributes of best logistics practice as good, successful, improved, and able to learn as the main driver, reason and value finally, which can turn into an improved practice if applied successfully. Because of their broad meaning, these attributes can appear very helpful, when looking for the theoretical and practical assumptions of the best logistics practices.

A lot of literature presents examples of methods of best logistics practices and their applications. For instance, Svensson (2010, p. 17) proposes three teleological approaches: formative, rationalist, transformative, which can be used for planning, implementation and evaluation of supply chains, however this research is highly theoretical and require applications. Another example comes from Zao et al. (2016, pp. 475–476), who have constructed the best supply chain process model of logistics for Free Trade Port Zone, which is based on the method of pairwise comparisons. According to other researchers, a SCOR model should be preferred as a tool for identification of the best logistics practices. They claim that "The SCOR-model is a reference model. It does not provide any optimization methods, but aims at providing a standardized terminology for the description of supply chains. This standardization allows benchmarking of processes and the extraction of best practices for certain processes" (Stadtler, Kilger, 2008, p. 41). The same authors are also proposing a benchmark method as another tool for identification and evaluation of logistics practices in comparison to the best-practice standards (Stadtler, Kilger, 2008, p. 127).

It should be mentioned that the problem of best logistics practices were noticed by European Commission, because it decided to spend a lot of money (3.05 mln Euro) on the project titled "BestLog" within the 6-th Framework Program (BestLog, 2017). This project, which was run by the consortium of nine institutions of nine European countries and had been carried out for four years between February

2006 and May 2010, resulted at many outcomes. Because authors of the article were engaged at the works of the project personally, we would like to say that the obtained results included especially the identification of thirty and description of twenty cases of best logistics practices, which now are available at the web page of European Logistics Association in brief (Case, 2017) and at the form of book in full (Cetinkaya et al., 2011), while the whole project turned into a subsidiary, known as Elabestlog (2017), of the European Logistics Association in Brussels. In reference to the aim of this article, one of the result of the project was the framework for assessment of the cases, which included partially a set of quantitative metrics and qualitative judgment by experts (Piotrowicz et al., 2017, p. 460). Especially, the professional expertise is the most used method for evaluating logistics processes with the aim to chose the best one if looking at the practice. There exists a large group of professional organizations and consulting companies, which promote best logistics practices through some events, known as awards, prizes, competition, ranking and so on to honor the holders of best logistics solutions. The most know example is the "ELA Award" organised by the European Logistics Association (ELA) every year. The newest award for 2017 was granted to the global agriculture company AGCO, known for instance by its brand – Massey Ferguson tractors, for the project "AGCO Smart Logistics Closes Digital Gap". A short description of the project is valuable to quote, because among others it covers some elements of assessment method, which is used by the association. "The ELA jury selected (out of 30 award-winning projects from national competitions) the AGCO and 4flow initiative as the best this year. (...) The approach is based upon the principle of combining an intelligent transportation management system, a standardized supplier development process, and risk management into a central cloud-based IT solution. The innovative approach utilizes smart algorithms that dynamically optimize the network requirements holistically, including capacities, supplier shipping requirements, lead-times, as well as monitoring a wide range of geopolitical, weather, and economic factors on a real-time basis in order to optimize the material flow. (...) The solution enabled AGCO to reduce cost of the inbound supply chain by more than 25 percent during the past years. Furthermore, on time delivery performance increased by 10 percent while process conformance has increased by 15 percent. Paired with significant improvements in Supply Chain agility, the company generates a competitive advantage in the marketplace. In addition to the significant improvements in costs, performance and quality, the initiative is reducing the CO_2 footprint through improved capacity utilization and therefore it not only benefits AGCO but the environment as well" (AGCO, 2017). The above description confirms that the main selection method of the best project form the others is a jury judgment based on a selected metrics, both qualitative and quantitative as for instance at this case: cost, time, CO_2 footprint.

Coming to the summaries of this chapter, it should be stated that the problem of best logistics practices has got its importance both at literature and practice. However, the obtained results are not satisfied, because the category "best logistics practice" is still disputable as well as how to identify and evaluate them. Especially, a focus on the problem of evaluation framework for identification of best logistics practices is taken at the next chapter.

2. Teleological 5R evaluation framework for identification of best logistics practices

To deal with the above stated problem two following theses are formulated. First, because value is a core category of axiology, an evaluation framework for best logistics practices should be derived from axiological assumptions for logistics. Speaking more detailed, due to the fact, that logistics practices are purposeful activities, teleological[1] assumptions (a part of axiology), should stand for the right evaluation conception for them. This thesis is related to the second one, because if the results obtained from the verification of the first thesis will appear positive, they can also positively verify the second thesis, namely teleological evaluation framework defines the best logistics practice.

Axiology (Greek: *áksios* – worth, valuable, precious) is a part of philosophy, which treats about values. Hence, the other name of axiology is a philosophy of value or theory of value and valuation (Hajduk, 2008, pp. 9, 89). The idea of axiology conception is expressed at the following paragraph. "The concept of value permeates our life at every step. We prefer one thing to another, we shift our attention from one event to another, we praise one behavior and condemn another, we like and dislike, and whenever we do it we value. Behind our passions, interests, purposive actions is the belief that they are worthwhile. We attach to them different degrees of importance or value. (...) In fact, we not only value, but are always conscious of a scale of values, which scale relates to a degree and quality of satisfactions" (Hart, 1971, p. 29). It means that axiology is present at every area of human activity, thus it can be applied also for logistics purposes.

At the field of logistics, the importance of axiology assumptions had been already noticed (Mankowski, 2016, p. 33). This author proposed a system of axiological categories in logistics, which can be applied for the purpose of logistics value identification. The result of works on this issue is illustrated at the Figure 1.

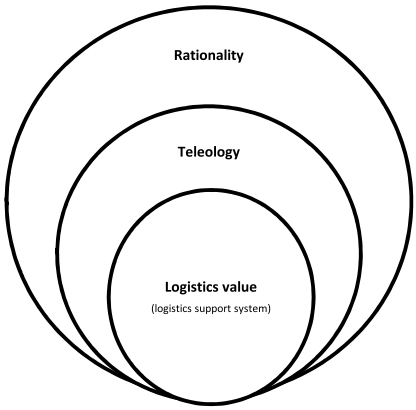


Figure 1. Logistics value at the axiology system
Source: (own elaboration)

[1] Greek τέλος, telos means end, purpose.

The broadest axiological category, which decides about the logistics value is a rationality (Turek, 2004, pp. 77–94). Due to the fact that rationality is treated as a property of a human being, and especially its consciousness and purposefulness, and that "The essence of human activity is to cause intentional (conscious) changes aiming for a particular purpose (...)" (Leśkiewicz, 1994, p. 22), the more detailed axiology categories are teleological ones. They stand for a set of logistics approaches, purposes, aims or targets, which, if met, decide on logistics values of logistics support system or its elements, for instance they decide if the actually used logistics practice on delivering goods to a customer was the best one or not.

If the teleological categories decide on logistics value, they should be taken as the main evaluation criteria for logistics practices. Teleology (form Greek: *telos* = achiving an aim + *logos* = word, science) is understood as a "philosophical view proclaiming that developmental processes in nature or society are going to an ultimate aim; finalism" (Tokarski, 1980, p. 751). At the area of logistics, three teleological approaches can be identified. First of them is quoted as 5R (Chaberek, 2002, p. 11), with a comment that the aim of the right quality and the aim of the right resource are redundant (a repetition of the same information), thus in practice it is not possible to describe the right resource without the required quality level. The second one is described as 3A: agility, adaptability, alignment (Lee, 2004, pp. 102–112), and the third one stands for a set of supply chain or logistics performance measures (Piotrowicz et al., 2007, pp. 463–465). The teleological approach based on 5R conception maintains that every human activities, individual or in group, need to be supported by a lot of other activities. The first kind of activities can be covered under so called primary processes, while the others at the supporting ones, including logistics process if resources are required. Thus the primary process determines the kinds of resources, their amount, the place and time for the delivery of goods, and at what cost, finally. In result, these five requirements stand for the 5R logistics aims to support the primary process at the right resources, with the right quantity, time, place, and cost. It can be added that the category "right" should not be identified by the maximum or minimum criteria, because for instance it is not good if three pallets were delivered instead of two, required by a customer, or one hour before the agreed time. The above mentioned conception of the logistics support function (not to be confused with the service function of the third party logistics sector) towards another main (or primary) process, combined with the need to solve multi-criterion decision problems related to 5R logistics aims, nearly 20 years ago, became a methodological basis for the research and didactic work of the Department of Logistics at the University of Gdańsk. This methodological approach, based on these two fundamental findings: the logistics support function and logistics optimization according to 5R objectives, was very often named as the Sopot School of Logistics by participants of the annual conferences[2]. The first studies systematizing the above concept and expressing it as a model of logistics support system of any purposeful human activity are

[2] Scientific Conference "Modeling of Logistics Processes and Systems" organized by the Department of Logistics, Faculty of Economics, University of Gdańsk, http://ekonom.ug.edu.pl/web/kl/index.htm [Accessed 10 June 2017].

included the following works (Chaberek, 2002, pp. 11–13; 2006, pp. 13–20; 2014, pp. 3–10; Chaberek, Karwacka, 2009, pp. 7–16). They have become a methodological foundation for many doctoral and postdoctoral theses, as well as commissioned researches. The logistics support function, raised in the above works, puts logistics (logistics process) on the same level as the primary process. Because both of them are mutually related, none of them can exist independently. Thus, logistics and its objectives (5R) can be analyzed practically only after identifying the main process. Conversely, no main process will occur without logistics support activities. The two next teleological approaches, namely 3A and a set of logistics performance measures, stand for the concretization of the 5R logistics aims, and allow focusing on some characteristics or metrics, which are of particular interest for the final customer or other members of supply chain.

Based on the above course of reasoning the following conception of teleological assumptions for evaluation of best logistics practices based on the 5R logistics aims criteria can be proposed. The core of the conception is expressed by a thesis that the logistics value is a logistics support system, especially the logistics process, which supports the primary process with the right resource or the service, in the right quantity, in the right location, in the right time and with the right cost (5R). So, logistics process can be discussed only at the relation to the primary process, which the logistics one supports at any needed resources or services. The main consequence of this relation is that the primary process demand determines the set of logistics aims by specifying, or even parameterizing the right resource or the service, the right quantity, the right location, the right time and the right cost. However, it is not a one-way relation, because the owner of logistics process also calculates its capabilities, benchmarks with competitors, considers regulations and other determinants, so this relation is rather a continuous multi-faced interaction, which leads to the final formation of 5R aims for logistics practices. This course of reasoning allows to derive a hypothesis that, if a logistics practice meets logistics aims contained at the 5R categories, it can be identified as the best one, and in consequence the 5R set of logistics aims stand for the main evaluations criteria for logistics practices (Figure 2).

Figure 2. Teleological framework for identification of best logistics practice and its evaluation
Source: (own elaboration)

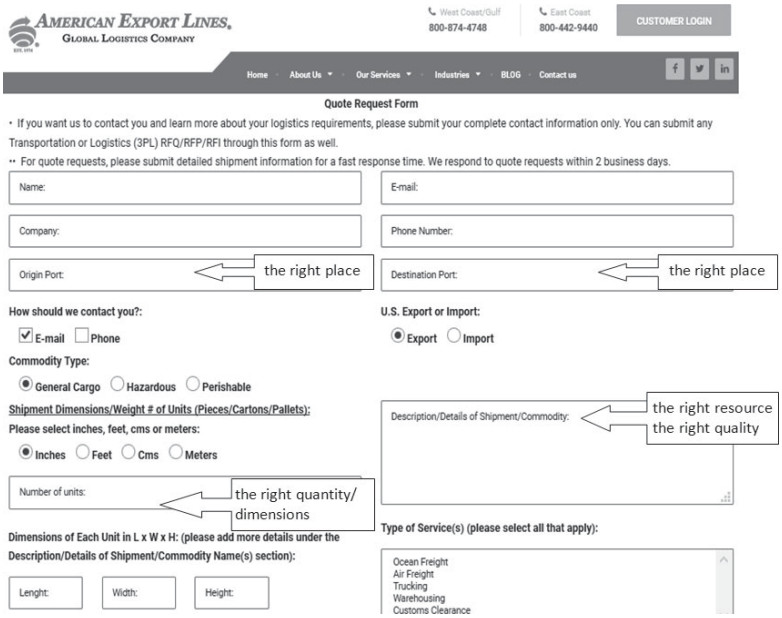


Figure 3. Quote request of American Export Lines
Source: (http://www.shipit.com/request-a-quote [Accessed 12 June 2017])

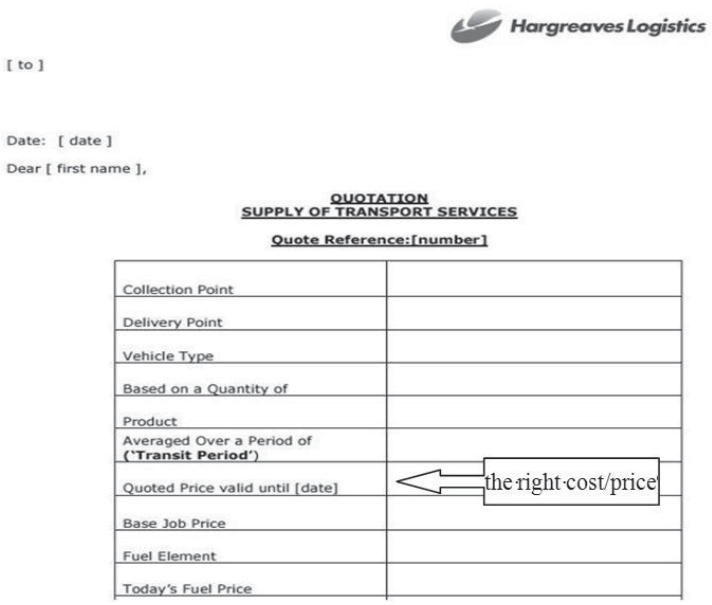
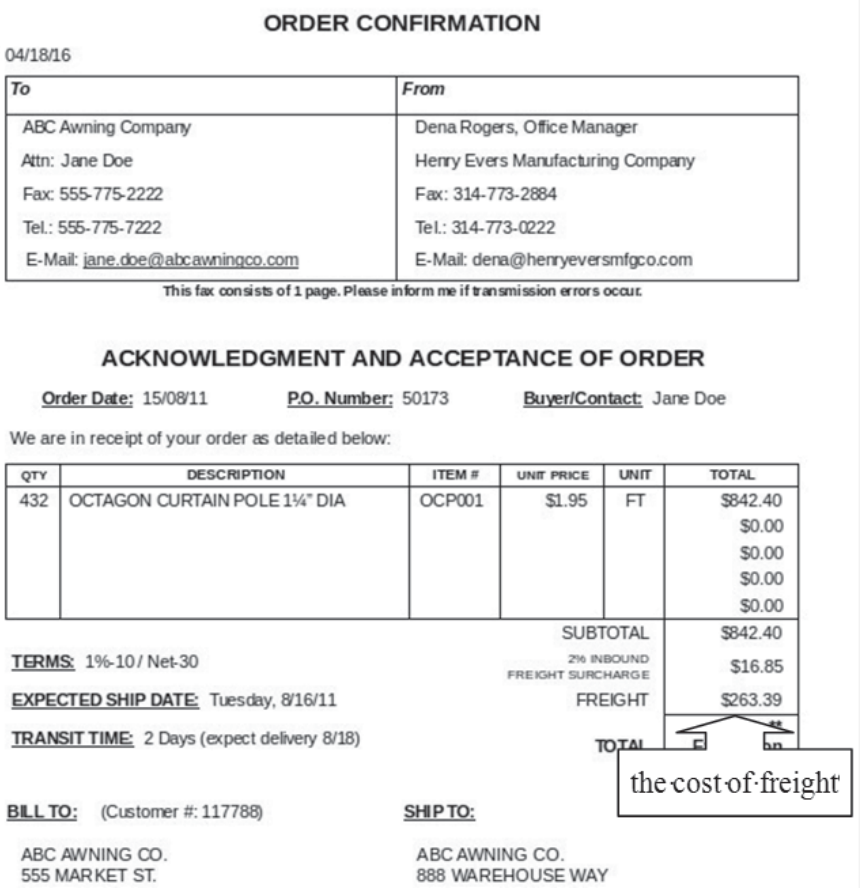


Figure 4. Quotation of Hargreaves Logistics
Source: (https://images.sampletemplates.com/wp-content/uploads/2017/04/Goods-Transport-Quotation.jpg [Accessed 12 June 2017])

The above theoretical considerations are confirmed by a business practice. The main and formal element of the initial transaction between the owner of the prime process, for instance production, and the logistics supporting process, is a request for quotation, or an order if the price is known. An example of the request is presented at the Figure 3. There is included 4R information, which requests for the fifth one – a cost/price for the customer. Thus the information about the cost is covered at the quotation (Figure 4), or at price list, tariff, proforma invoice, and finally confirmed at order confirmation (Figure 5), or agreement/ contract between logistics operator and the customer. The above practical examples prove that the logistics 5R aims are fully sufficient criteria to identify best logistics practices and estimate them.



ORDER CONFIRMATION

04/18/16

To	*From*
ABC Awning Company	Dena Rogers, Office Manager
Attn: Jane Doe	Henry Evers Manufacturing Company
Fax: 555-775-2222	Fax: 314-773-2884
Tel.: 555-775-7222	Tel.: 314-773-0222
E-Mail: jane.doe@abcawningco.com	E-Mail: dena@henryeversmfgco.com

This fax consists of 1 page. Please inform me if transmission errors occur.

ACKNOWLEDGMENT AND ACCEPTANCE OF ORDER

Order Date: 15/08/11 **P.O. Number:** 50173 **Buyer/Contact:** Jane Doe

We are in receipt of your order as detailed below:

QTY	DESCRIPTION	ITEM #	UNIT PRICE	UNIT	TOTAL
432	OCTAGON CURTAIN POLE 1¼" DIA	OCP001	$1.95	FT	$842.40
					$0.00
					$0.00
					$0.00
					$0.00
			SUBTOTAL		$842.40
			2% INBOUND FREIGHT SURCHARGE		$16.85
			FREIGHT		$263.39
			TOTAL		

TERMS: 1%-10 / Net-30

EXPECTED SHIP DATE: Tuesday, 8/16/11

TRANSIT TIME: 2 Days (expect delivery 8/18)

the cost of freight

BILL TO: (Customer #: 117788)

ABC AWNING CO.
555 MARKET ST.

SHIP TO:

ABC AWNING CO.
888 WAREHOUSE WAY

Figure 5. Order confirmation including the cost of freight
Source: (https://images.template.net/wp-content/uploads/2016/04/18141633/Order-Confirmation-Template-Free-Editable-Download.jpg [Accessed 12 June 2017])

Conclusions

The above presented research results prove that the teleological conception of 5R logistics aims (or objectives, purposes) can be used for identification and evaluation of best logistics practices in theory and in practice. The strong side of this conception is in that it is not much complicated from one side and ensures a relatively high level of reliability and correctness when compared with the other practices on the other side. This conception feature is very important especially from the practical point of view, because the 5R aims can be understood by logistics managers intuitively at the same way, what ensure the same assessment results of the logistics practices. The novelty of this conception is included at the thesis that the set of logistics 5R aims can be understood and identified only in relation to the primary process (production, trade, service), which determines the right resource, the right quantity, the right location, the right time and the right cost towards its logistics support process.

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Corresponding authors

Mirosław Chaberek can be contacted at: miroslaw.chaberek@ug.edu.pl
Cezary Mańkowski can be contacted at: ekocm@univ.gda.pl

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Jonatan Rantanen[a)], David B. Grant[a), b)], Wojciech Piotrowicz[a)]

a) Hanken School of Economics, Finland
b) Hull University Business School, UK

INVESTIGATING SUPPLY CHAIN COOPERATION IN FINNISH GROCERY RETAIL

Abstract

This paper explores how a cooperative approach to supply chain management enhances supply chain performance under fluctuating demand and uncertainty in the grocery retail sector. The exploratory and qualitative empirical study comprises a two-echelon case study of a Finnish grocery retail supply chain focussing on a grocery wholesaler and its tier 1, small retail customers. Interviews were conducted with key respondents at both echelon levels and it was found that cooperation can be a useful and successful technique to reduce costs and improve supply chain performance in a volatile and uncertain demand context. A list of enablers and barriers for supply chain cooperation were developed to guide practitioners and there is a brief discussion of this study's implications for Poland.

Keywords: supply chain management, supply chain cooperation, supply chain integration, retail, grocery sector

Introduction

Several research streams regarding the practical implementation of supply chain cooperation (SCC) and the benefits from such cooperation in the retail grocery sector have developed over the last two decades[1]. Early advances in the field of SCC were primarily concerned with information exchange (Skjoett-Larsen et al., 2003), including for example continuous replenishment (CR) and vendor-managed inventory (VMI). Later work has holistically addressed additional supply chain

[1] We note the term collaboration is widely used in the North American and UK contexts as opposed to cooperation and we suggest anyone wanting to read more around this topic should search using both terms.

(SC) needs by widening the scope to joint planning, forecasting and replenishment in the forms of efficient consumer response (ECR) and cooperative planning, forecasting and replenishment (CPFR).

However, issues of fluctuating demand and demand uncertainty identified at the turn of the Millennium (Barratt, Oliveira, 2001) still affect supply chain performance using advanced cooperative processes (Ehrenthal et al., 2014), and it has been suggested that deeper cooperation is the key to decreasing the impact of demand fluctuations (Simatupang, Sridharan, 2005; Alftan et al., 2015). Thus, "after years of attention to [SCC] with mixed reviews it seems [SCC] is both active and understudied. Firms are choosing different levels of [SCC] with partners [and] (...) now is the time for deep and detailed studies of firm" [SCC], strategies behind it, and "what can reasonably be expected from" [SCC] (Ralston et al., 2017, p. 525).

The grocery retail sector and its associated supply chains differ from the manufacturing and non-grocery sectors due to the perishable nature of most products and greater demand fluctuations caused by more frequent purchases and promotional campaigns (Taylor, Fearne, 2009). Some research has investigated the state of SCC and different SCC initiatives in the retail grocery sector (see for example Kaipia et al., 2013; Ehrenthal et al., 2014; Elkady et al., 2014; Alftan et al., 2015), however research on the links between information technology (IT) sharing, SCC, and SC performance remains sparse (Elkady et al., 2014). In addition, demand uncertainty and seasonality are areas often poorly considered by smaller retail chains in particular (Ehrenthal et al., 2014). This paper addresses these shortcomings by exploring the gap between IT, SCC, and SC performance to extend knowledge from previous research and combine it with fresh empirical data.

1. Literature Review

Ralston et al. (2017) consider SCC relationships as "long-term relationships where participants generally cooperate, share information, and work together to plan and even modify their business practices to improve joint performance" (2017, p. 508). Nowadays, SCC is considered vital to achieve increased competitive advantage for a particular SC (Kumar, Banerjee, 2012). Advances in IT and the Internet as an IT platform have made technology easily available and less costly for firms, with the result that the status of IT as a competitive advantage enabler has been reduced, turning IT instead into a competitive necessity or hygiene factor (Fawcett et al., 2011). However, previous failures to obtain expected benefits from IT implementation, especially in the cooperative efforts of small supply chains, have demonstrated flaws in thinking that SCC always increases supply chain (Elkady et al., 2014).

Furthermore, some discussions about SCC initiatives are still at a theoretical level and have not progressed to widespread practical application in industry (Büyüközkan, Vardaloğlu, 2012; Panahifar et al., 2014). The literature also suggests that cooperation is not a question of 'either or' and that supply chains should cooperate instead on different levels with different firms and that the intensity

of cooperation with different partners should generally increase gradually with time, resulting in a contingent approach to cooperation among companies (Skjoett-Larsen et al., 2003; Danese, 2011).

Supply chain cooperation has been described and defined in several different ways however the general idea is that supply chains work together to achieve a competitive advantage (Soosay, Hyland, 2015). The practical implementation of supply chain management (SCM) can be seen as a balance between two processes as cooperation is about both the relationship among companies as well as the integration of business processes of two or more companies deciding to cooperate. The type of supply chain cooperation can be assessed on two different scales: systems cooperation (Kim, Lee, 2010) and cooperation depth (Matopoulos et al., 2007). Systems cooperation can be viewed as the extent to which supply chain partners align and integrate their IT systems with each other, while the depth of a cooperative relationship can be either strategic, tactical or operational (Kim, Lee, 2010).

Regarding depth, at a strategic level firms seek to develop a culture of cooperation and relationships that will influence all business processes and decisions. At a tactical level firms seek some form of integration with each other while on an operational level firms focus on information exchange (Matopoulos et al., 2007). Strategic and systems cooperation have a tendency to strengthen each other: increased depth of cooperation make increased systems integration and real-time information exchange necessary, while the sharing of increasingly sensitive data and systems integration call for a more strategic partnership between firms (Kim, Lee, 2010).

A cooperative relationship begins from two factors: trust and technology (Barratt, Oliveira, 2001). Trust is seen as an important enabler of cooperation and conversely a lack of trust is seen as a barrier (Barratt, Oliveira, 2001; Skjoett-Larsen et al., 2003; Attaran, Attaran, 2007). A lack of trust might also lead to more transactional as opposed to relational behaviour on behalf of cooperating firms (Grant, 2005). Simatupang and Sridharan (2005) suggest five critical factors for supply chain cooperation: a cooperative performance system (CPS), information sharing, decision synchronization, incentive alignment, and integrated supply chain processes.

The concept of power is an integral part of supply chain relationship management as levels of trust and dependency can either enable or inhibit the development of cooperative relationships (Matopoulos et al., 2007), while a fair sharing of risks and rewards are necessary for a successful SC relationship (Simatupang, Sridharan, 2005). The alignment of supply chain partners is critical as synchronization of both systems and decision-making is in a key role in SCC (Matopoulos et al., 2007).

Information sharing also plays a key role in the coordination of supply chain activities, and especially in reducing the bullwhip effect or demand amplification (Elkady et al., 2014). The extent of cooperation is also important as SCC requires resources and thus firms have to choose how and on what level they should cooperate. Skjoett-Larsen et al. (2003) suggested that there are three levels of CPFR cooperation based on the scope (number of business processes in cooperation) and depth (level of integration of these processes), while Matopoulos et al. (2007) suggested similar levels of cooperative relationships. The basic idea behind this is that firms can tailor suitable cooperative solutions for their specific needs (Danese, 2011).

Thus, SCC consists of managing supply chain activities and managing supply chain relationships. These include the process of selecting cooperative partners, what practical implementations and processes the cooperation should involve, and the management of levels of trust and power among partners. The implementation of SCC also requires firms to emphasize and exploit enablers while mitigating and removing barriers to cooperation. As the literature suggests, the need for cooperation generally comes from external, macro-industrial factors in the form of increased competition.

The grocery retail setting is particularly competitive due to homogeneous products that make price a key competing factor between retail chains. Key drivers behind the integration of supply chain partners here are the need to achieve increased effectiveness for the whole supply chain as well as higher quality service to customers. Also, an internal supply chain requirement to mitigating the bullwhip effect is an important driver for increased transparency and integration in the SC. As the primary focus of this paper is on information flows, IT capabilities thus become a primary driver for supply chain processes.

The objective of this paper and its related empirical study were to investigate how cooperative supply chain capabilities can cope with uncertain demand, i.e. extend previous research on cooperative supply chains to a field which is not extensively researched yet (Elkady et al., 2014). One of the growing aspects of contemporary SCM research is how technological advances enable supply chain cooperation (Soosay, Hyland, 2015) as well as how human resources, particularly at store level, interact with various systems and replenishment methods (Trautrims et al., 2012). In this context, we consider depth to be vertical integration only. There has been some work on horizontal collaboration but the retail grocery sector has been slow to adopt this concept (Hingley et al., 2011) and thus it is outside the scope of what we want to explore. Thus, we developed an empirical study to explore how aspects of this phenomenon work in practice (Yin, 2009). The research questions for this study are as follows:

RQ1: How are the various partners or actors collaborating in this supply chain?

RQ2: What are perceived barriers and enablers to supply chain cooperation in the supply chain?

RQ3: What are practical implications of increased supply chain cooperation and information sharing in the supply chain?

The first research question seeks to explore the function of the supply chain cooperation within the context of wholesaler-retailer. However, the second and third research questions are more focused on descriptive research, to generate an understanding of actor expectations and perceptions of SCC.

2. Methodology

The empirical study is conducted from a 'reality-oriented' perspective, placing focus on the validity, reliability and objectivity of the data in light of previous literature and taking into account the fact that total objectivity is not possible.

The research process is thus inductive, i.e. progressing from observations toward enhancing extant theory (Patton, 2002). We use a case study as it is an appropriate method when doing exploratory research to address what, why and how questions (Ellram, 1996; Yin, 2009). Case studies are studies that "focus on holistic situations in real life settings, and tend to have set boundaries of interest, such as an organization, a particular industry, or a particular type of operation" (Ellram, 1996, p. 99).

Previous literature already provides some answers for the why, i.e. to answer to fiercer competition (Matopoulos et al., 2007) and to reduce waste and increase shelf availability and effectiveness, ultimately providing increased service levels to customers (Kaipia et al., 2006; Kaipia et al., 2013; Alftan et al., 2015). Thus, this study specifically focuses on the how and what regarding links between performance increases and cooperation with a focus on the challenges of demand volatility and uncertainty.

The empirical study investigated two echelons, a wholesaler (focal company) and two of its retail customers, and specifically focuses on a real-life setting within a specified bound of interest (i.e. specific organization, industry and operational setting). The focal company, which is called WS in this paper, is a wholesaler in the Finnish grocery industry. The retail customers of WS that are part of this research are called RS and RW in this paper.

RS is a retail chain consisting of several hundred small grocery stores operating nationwide in Finland. RW is a retailer-wholesaler, whose customers consist of primarily smaller grocery and retail chains and corporate customers in the HoReCa (Hotel, Restaurant, and Catering) sector. RW also operates cash-and-carry grocery stores that serve both private and corporate customers (primarily small restaurants) directly around Finland. WS obviously has other customers, but RS and RW are the two most important when considering revenue and volumes, and thus are the only ones included in the case study. RS and RW also have a symbiotic relationship with WS through a shared ownership structure.

Empirical data were gathered through semi-structured interviews with key personnel from the three companies; see Table 1 for demographic details. The sampling was developed with the planning manager of WS and is a purposeful sample based on the perceived quality of information that the respondent could give (Patton, 2002). We used an interview guide to aid in the data gathering process and give structure and coverage to the interviews however interviews were still conversational with open-ended questions to allow increased depth (Ellram, 1996; Patton, 2002).

Interview transcripts were analysed using content and thematic analysis techniques to determine similarities and differences (Patton, 2002). The small number of interviews for this exploratory study does not justify the use of qualitative data analysis software such as NVivo (Dey, 1993). During the analysis process some additional questions arose and were answered through e-mail correspondence with PlanMng from WS.

Table 1. Interview Respondents

Organization	Title	Abbreviation
RS	Logistics Manager	LogMng
RW	Logistics Development Manager	LogDev
WS	Planning Manager	PlanMng
WS	Logistics Manager	LogMng
WS	Logistics Development Manager	LogDev
WS	Planning Manager	PlanMng

Source: (own elaboration)

Research quality in a qualitative context was determined by the notion of trustworthiness and its four criteria of quality, as opposed to usual quantitative quality measures of external and internal validity, reliability and objectivity (Halldórsson, Aastrup, 2003). The four quality criteria for trustworthiness are credibility (degree of match between respondents' view of reality and a researcher's representation of these views); transferability (extent to which the study is able to make general claims); dependability (concerned with the stability of data over time); and confirmability (findings represent the results of the inquiry and not the researcher's biases). Despite the small number of interviewees we believe our use of the trustworthiness elements and criteria has enabled us to collect some of the rich data we anticipated.

3. Analysis and Discussion

RQ1: How are the various partners or actors collaborating in this supply chain?

The three organizations cooperate in all phases of the physical flow of goods through the supply chain on a range of activities including procurement, quality control and importation of goods. Forecasting and replenishment is centralized to WS, and strategic business plans are made in cooperation through regular meetings on multiple executive levels. This can be seen as cooperation with regards to exception management and promotional campaigns, but also in the day-to-day distribution and logistics as these are largely handled by WS. The distribution of goods is outsourced to third-party logistics (3PL) firms and while WS coordinates and handles the process of sending the right cargo with the right truck to its customers it does not own any trucks itself.

The interviewees listed multiple reasons for this kind of cooperative approach. The case supply chain is characterized by a drive to enable better service to the end customer and increase efficiency or reduce redundancies in the supply chain. The motive for increased cooperation is to increase the efficiency of the supply chain and one of the interviewees commented on the cooperation in the following way: "of course we work more like a single company (...), create a win-win-win situation through success" (LogMng, RS). The role of WS in the supply chain was described in the following way: "we are this kind of strategic supply chain partner, so we have sought integration both with customers and towards suppliers (...) and build more added value through this, compared to buying and selling which is more like

traditional wholesaling" (LogMng, WS). As Simatupang and Sridharan (2005) suggest supply chain cooperation needs a fair balance of power and this supply chain has resolved the issue through the ownership structure of the wholesaler. Thus, a lot of the executive power can be transferred to the wholesaler without the retail echelon of the supply chain losing control. Costs of this arrangement are generally also distributed according to the resources allocated to each of the retailers.

Some interviewees also mentioned other important reasons for cooperation such as the idea to use shared and common information and to work more like a single company across the supply chain, instead of everyone doing their own thing. The supply chain collaborates on multiple levels, and as Danese (2011) and Skjoett-Larsen et al. (2003) suggest cooperation can be seen as a gradual process or a contingency from 'basic cooperation' to 'advanced cooperation'. This is also something that can be applied to the cooperative practices of WS, as it collaborates on different levels with some of its customers than with others, based on mutual needs and understandings. As suggested by Matopoulos et al. (2007) firms should choose with whom, and on what level, they want to cooperate (i.e. operational, tactical, or strategic). WS has a high level of cooperation with especially RS, and this has also brought efficient synergies to both companies.

The cooperation in the supply chain is quite extensive, as a centralized forecasting and replenishment function is managed by WS and the goal is to use this data as far as possible both downstream and upstream in the supply chain. The management of relationships in the SC is handled through agreements on cost sharing and trust building (Grant, 2005), and also through KPI and data showing that the integration actually works. This leads to the topic of the second research question.

RQ2: What are perceived as barriers and enablers to supply chain cooperation in the supply chain?

Three key topics emerged in the interviews that cover most of the enablers mentioned: culture (trust, willingness to cooperate, top management support), communication and (technological) capabilities. These topics are also frequently found and cited in literature as key enablers to SCC (Barratt, Oliveira, 2001). The role of IT was mentioned several times however the underlying culture of openness, trust and communication was in a key role in enabling the technological aspects of cooperation. The barriers are more diverse and views on the matter differed more between respondents as well. Generally, the topic of barriers was considered more difficult as the cooperation in the supply chain seemed to be working very smoothly. IT capabilities in the supply chain are generally considered adequate, but the accuracy and reliability of the forecast was mentioned as a limit to the extent of IT-enabled cooperation. However, the main barriers were seen in cooperative culture and traditional thinking that causes companies to hold information secret from supply chain partners, and this is also in line with previous research (Skjoett-Larsen et al., 2003).

Enablers were considerably more prominent when the interviewees were asked about possible enablers and barriers. In particularly, the technical aspects and cooperative culture were applauded by the respondents. However, previous research suggests that IT alone is not enough to enable cooperation on a profound level, and thus it would seem like the corporate culture has enabled the technical

side of the integration to work at its full potential. Forecasting accuracy was also at some points not good enough, and then flexibility and communication were considered necessary along with improved forecasting abilities to enable the cooperation to go further. Most of the respondents had also positive attitudes towards the idea of further integration and that there were further gains to be realized from increasing the depth and width of integration. Also, the shared ownership and company structure solved many of the issues related to power that Matopoulos et al. (2007) pointed out, i.e. the wholesaler does not gain all the power in the supply chain even though the forecasting and replenishment is concentrated to it.

However, the respondents emphasized that barriers were quite minor compared to enablers and that the practical results and KPIs strongly supported cooperation. As the transparency of KPIs became better through increased understanding of the partners business decisions, it was also easier to 'sell' the new cooperative practices within the organizations as the numbers supported this development. The interviewees were also quite content with the results of the integration in the supply chain, and this could also be seen from the answers to the last research question.

RQ3: What are practical implications of increased supply chain cooperation and information sharing in this supply chain?

The interviewees reported a range of benefits from SCC and information sharing including more efficient SC operations and improved customer service. Generally, the cooperation was not regarded as something that would bring additional costs or other harmful effects as the integration of processes such as forecasting and replenishment freed time from other instances in the supply chain instead. If costs arose from some cooperative activities, they would usually be divided between the customers according to the volume impact of the process.

The main benefit of the cooperation to retailers RS and RW was a more efficient allocation of workforce. Store employees no longer had to spend as much time ordering and managing store inventory levels, instead the centralized forecasting and replenishment function freed more time for the 'core business' of selling and serving customers (Trautrims et al., 2012). The main benefit at WS was more efficient capacity utilization and more possibilities for optimization. The integrated forecasting and replenishment function at WS also provided better visibility and less redundant work throughout the supply chains, and this was also one of the stated purposes of this arrangement.

This was commented on in the following way by one of the interviewees: "well, the starting point for all these kinds of implementations was to start by freeing time at the store end to concentrate on the relevant tasks, that is customer service. Ordering was not their actual core activity, rather it is selling products and serving customers. (...) And of course through all the possibilities to forecast we have more information at our disposal here at [WS] so we have the possibility to plan our activities better" (PlanMng, WS).

4. Implications for Poland

Here we provide observations from extant literature on the foregoing issues as they may relate to Poland. Only English language academic papers were reviewed for this section. The state of Polish retail, past, and expected changes for the future are briefly presented, looking at development of the retail structure, cooperation among actors, as well as barriers and enablers required for cooperation.

4.1. Changes in retail structure

Waters (1999) documented the change in Poland's industrial policy, which concentrated on heavy industry and mining but put no emphasis on the retail sector prior to 1989. Subsequently, Poland went through a period of major economic change and the existing distribution system could not cope with increasing consumer demands. The government withdrew from the retail sector and encouraged private ownership and welcomed foreign companies to open branches. As a result, retail hypermarket operators from Western Europe moved into the market strongly during the mid-1990s (Dawson, Henley, 2000). Key changes taking place in the distribution of Fast Moving Consumer Goods (FMCG) in Poland included a sharp rise in the number of retail outlets, grocery stores, supermarkets, shopping malls and completely new food distribution channels. Hypermarkets and discount stores controlled by foreign chains changed the image of FMCG distribution in Poland (Reysowski, 2008).

However, it is important to note that in Poland small private retailers already existed, even during the communist period along with state-owned chains, or were established during transition. These retailers, typically family-owned stores, formed the core of a new private sector which proved to be flexible and agile in adapting to changing circumstances and grew rapidly during periods of economic uncertainty when other sectors faced less stable futures (Waters, 1999; Lorentz et al., 2007). Poland was among the first of the Central and Eastern European countries to remove trade barriers and allowed Foreign Direct Investment (FDI) in both the retail and agri-food sectors. This in turn attracted inflow of capital and knowledge. Poland was within the first wave of retail modernisation among post-communist countries (Dries et.al., 2004), so the maturity and convergence towards modernity, which was not much different from 'western' retail, was dynamic. AT Kearney (2016) noted that the Polish retail market has already passed the maturity stage and reinforces observations of Karasiewicz and Nowak (2010) that indicated a period of market consolidation and increased competition in the early 2000s. Poland was the second most internationalised market in Europe behind France (Coe, 2004), and fierce competition between retail chains also enhanced cooperation among SC members and adoption of Western management practices.

4.2. Cooperation and management practices

Economic power, which had previously been concentrated in manufacturers and the bureaucracy of obligatory intermediation, clearly moved to the retailers, similar to the changes that occurred in UK grocery retail supply chains in the 1970s (Fernie, Grant, 2008). Growth of foreign retail was associated with a transfer of not only capital, but also knowledge, business culture, practices and connections of Polish producers into te global supply chains.

Replication of Western structures and practices was typical in the early stage of retail internationalisation (Michalak, 2001). Later, as the market matured foreign retail companies adjusted their practices to local settings while at the same time Polish players adapted Westerns tools, techniques and structures (Páll, Hanf, 2013). Mehta et al. (2001) investigated the transferability of management practices across cultures in marketing channels and examined leadership styles, cooperation, and channel member performance across three divergent national cultures, the USA, Finland and Poland. They found that adaptation of leadership style to reflect cultural differences is necessary to manage or gain cooperation in international marketing channels; that existing marketing channel structures and changes occurring, in particular Poland, may affect channel member responses to leadership styles; and building cooperation in international marketing channels may take time in some countries as old attitudes and behaviours need to disappear before new ones that promote rather than inhibit cooperation can emerge.

Management practices in Poland involved lean techniques which aim at cost and inventory reduction across the SC as well as agile SCs that are concerned with customer responsiveness, people and information, cooperation within and between firms in order to better meet customer needs and gain competitive advantage (Van Hoek et al., 2001; Kisperska-Moron, Swierczek, 2009). Kisperska-Moron and Swierczek (2009) note that integration in an agile supply chain means cooperation between buyers and suppliers, joint product development, common systems and shared information. They further argue that such cooperation among business partners is a vital factor for agility of firms in Polish supply chains in Poland; i.e. a firm's positive attitude towards cooperation with suppliers and customers also enhances efforts to build agility in the entire supply chain.

Together with foreign retailers, a focus on quality improvement appeared, starting from the introduction of private quality standards (Michalak, 2011). Such rising quality requirements are key factors for food supply chain redesign and Hanf and Pieniadz (2007) argue that food supply chains proceed through hierarchical strategic networks coordinated by powerful focal firms, which require strong leadership. These firms choose a quality strategy and employ chain quality management concepts by exerting managerial discretion to achieve super-ordinate network aims. Hanf and Pieniadz (2007) tested these concepts in the Polish dairy market and found firms' activities are generally aligned with current market opportunities for optimal enterprise performance. They also determined that manufacturers of well-branded products create an advanced network structure that has a focal company exercising quality management.

Further changes were related to redesign of logistics systems, foreign retailers closely cooperate with third-party logistics (3PLs) service providers, however small and medium-sized enterprises (SMEs) still lag behind in the use of modern logistics (Jałowiecki et.al., 2014).

4.3. Barriers and enablers in cooperation

Fischer et al. (2008) examined inter-enterprise relationship situations in five different European Union (EU) countries, Germany, UK, Ireland, Finland, and Poland, for two different commodities (meat and cereals) and two different chain stages (upstream: farmers-processors and downstream: processors-retailers). A corollary study investigated consumer trust in food, which has become an important factor for the stability of the food sector, and found that a prerequisite for the ability to communicate the trustworthiness of food to consumers is the creation, maintenance, and communication of trust between companies across the entire food value chain (Fritz, Fischer, 2007). Lack of trust, however, together with low level of available capital and slow modernisation were listed as barriers for consolidation among small retailers. Even in face of the competition, small shop owners were still reluctant to cooperate (Michalak, 2011). Trust was the major issue, as in Poland there was improvement in IT accessibility and usage (Piotrowicz, 2015), thus there are tools for cooperation available. Despite the problems competition slowly pushed small retailers towards consolidation and cooperation, which was often supported by wholesalers. Wholesalers, as powerful market players, acted as initiators and moderators of such cooperation (Domański, 2011).

Fischer et al. (2008) found that a high correlation exists between good communication, equal power distribution between business partners, and the development of personal bonds, indicating these factors can be collectively regarded as part of the relationship building process and should be developed together to enhance inter-enterprise relations. The most important contributor to the sustainability of a business relationship is good communication, which involves adequate communication frequency and high information quality, and was found particularly relevant in Finland and Poland. Such formal relationships appear preferred by long term-oriented businesses or those which operate in quality-oriented markets.

In essence the Polish experience, while temporally lagging western European countries such as Finland, appears to be following suit as regards the importance of cooperation in the retail grocery sector. However, differences still exist. Managerial practices and tools for cooperation, such as IT, are widely available, the tangible retail (stores, malls), IT (internet access, bank payment systems) and logistics (roads, railways and warehouses) infrastructures are modernised, reaching or even exceeding Western standards, while the societal changes are much slower. This includes low trust, hesitation or even aversion to close cooperation, which likely are grounded in the pre- and early transition periods, when institutions, norms and enforcements mechanisms in business were very weak.

Conclusions

This study of cooperation in Finnish grocery retailing finds that increased information sharing and IT integration, together with SCC, provides increased supply chain effectiveness for all firms involved. The most important enablers for cooperation are trust and cooperative culture in conjunction with technology. On the other hand, the most important barrier identified is the unwillingness to share information or ultimately to cooperate. This finding highlights the importance of cooperation acceptance among firm personnel and managers, as well as the importance of extensive information sharing. These findings support previous literature regarding enablers and barriers, especially trust issues prominent in this case (Barratt, Oliveira, 2001; Simatupang, Sridharan, 2005).

The process of implementing cooperative approaches for a range of activities and building supportive IT capabilities appears to be a gradual process with a limited beginning and expansion later into areas where and when the firms experienced a need for it, and this finding corroborates the literature as well (Skjoett-Larsen et al., 2003; Danese, 2011). Furthermore, the findings also suggest that the centralization of forecasting and replenishment to the wholesaler, together with the sharing of forecast data both upstream and downstream in the supply chain, i.e. almost a vertically integrated approach (Hingley et al., 2011) can be a very powerful method of increasing supply chain efficiency. Finally, this study gives insights into the complex processes and the nature of the cooperation in this supply chain.

The results of this paper will also be of interest to practitioners looking for ideas and cases of practical implementation for deep and strategic supply chain cooperation. The main practical implications highlight the importance of information sharing and strategic alignment on successful cooperation. A societal impact of this study can also be identified, as one of the results of increased forecasting accuracy means less spoilage, therefore resulting in less waste and pollution.

As with all research there are several limitations to this study. The one supply chain case and the small sample means the findings are not applicable to other supply chains or industries. Nevertheless, this study provides interesting points of departure for further research. Future studies should seek to quantitatively verify the effects of centralized forecasting and replenishment for several actors in the supply chain both upstream and downstream. Also, the delimitation to not include suppliers of WS warrants additional studies from an upstream multi-echelon viewpoint. The section focused on Polish retail is based on secondary sources in English language, thus further empirical research in the Polish context could validate future developments for Poland.

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Corresponding authors

Jonatan Rantanen can be contacted at: jonatan.rantanen@gmail.com
David B. Grant can be contacted at: D.Grant@hull.ac.uk
Wojciech Piotrowicz can be contacted at: wojciech.piotrowicz@hanken.fi

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Peter Maas Geesteranus[a)], **Cezary Mańkowski**[b)]

a) Department of Logistics, Faculty of Economics, Windesheim University of Applied Sciences, Zwolle, The Netherlands
b) Department of Logistics, Faculty of Economics, University of Gdańsk, Poland

HEALTHCARE LOGISTICS: AN INTEGRAL, PROCESS-ORIENTED APPROACH

Abstract

The healthcare industry is in full swing. Pressure on the industry increases as a result of social, economic and financial developments. An aging population, increase in care demand, high costs and higher demands on customer value are significant aspects in this. One of the ways of dealing with this, in the Netherlands as well as in Poland, is to organize healthcare processes more efficiently in combination with a more empathetic focus on the customer. Healthcare Logistics stands for an integral approach of the design of healthcare processes, in order to make a contribution to the optimizing of customer value, cost control and savings in the healthcare. Lean and process management focus mainly on designing healthcare processes as efficient as possible where appointments with the customer of those processes are the principle. The logistic contribution counts mainly for tuning the required and available capacity. For the development and putting into practice of integral and customer oriented process management there are several models and tools available, which are deployed in conjunction with each other. Hence the article is focused on integral process oriented approach of healthcare logistics.

Keywords: Healthcare Logistics, Lean, process management

Introduction

The healthcare sector in the Netherlands is in full swing and faces big challenges. Developments on the side of the healthcare demand as well as on the side of the healthcare offer demand a transition in the way of thinking about

the organization of the healthcare offer. Traditional thinking in 1st, 2nd and 3rd line-healthcare paves the way for an integral approach of and cooperation in the entire healthcare chain. The government's role and (along with that) the financing of healthcare change. Both from substantive healthcare as from organizational arguments the role of the healthcare demander, the customer, client or patient changes from dependent to independent and directing. As a result of these developments organizations reposition themselves, new offers and providers emerge, healthcare concepts change and healthcare providers focus on costs control and saving. Also views considering organization design change firmly. They move from a task and function oriented approach in, traditionally, hierarchically organized environments to a process oriented organization design, in which the importance of the patient and smart designs of processes are on the front. Self-control makes its entry. In Poland, the healthcare sector is also in full swing, though from an entirely different basis. Here, costs control and saving also make an important contribution to a healthier sector (MZ, 2017; PWC, 2017).

Hence, this article follows the way in which, given the turbulent healthcare context, an integral process oriented approach can make a contribution to an important aspect of the developments: organizing healthcare more efficiently or more precise, designing healthcare processes more effectively, where the result is a healthier balance between healthcare costs and results. Staff and treatment costs generate a large chunk of the healthcare costs, thus a focus on deploying people and tools more efficiently is an important priority.

The outlined principle, developments, methods, theories and models determine the purpose of the article, which is a development of an integral process oriented approach at the turbulent healthcare logistics. To meet this aim two main research methods are used. First of them is a literature review, which identifies the 'state of the art' – perceptions about healthcare logistics. The literature results are verified by one of the Authors (Peter Maas Geesteranus) experience, which was gathered during the past decade in the higher vocational education in the Netherlands. Subsequently the following issues are discussed:

– healthcare logistics:
  a) definitions, principles en defining,
  b) strategy, focus, management levels,
  c) integral approach organisation-design of healthcare processes;
– primary processes as principle for organization design:
  a) tuning demand and offer,
  b) the healthcare demand defined: customer and result,
  c) healthcare offer: process optimalisation.

Based on the theory and Author (Peter Maas Geesteranus) vocational experience, the integral an integral process oriented approach at the turbulent healthcare logistics is formulated at the form of a MoVer-model of healthcare logistics.

1. Conception of healthcare logistics

The developments in society and healthcare sector require a reorientation on customer oriented healthcare as a result of a process and (therefore) more integral and thorough knowledge and insight on business administration processes. Healthcare organizations are traditionally predominantly activity and capacity oriented. The future demands a fundamentally different vision on the design of healthcare: customer oriented and process driven. One of a critical element of effective and efficient functioning of healthcare organizations is logistics. Healthcare logistics concerns all activities that are related to the development and execution of a vision and the policy regarding the design of healthcare processes in the broad healthcare sector, with specific attention to the logistic aspects of it, in conjunction with the total business management, as well as the realization of it in healthcare organizations. Healthcare logistic management makes important contributions to making and keeping qualitative good healthcare and assistance affordable. Hence the quality of healthcare is the key performance driver for all the logistics activities at the healthcare organizations, and is defined as the extent to which the healthcare offer is tailored to the wishes of the client/patient, who, to a greater or lesser extent, wish to have influence on:

– the form and content in which the healthcare is offered;
– the person that executes the healthcare;
– the place, where the healthcare is offered;
– the moment (day and time), where the healthcare is offered (Moeke, Verkooijen, 2013).

On the other side, mainly from the economic efficiency point of view, there is a strong correlation between the level of quality and costs. This fact in healthcare practice put on logistics management a task to find optimum by a careful balancing with the bundle of offered healthcare services as a result of the desires and preferences of the client/patient with the consideration of a responsible commitment of and needed resources, which usage is reflected by cost category (costs) at the form of:

– the financial space of the indication and/or the own pocket,
– the professional responsibility of the healthcare and assistance,
– the organizational responsibility of the provider,
– generally accepted values and standards.

In addition, the practical balancing between these two contradictory categories of quality and cost are performed under the continuous changing environmental factors, mainly state or local government financing circumstances, national healthcare regulations, focus on positive financial result etc. The understanding of healthcare quality in connection with costs control allows to define the healthcare logistic management as "Controlling the treatment-/healthcare-/support processes and the related deployment of means (professionals/equipments), the information and flow of goods, in such a way that the desires of the client/patient are met where the possible costs are as favorable as possible" (Moeke, Verkooijen, 2013). In addition to the above definition it should be added, that in the healthcare there

is a distinction between primary, supporting and supplying processes. Increasingly and especially during the last decade, the logistic profession stands in the interest of healthcare organizations as a significant instrument to improve the relation between the costs and quality. In business, logistic is a control instrument of the flow of goods in the track of supplier to client. The characteristic of the primary process in the healthcare sector is in it, that the healthcare process is a service, what means that raw materials, products and customer are united during the performance of the healthcare service at the time and space. Thus, the effective and efficient management of the primary and supporting processes is a specialty of the healthcare industry.

In the last years much attention has been paid to the introduction of process management in the healthcare sector, including logistics, what has been also reflected at the literature. Landry and Philippe (2004) underline the increasing role of logistics activities for healthcare organizations, especially for the improvement of service quality and keeping expenditures on the acceptable level. According to these Authors (Landry, Philippe, 2004, pp. 25, 29), up to 46% of a hospital's total operating budget is spent on logistics related activities, what cause a shift from a limited role of no strategic value to a more proactive role, where logistics provides credible and significant support to the healthcare organization. A continuation of the thesis can be found at the article of Aronsson, Abrahamsson and Spens (2011). These Authors formulate a conception of supply chain orientation (SCO) for the health services sector, reflected above all at a hybrid strategy, which combines lean and agile supply process resulting in flexible adjustment to the patients. There can also be found some case studies at the literature. One of them regards a case at North Mississippi Health Services (Jin, Switzer, Agirbas, 2008), which was scored according to four parameters (fill rate, accuracy rate, efficiency and expiration/spoilage rate) and an improvement project, applying Six Sigma and Lean Thinking principles, was elaborated to enchance the offered level of health care services. An overview of the other cases is presented at the article of Taner, Sezen and Anthony (2007). The above mentioned literature supported by practical observations allow to drow some remarks, namely that a distinction is made between managing healthcare units and managing healthcare processes. In the healthcare unit the aim is to optimize deployment of the available capacity of resources (professionals and equipment). The goal of the management of the healthcare process is to optimize the lead time of the patient. Logistically, these approaches are designated as respectively push and pull strategy in terms of management practice. Pure unit management leads to unacceptable waiting and lead times, and approach, which is solely oriented towards process management, leads to low occupancy rates and therefore too high costs. A tuned and integral deployment of process as well as a unit management leads to an optimal situation or the balance between flow of the patient (quality) and occupancy rate of the capacity (costs).

Shifting into the integrality conception, it can be said that such terms as comprehensive, or interrelated are short definitions of it. With that, an ambitious as well as important and even conditional principle is formulated. Identification of the customer and his desires and the thereon tuned integral business

management are the two core elements of the vision on healthcare logistics. At integral business management there is a balanced attention to the following three fields: strategy-design-management. In this article the focus lies on infrastructure based on strategy (Veen, 2013), what is presented at the Figure 1. Not unimportant is the last aspect of integral business management: leadership, responsibility, ownership, summarized in the concept's culture and behavior.

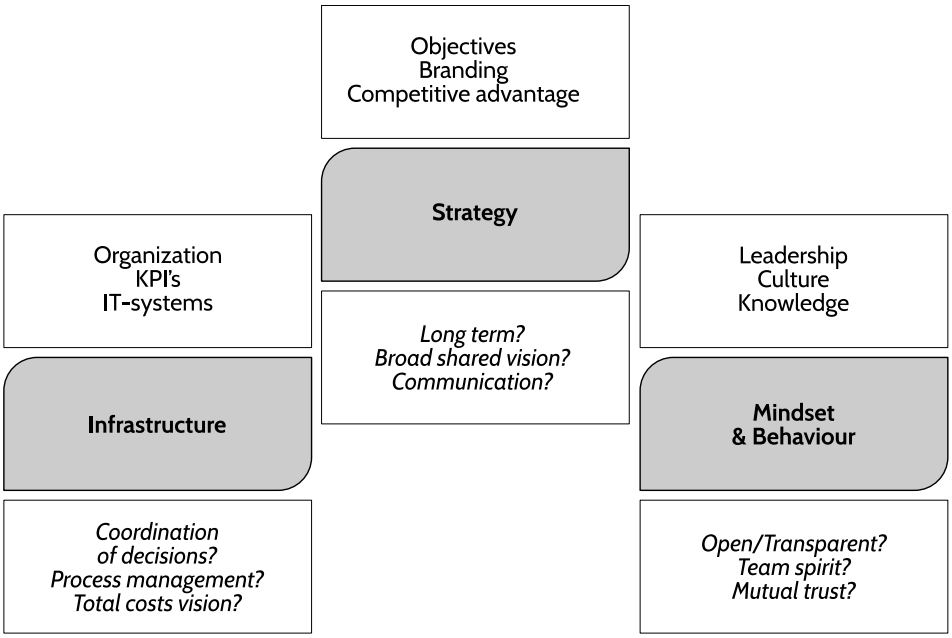

Figure 1. Implementation fields
Source: (Veen, 2013)

As argued before, the shift from 'action/task/function oriented work' to 'process driven' makes for a very important challenge in the organization of the healthcare sector the coming decade. Process management requires an integral approach: in the primary chain as well as in the supplying and supporting processes. Integral business management occurs on four axes and in mutual interrelationship between those axes (Figure 2):

– vertical integration: management (strategic, tactic, operational), leading and leadership;
– horizontal integration: supply chain management, which tunes activities in the primary healthcare process within organizations and in the entire healthcare chain (1st line: reference, 2nd line: treatment, 3rd line: aftercare);
– process integration, which tunes primary and miscellaneous processes (secondary, supporting, supplying, etc.);
– organizational integration, which regards business administration, tuning of all policy areas in service to the primary process.

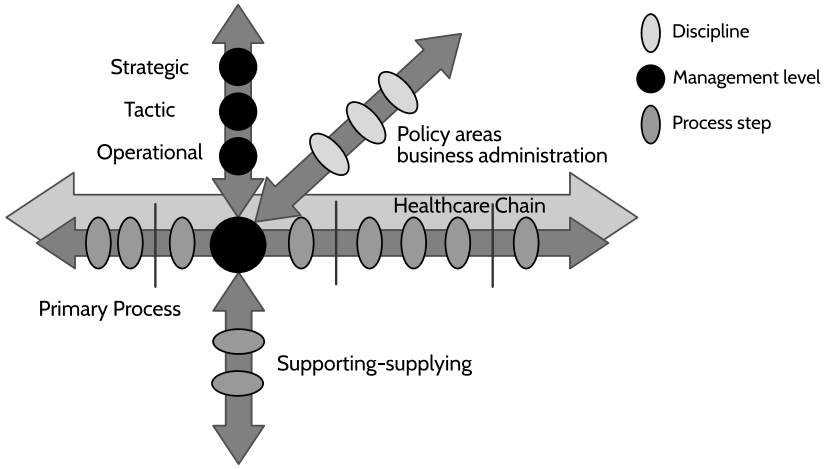

Figure 2. Integral business management
Source: (own elaboration)

In relation to vertical integration, it gives response to the question how are decisions on strategic, tactical, operational level regarding design of the organization and (improvement of) business management made in conjunction with each other, in such a way that it complies with the integral arrangements concerning costs and quality? The relation between the management levels are filled by having the PDCA cycle of management and responsibility connection on diverse levels, what is presented at the Figure 3 and 4. The value strategies model of Treacy and Wiersema (1995) is meant to develop company strategies (Figure 5). To the benefit of the healthcare sector, the model helps gaining insight on the translation of the mission of the organization in concrete statements about the organization as a whole, or for its components in strategy, policy and objectives. Thereby, choices are made in conjunction, but independent from the context, for profiling on the following areas:

– expertise: healthcare expertise, means;
– affordability: operational excellence, smart organizing;
– customer orientation: focus on customer, self-reliance, direction over own life and healthcare.

The choice on strategic level can be translated to more concrete objectives on these three areas on tactical level, which are helpful when it comes to designing the process, and also the operational level for the benefit of the process management and responsibility.

In relation to the horizontal integration in supply chain management, it gives an answer to the question how is the healthcare process during the entire healthcare chain (= creation of healthcare demand till its solving) organized in such a way, that the arrangements regarding costs and quality are met? Integral process management plays a role in here. Decisions are taken in mutual cohesion between the links (activities/units) in the entire chain wherein all of them are responsible for the whole, from which the performance of every link is derived.

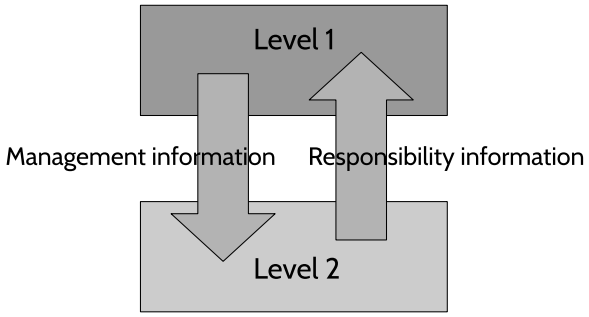

Figure 3. Management Levels
Source: (own elaboration)

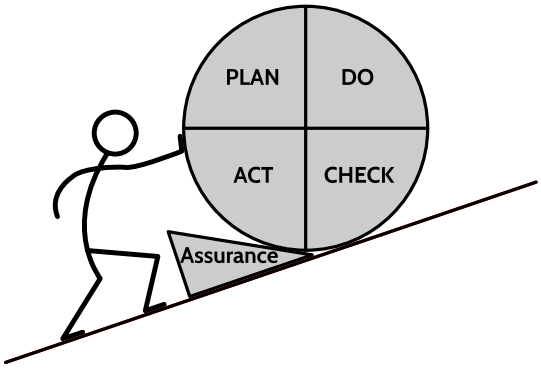

Figure 4. Management cycle PDCA
Source: (own elaboration based on Deming cycle)

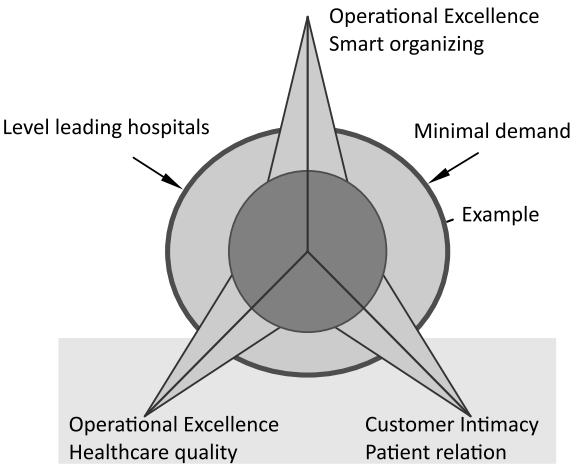

Figure 5. Value strategies
Source: (Treacy, Wiersema, 1995)

In relation to the process integration, it gives an answer to the question how are the primary and the miscellaneous processes integrated, in such a way that the primary process is facilitated, and that, as a result, the integral arrangements regarding the costs and quality are met? The relation between primary and supplying/supporting processes is a customer/supplier relation, wherein services are made based on arrangements made in advance regarding quality/service level/ KPI's (Service-Level-Agreement). The primary (healthcare) process is the customer servicing process, which stands for the 'heartbeat' of the organization, determines the secondary processes, including logistics one, which supply the first one at all the resources needed.

Finally, in relation to the organizational integration (business administration) aspect of integral business management, it gives an answer to the question how are decisions with regard to all company aspects taken in such a coherent manner, that the integral arrangements regarding costs and quality are met? These aspects concern among others finances, business economy, communication, HRM, safety, quality policy, etc.

2. Primary processes as a basis for organization design

To obtain insight on the cohesion in processes, a model has been developed, where all aspects are addressed. This is where the relation customer-result-process becomes clear. The integral approach is an elaboration of the infrastructure aspect (Veen, 2013). The tuning between the healthcare demand and healthcare offer is derived from the cohesion between both of these, which includes the vision on:

– the developments from the demand side, existing from the customer typing and the demanded/expected/agreed resultant of the healthcare process;
– the offer side as designing the healthcare process in such a way that it leads to the desired results.

A very effective way to analyze and (re)design healthcare processes is lean. Lean lays an excellent link between demand and offer. The lean philosophy states that "The core idea is to maximize customer value while minimizing waste. Simply, lean means creating more value for customers with fewer resources" (Lean, 2017). Here, the balance between the desires of the customer on one side, and the customer-service as delivered by the process on the other side, is central as shown in Figure 6.

Subsequently the three main aspects of the customer-result-process are discussed. First of them touches the problem of how do we specify customer (in various customer-supplier relations), where the end customer is the healthcare demander. At this aspect three processes can be identified:

– primary process: healthcare demander to type (diagnose) + healthcare demand (volume-variability-predictability);
– subprocess: customer is the owner of the following subprocess (step/healthcare activity);
– supporting/supplying process: primary process is owned by a customer.

Results are to specify in (agreed) profits:

– substantively: which healthcare desired/required (form, content, person, place), diagnose, substantively, relational;
– organizational: point of time (delivery time, waiting time), extent, flexibility, costs.

The above course of reasoning leads to the thesis that the healthcare demand generates the profits for the healthcare process. The healthcare offer (the healthcare process) ideally consists of logically successive process steps, where the principle is that each step (act 1-2-3-...) gives added value to the agreed process result and thus the customer. The healthcare offer consists of three main aspects: process steps/activities, capacities (people and means), management.

With analyzing, diverse analysis instruments are utilized in mutual cohesion. At the Figure 7, the most important means for the health-care process improvement are displayed.

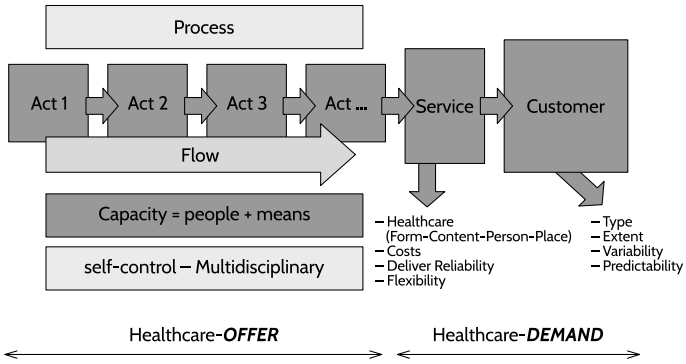

Figure 6. Integral process approach
Source: (own elaboration)

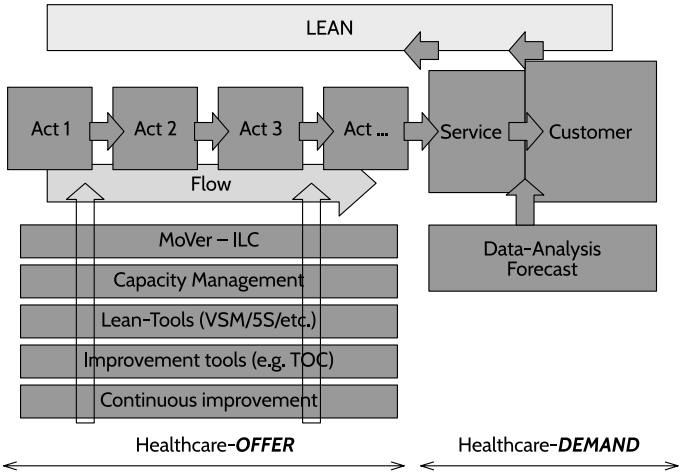

Figure 7. Analysis instruments
Source: (own elaboration)

3. Instruments for process-description, design and improvement

The Integral Logistic Concept (Visser, Goor, 1994) offers an excellent systematic in order to map the business management. It raises mission/vision/strategy/(logistic) policy objectives and organization (process) design in mutual cohesion. It aids in identifying shortages, which is an important requirement for the process improvement.

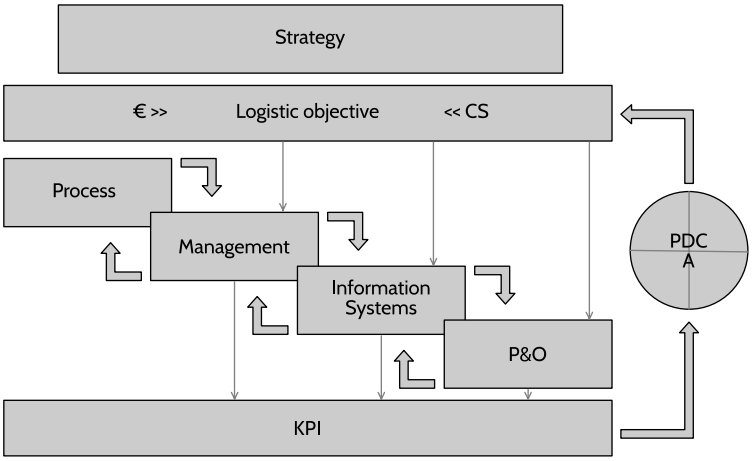

Figure 8. Integral Logistic Concept (ILC)
Source: (Visser, Goor, 1994)

Comparable to the ILC is the MoVer-model (Moeke, 2016). Its cooperation is the same as the ILC, however with more and specific attention to the customer perspective. The model is shown in Figure 9.

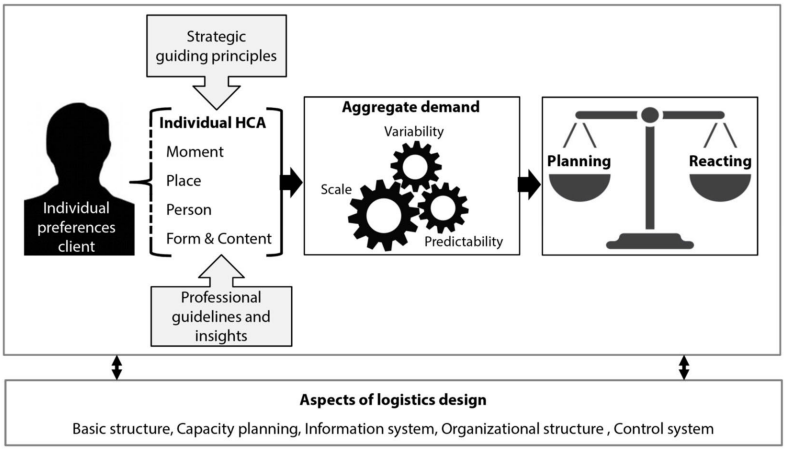

Figure 9. MoVer-model of health-care logistics
Source: (Moeke, 2016)

In the lower part of the MoVer-model the aspects of logistics design are mentioned. One important aspect is tuning demand and offer from the perspective of capacity management. The natural variation in arrival of patients (volume, variability) as well as the artificial variability from the offer side require some flexibility in waiting times from the demand side and the occupancy rate of the capacity from the offer side (Figure 10).

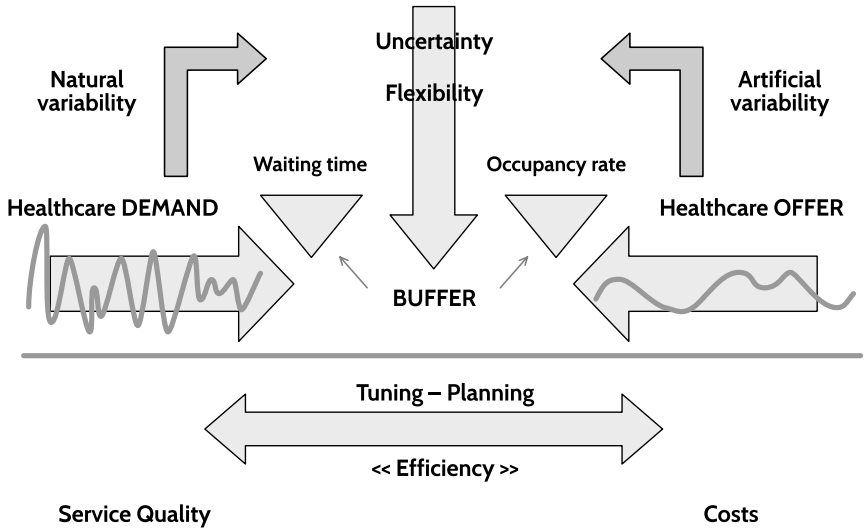

Figure 10. Tuning of healthcare demand/offer
Source: (own elaboration)

Shifting to the lean as a philosophy and instrument in order to work smarter, it should be noticed it is popular in the healthcare sector. The focus here is on integral philosophy, more than the solely operational (local) health-care logistics process improvements. Lean is aimed at the process optimizing in the following steps:

1) identify the customer (diagnose(group), volume, variability);
2) identify the service/product (type, place, time, person) to be delivered;
3) describe the current process (ILC/MoVer);
4) value the process on the basis of added value (value stream mapping, wastes);
5) recreate the process;
6) implement the new situation (logistic change management).

In step 4 (more operational) lean aspects appear, such as: value stream mapping, removal of waste.

Lean knows eight wastes and aims to stabilize processes. The philosophy assumes the delivery of added value and the instruments aid in identifying the added value. Figure 11 shows the positions of lean in relation to other improvement tools and methods.

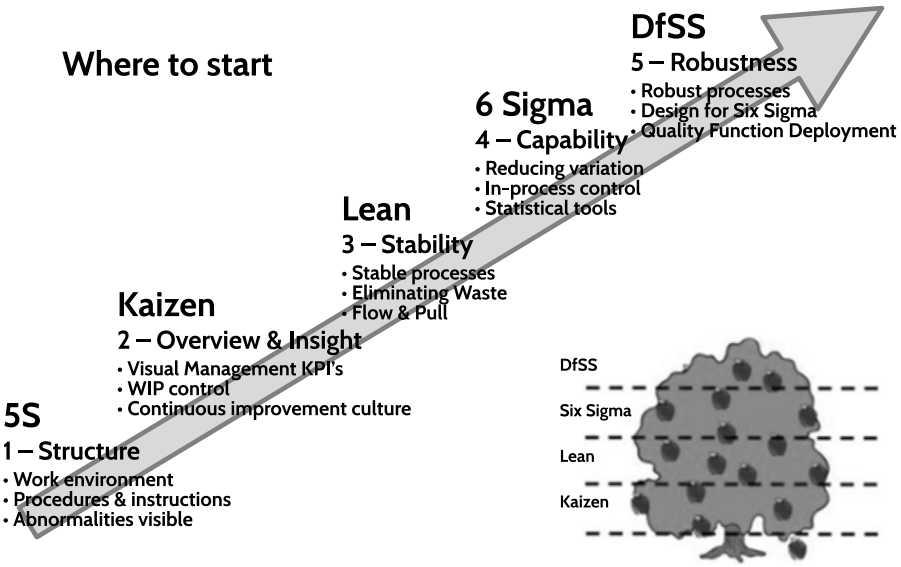

Figure 11. Lean in relation to other improvement methods
Source: (Global, 2017)

Conclusion

Integral management on healthcare processes, lean management, continuous improvement and the leadership and self-control, which are equipped thereon, are success factors in a shift to customer oriented healthcare and costs control and saving. The key healthcare concept is integral process management. From the lean philosophy, processes are designed on enlarging the customer value. There are various models and instruments available in order to reach that, including the Mover-model, the Integral Logistic Concept, Value Stream mapping, removal of wastes and continuous improvement. Applied properly and in cohesion it leads to a process oriented design with, as a result, costs control and saving in combination with greater customer value at the healthcare sector. Partly under influence of financial and organizational pressure on the sector, a shift to a more facilitating leadership takes place, and with that to a different professional attitude and behavioral skills of the staff. Self-control where ownership and responsibility are of importance becomes more significant. It is interesting to research how this should look like and how this can be developed, in order to successfully make the shift in 'organization thinking' of function and task oriented to process driven. This aspect falls outside the scope of this article, but is of great significance within the framework of the integral approach, because behavior, change preparedness are requirements for the continuous improvement of the healthcare process.

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Corresponding authors

Peter Maas Geesteranus can be contacted at: pje.maas-geesteranus@windesheim.nl
Cezary Mańkowski can be contacted at: ekocm@univ.gda.pl

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Mariusz Jedliński[a)], Magdalena Malinowska[b)], Andrzej Rzeczycki[c)]

a) Department of Logistics, Faculty of Management and Economics of Services, University of Szczecin
b) Department of Logistics, Faculty of Management and Economics of Services, University of Szczecin
c) Department of Logistics, Faculty of Management and Economics of Services, University of Szczecin

THE LABORATORY OF LOGISTICS RESEARCH AND ANALYSIS "LOGLAB" AS AN ENVIRONMENT FOR MODELING THE PROFESSIONAL COMPETENCIES IN LOGISTICS

Abstract

The aim of the article is to present the idea, design and implementation of the project LogLab – the Laboratory of Logistics Research and Analysis, as well as analysis and evaluation of the obtained by the students learning results within various education levels of logistics on the Faculty of Management and Economics of Services of the University of Szczecin. The authors propose a holistic approach based on the synthesis of intentions (learning concepts) and learning outcomes, regarding it as a creative alternative that does not exclude other possibilities and ways of accomplishing similar projects, but in its intellectual differentiation, complements other applied ways of projecting intentions, implemented didactic processes and utilized for their purposes tools and methods. They assume, that the basic problem in the preparation, implementation and validation of the usability of such projects is to identify the universal and unique characteristics that can more deeply describe the utility of this proposal oriented on education of the future logistics professionals for the local, national and international labor market. The conducted considerations lead to the conclusion that the attempt was successful, as it enabled more complex integration the epistemological layer in the field of directional use of logistics with the practice of controlling the logistics processes, however indicated the existence of many similarities, as well as important differences with the phenomena that were characteristic to the other areas of specialized education.

Keywords: logistics education, logistics competence, logistics laboratory – LogLab, Service Inter-Lab Centre

Introduction

The problem of the quality of logistic education is undoubtedly a key issue, widely discussed both by the scientific bodies responsible for the preparation of the education offers and their effective implementation as well as economic units, organizations and institutions, which are beneficiaries of this education by the possibility of obtaining a well-prepared graduates (Klumpp, 2013; Kurasiński, Szeląg, 2014; Niine, Koppel, 2014; Centrum Ewaluacji i Analiz Polityk Publicznych, Interdyscyplinarne Centrum Badań i Rozwoju Organizacji Uniwersytet Jagielloński, 2015; Derwik, Hellström, Karlsson, 2016; Jedliński, 2016; Lutz, Birou, 2016). Implementing the part of learning process by the use of the modern laboratory equipped both by the up-to-date technical and technological equipment and cross-cutting computer software, allows each student to create individual models of the virtual logistics reality and is fully justified approach to value-added realization of the didactic processes.

On the other hand, in relation to the scientific and didactic staff, the expected and extremely desirable observed behavior is not only the implementation and the didactic operation of the infrastructural resources (physical and social resources) but also the highest attention to the constant development and improvement of teaching methods and tools, which usefulness is objectively verify (e.g. through questionnaire surveys).

The aim of the article is to analyze the process of implementation and utilization of innovative logistic laboratory in the education process. Authors presents from one hand the complexity of the Laboratory of Logistics Research and Analysis "LogLab" to redefine and fulfill the way of teaching/learning on the field of logistics at the University of Szczecin and from the other hand the changes developed in study curricula and assessed by the students during the evaluation process. The assessment was dedicated to verify the professional learning results obtained by the students during the learning process.

The article is divided into 4 sections presenting in the first two of them the concept of the laboratory and curricula changes in logistics at the Faculty of Management and Economics of Services and in the last two sections the methodology of empirical research and the results of evaluation process concerning the implemented changes from the students point of view.

1. The concept of the Laboratory of Logistics Research and Analysis "LogLab"

The Laboratory of Logistics Research and Analysis "LogLab" has been planned as one of the specialized laboratory within the Service Inter-Lab a Centre for the Transfer of Knowledge and Innovation for Service Sector (Figure 1). The project of the Centre was carried out by the Faculty of Management and Economics of Services of the University of Szczecin. It was financed from the Regional Operational Programme for Zachodniopomorskie 2007–2013. With the budget of 68 million

of PLN, the Service Inter-Lab Centre was planned as a scientific unit, educational institution, research and development centre, knowledge and technology transfer centre, business incubator and a business environment institution. To fulfil the established goals, the Service Inter-Lab Centre was equipped by a complex of seminar and conference rooms, modern computer labs and mobile rooms with specialized infrastructure, managerial information unit.

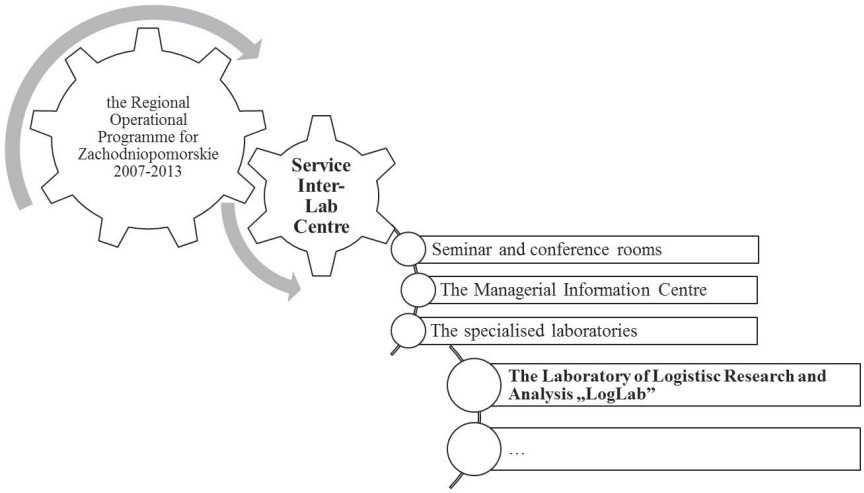

Figure 1. The concept of Service Inter-Lab Centre
Source: (own elaboration based on: Service Inter-Lab Centre, 2016)

The LogLab vision was based taking into account three main aspects:

– requirements of the most popular competency standards in logistics (APICS, SOLE, ELA, CILT) (European Logistics Association, 2014; Niine, Koppel, 2014; Apics, 2016);
– requirements of the European and Polish Qualification Framework (ERK, PRK-ealier KRK) and educational standards in Logistics (Bologna Process Coordination Group for Qualifications Framework, 2009; Kraśniewski, 2011);
– learning profile at the Faculty of Management and Economics of Services and potential of the teaching staff.

Each of the mentioned aspects was considered separately as well as summarized together to find consensus and coherent vision of the laboratory. Analysis of the international competency standards in logistics let to research the requirements during the certification process. Main issue was to diagnose fields and specializations, which can be supported and developed at the university using the logistics laboratory. ERK, PRK and educational standards in logistics was the basis to discuss the possibility of extension of the educational offer and list of acquired competencies during the teaching/learning process. In case of learning profile and potential of the teaching staff the main field of discussion was to support teacher and students in their future research. The specified curses were considered as a background to implement the dedicated solutions within the curricula.

On the basis of conducted investigations the following goals were established as crucial for the concept of the laboratory:
– reinforcement of the curricula,
– deeper supplementation of the labour market requirements,
– the ability to simulate and verify the typical work of logistician,
– reinforcement of the research potential of university staff.

Additionally two main trends were identified to prepare the laboratory project. The first one was dedicated to select IT solutions, that support different logistics and transportation processes. It included from one hand the general applications dedicated to model, analyze and assess processes, and from the other hand the specialized solutions responsible for warehouse management, transportation management, visualization and analysis of spatial data. For the purpose of development the managerial, collaboration and communication skills the educational games were researched. The aim of the second trend was to create the environment, that enables verification of the technology usability within the logistics processes realization. The warehouse was recommended as a "pure logistics environment" within is possible to implement different running strategies and automatization.

Taking into account the existing constrains (mainly the budget and space) the specification of the software was elaborated as well as the project of "miniaturized" warehouse equipped by modern technologies was defined. The space management assumed that the surface of 200 m^2 is divided into 2 areas (Figure 2): warehouse and computer room with 24 workstations. The laboratory was located on the 1-st floor of the Service Inter-Lab Centre, what required additional constructive works related to adapting the space for warehouse and strengthening the floor for the purpose of applied equipment.

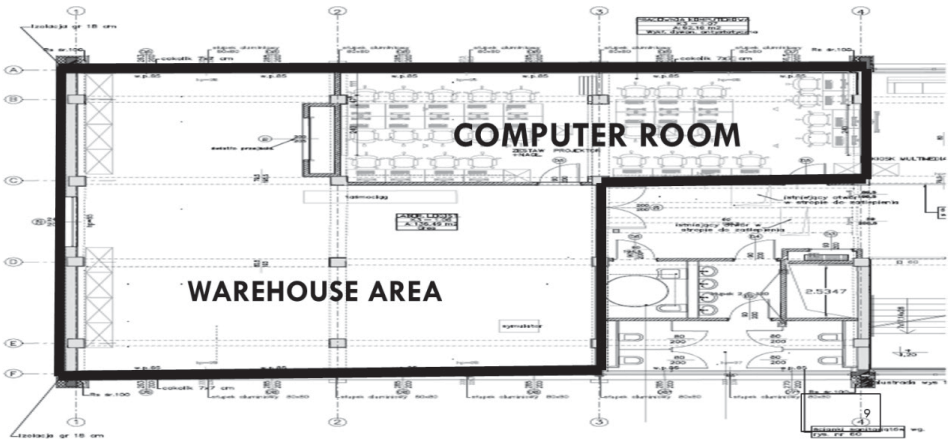

Figure 2. The area of the Laboratory of Logistics Research and Analysis "LogLab"
Source: (Service Inter-Lab Centre, 2012)

On the basis of prepared plan the main warehouse infrastructure is as following: warehouse shelving, vertical storage carousel, forklift simulator, roller conveyor, lock seals, high-speed door, order picking table, hand pallet trucks, workbench, different types of containers, different types of pallets, products phantoms.

The automatization is provided by implementation technologies to support warehouse management. It consists of: barcode technology, RFID, pick-by-light, pick-by-voice.

Within the automatization application the appropriate devices and materials are utilized. There are barcode and RFID terminals, pick-by-voice terminals, RFID and barcode printer, different types of labels and transponders operated during the simulation of typical warehouse processes: receiving, storage, order-picking, shipping. All the processes are managed by using the warehouse management system, what allows to identify and check the facilities of the software and level of its integration with the equipment.

Warehouse management system is one of the software, that fulfill the needs required in the concept of the laboratory. However, there are many other IT solutions, that were obtained for the purpose of management, simulation and modeling, analysis and evaluation of logistics systems and processes. Additionally, there are some solutions adapted from already existed list of software possessed by the University or Service Inter-Lab Centre. This merger was a consequence of creation the coherent vision of the laboratory, which should possibly wide support the development of students and teachers competences on the field of logistics as well as encourage entrepreneurs to realize common projects and establish collaboration. The list of the software utilized in the laboratory is presented in Table 1. In addition to commonly known and applied in logistics and transport solutions, there are also computer games or computer-aided games, which let to better understand the supply chain organization, distribution processes or logistics support of production. The logistic laboratory software and equipment contains also the solution dedicated to manage restaurants, hotels and bars. The crucial idea to acquire this specific set was to present the different facilities of such a software, especially in case of logistics issues involved with order processing and warehouse management. It was important due to the crucial significance and dynamic growth of tourism in our West Pomeranian region (Wydział Polityki Regionalnej Urzędu Marszałkowskiego Województwa Zachodniopomorskiego, 2010) as well as reinforcement of some study courses conducted at the faculty.

Table 1. The list of the software utilized in the laboratory

ERP SYSTEMS	
Comarch ERP Optima	The modular software dedicated to small- and medium-sized enterprises supporting management and executive processes in the following areas: financial and accounting, controlling, customer relationship management, services, trade and warehouse management, mobile service, workflow and project management, business intelligence
X2 System	The modular software supported the management processes of hotels, restaurants and retail trade. It provides features such as: human resources management, warehouse management, supply management, goods management, sales management with POS terminals service, controlling and reporting

WMS SYSTEM	
Optipromag	Integrated warehouse management system enables to support warehouse operation, in particular: material storage, monitor the inventory flow, manage the warehouse automation equipment, picking, shipping, quality control, evaluation the effectiveness of warehouse operation
TMS SYSTEMS	
Sky Logic	Modular system dedicated to transportation management. System allows modeling the logistic structures, vehicle load and route optimization, orders processing, transportation tracking, fleet management, geolocation, drivers mobile management, invoicing and booking documents processing, transport indicators evaluation
TMS Falcon	The transportation management system that allows for transportation orders management, estimation and accounting the transport cost, building the pricing taking into account the different components of cost (distance, number of pallets, weight, fuel additive, place of origin, etc.), optimization the supply and elimination of inefficient transport, monitoring the transportation costs
MODELING AND SIMULATION SYSTEMS	
Adonis	A software designed to comprehensive support of process management: from describing the processes within the organization, through process optimization to continuous monitoring of the specified objectives. Adonis is equipped with components for modeling, analysis, simulation, and evaluation, which enables to create multi-dimensional business process models, perform statistical analysis on the basis of developed models, continuously monitor the achieved results
Arena Simulation Software	Simulation software with the ability to create 2D and 3D visualization. It enables the visualization and analysis of operational processes of enterprises (technological processes, logistics, business, etc.). The solution is equipped with a set of tools to collect, analyze and visualize the data obtained during the simulation. The process optimization on the basis of achieved simulation results gives the ability to improve process efficiency by reducing the time and costs
Vissim, Visum, Viswalk	A software suite for modeling the traffic of individual and public transport as well as the pedestrian traffic. The software lets to design, visualize, test, predict and evaluate different scenarios of transportation processes, make analyzes of capacity in various situations, both in urban areas, on rural roads and highways
INFRASTRUCTURE DESIGN AND ANALYSIS SYSTEMS	
AutoCAD	The software used for two-dimensional (2D) and three-dimensional (3D) computer-aided design (CAD). It allows you to design the structural and infrastructure components, and create the relevant documentation. The software is equipped with a few vertical programs to create projects of varying specificity of industry e.g.: AutoCAD Electrical, AutoCAD Mechanical, Mechanical Desktop, Architectural Desktop, Civil Design, etc.
ARCGIS	A geographic information system (GIS) designed to work with maps and geographic information. It allows to acquire, manage and visualize the spatial data and create the graphic files. The system lets to manage geographic information in a database, conduct comprehensive analysis of mapped information and support the decision making process in terms of spatial distribution, evaluation of existing spatial relationships between data and existing trends (Esri Polska, 2016)
E-COMMERCE SYSTEM	
Home.pl	Software dedicated to run an online store. It contains the components required for the analysis and evaluation the issues related to inventory management, the flow of goods, cooperation with partners, supply management, order managements, payments management

EDUCATIONAL GAMES	
Beer game	Training game that allows to understand the basic challenges of supply chain management (in particular, the mechanism and results of Forrester effect). It lets to analyze links between supply chain units and activities that are undertaken in various areas of its functioning. On the basis of the game, participants can appreciate the role of communication, collaboration and information flow within the supply chain
TransEdu	A computer game represents the functioning of the transportation exchange. It allows to play the role of road transport and on the basis of possessed vehicles offer them as a transportation mode. The effects of the executed orders a can be followed and analyzed up to date and the effectiveness of the transactions and transport operations can be assessed
Service simulation	Board game with the computer-aided support that presents the business activity of the transportation company. It enables to identify and analyze the activities within the strategic and operational management, including issues related to the settlement
Distribution simulation	Board game with the computer-aided support that presents the management process within the trading and distribution company. It allows to present the rules concerning the creation of trade and market strategy as well as the principles in terms of sales planning (including cost and price issues) and supportive actions (promotion, customer loyalty development)
Production simulation	Board game with the computer-aided support dedicated to present management processes in production company. It allows to reflect the activities related to the organization of production (the relationship between sockets, planning changeovers, coping with delays), purchases planning and decisions making as well as costs, including storage cost of raw materials and products. The game shows the effects of actions and their impact on the operating costs of the company

Source: (own elaboration based on: Kołodziejczyk, Szołtysek, 2012; Adith Technologies, 2016; Autodesk, 2016; Benson Consultants, 2016; BOC-group, 2016; Comarch, 2016; Home.pl, 2016; HRsymulacje, 2016; Logitrans, 2016; Optidata, 2016a, 2016b; PTV Group, 2016a, 2016b, 2016c; Rockwell Automation, 2016)

The software and equipment that is located in "LogLab" was bought by the University of Szczecin in accordance with the polish law regulations. The specification of crucial requirements of all selected items was commonly published and the final providers were assessed on the basis of submitted offers, taking into account the ability to fulfill the requirements as well as the price of their offers. The process of implementation was finished at the end of 2013, however the maintenance and product adjustment is still ongoing process.

2. The Laboratory of Logistics Research and Analysis "LogLab" as a source of curricula changes on the field of logistics

The "LogLab" implementation was one of the main factors to rearrange or build new studies curricula on the field of logistics. The changes included two aspects:
– implementation the laboratory classes within the bachelor and master studies,
– developing the educational offer by designing the engineering studies.

The effect of this action let to develop the following courses with the laboratory classes: within the bachelor studies – warehouse management, customer

and suppliers relationship management, modeling and control the logistic processes, packages and load units in logistic systems, information systems in warehouse management and warehouse management by using information technology, technical and technological aspects of warehouse operations, material management; within the master studies – city logistics, modern warehouse systems, warehouse infrastructure design, processes and logistics systems design, logistic strategies and instruments of supply chain management. Additionally, both the new laboratory classes and the designing of the engineering studies let to expand the range of learning outcomes acquired during the studies. Nowadays, the courses curricula ale developed with the engineering competencies, learning outcomes on the field of technical sciences and extended range of social science learning outcomes (Figure 3).

Changes in curricula have been directed in particular to increase the number of laboratory classes (computer lab and warehouse lab). After a year of launching the Service Inter-Lab average number of hours dedicated to laboratory classes in particular courses has been increased:

a) on Bachelor studies – from 60 to 105 hours on each specialty (the highest increase: 150 hours at the specialty of "Design and exploitation of warehouse systems"),
b) on Master studies – from 30 to 100 hours (the highest increase: 120 hours at the specialty "Manager of supply chains").

Additionally, the engineering studies have been focused on the competences of IT systems in logistics. Offered to students is 555 hours of various laboratory classes (an average of 380 hours on each specialty). In accordance with the established curricula the laboratories are 20% of whole study program, which means that students of "Engineering of logistics systems" specialty participate in 315 hours on computer labs, 45 hours in the warehouse workshop and 60 hours in laboratories of mechanics and electrical engineering. For comparison in the research study of the structure of the logistics curricula in the world (Jim Wu, 2007) share of the IT courses amounted 10% for developed countries and 14% for developing countries (with no distinction between forms of classes).

Along with the change of classes' forms the directional effects of logistics were updated (and in the case of engineering studies introduced). Crucial issues concerning knowledge and skills were highlighted in the field of: logistics management systems, IT systems and diagnostic techniques, documentation creation and presentation of the results, modeling, simulation and analytical systems, design and safe operation of logistics infrastructure, organization and implementation of business operation, planning and conducting experiments (including analyzes and computer simulations), analysis and evaluation of existing and planned technical solutions in logistics, as well as creating, documenting and evaluating projects.

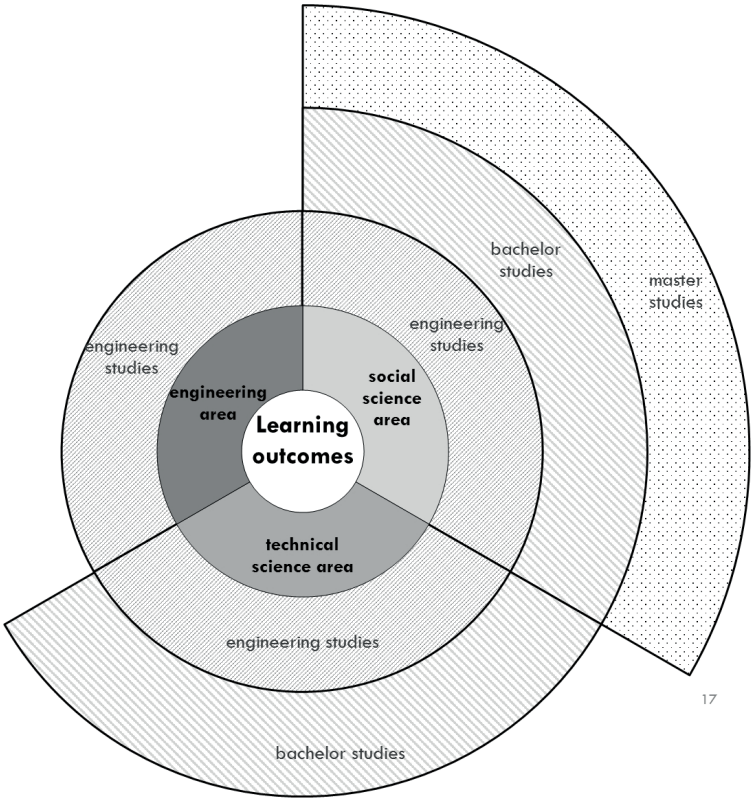

Figure 3. Range of learning outcomes during the bachelor, engineering and master studies on the field of logistics
Source: (own elaboration)

Changes in the contents of classes at I and II stage of studies have been introduced, among others, in courses:

1) Warehouse management – students create warehouses and records of goods, suppliers, customers and logistic units, prepare the documentation and analyze the information from the WMS system;
2) Material management – during classes students utilize the TMS system to create records of vehicles, drivers, orders, price lists, plan transport in manual mode, on the map and by using the attached optimizer (by modifying its settings), as well as evaluate transactions based on the system reports;
3) Processes and logistics systems design – during classes students learn how to model the logistics customer service process in BPMN 2.0 and carry out the analysis taking into account time and cost. To pass the course they are obligated to prepare the project of given logistics process, including "as is" and "to be" models (based on the identified bugs), as well as model the working environment, documents, information systems, and others (depending on the tasks and ambitions of students);

4) City logistics – using the Vissim software let the students to prepare projects that have on aim the traffic improvement or introduction the new elements (e.g. new lane) based on required by the lecturer intersections to verify the throughput for different traffic parameters;
5) Logistics infrastructure design – the ArcMap is selected to prepare the project zoning the area for the purpose of construction the storage facilities with a specific type of goods. Additionally Visio is used to present the internal space of created warehouses. The whole task is fulfilled by comprehensive project documentation describing the assumptions, applicable standards and the warehouse processes;
6) Information systems in warehouse management and warehouse management by using information technology – in the ERP system students learn how to prepare operations concerning the supply, production, distribution and warehousing. Additionally they analyze the existing databases of ERP system and prepare documentation within the loop "procure to pay";
7) Technical and technological aspects of the warehouse operations – in the form of workshops students learn how to use various warehouse equipment, perform devices speed tests, compare the methods of automatic identification, manage the warehouse automation within the IT systems, as well as analyze the physical warehouse process in WMS;
8) Packages and load units in logistic systems – students perform the physical design of packaging the products, at the same time preparing the its strategy of logistics and marketing implementation on the market; they learn about the different types of loading units used in logistics and the method of its preparation and marking.

Within the various courses were also introduced some elements of decision games designed for indirection clarification of issues such as the supply chains functioning, negotiations, establishing strategy, setting the value of the company, freight forwarding. Since two years of conducting the course of "Logistics decision games" in bilingual mode (English-Polish), the students simulate the logistics work by using didactic games (computer and board ones).

The changes made to the learning outcomes, the forms of course credits, and the inclusion in the teaching process of business projects are in line with the integrative skill development approach in teaching (van Hoyek, 2001), both for the high development of research and market relevance skills.

The presented scope of changes does not exhaust all improvements in the courses of Logistics studies, in which the laboratory classes were proposed. It shows the direction of these changes. The presented approach is also applied to other subjects, on a different specializations, but often with another IT solutions. The engineering courses have been omitted in above description, however the crucial backgrounds of theirs curricula are derived from outlined changes, enriched with the technical and engineering aspects, e.g. in the field of engineering graphics, database systems analysis and geographic information.

3. Research methodology

In the period 2014–2016, when the laboratory "LogLab" was being utilized during laboratory classes, the evaluation process was carried out to assess how the demonstrated changes in the curricula were perceived by the students. Two student surveys were conducted to gain feedback and further improve the curricula. The first one was based on five-point scale (1 – the worst, 5 – the best) and conducted at the end of semester. It allowd to get the general review of the level of knowledge and skills gained during the learning process. Additionally, the aspects of creative thinking was analyzed. The second survey was a detailed research conducted among the third year students of the specialty "Design and exploitation of warehouse systems", who had the widest spectrum of the laboratory courses. It let to verify the specified professional learning results from the point of view of different course forms: lecture, exercise, laboratories. The achieved from the first questionnaire results were based on the sample of 255 students participated in the laboratory courses (39.8% of all logistics students in the consider years). The second study concerned a group of 35 students (72.9% of students studying on specialty "Design and exploitation of warehouse systems" in research period).

4. Evaluation of the curricula changes in the context of functioning The Laboratory of Logistics Research and Analysis

In the first study the analysis of questions referred to the laboratory classes shows that 47% of students rated the achieved knowledge at 5 and 30% at 4, as in the case of acquired skills – 46% of students at 5 and 31% at 4. Slightly lower was assessed mobilization for independent work and creative thinking – adequately at 5 by 47% of respondents and at 4 by 25% ones. This may results from the fact that part of the courses actually are not oriented at stimulating creativity but the ability of mapping certain situations in IT systems. Detailed average scores divided into courses are presented in Table 2.

Table 2. The average rating of laboratory classes performed by the students during the semester output survey

Course title	Knowledge	Skills	Creative thinking
warehouse management	3.6	3.5	3.6
processes and logistics systems design	4.5	4.5	4.5
IT systems in stock management and warehouse management through computer systems	4.2	4.4	4.0
technological and technical aspects of warehouse operations	4.3	4.5	4.3
material management	4.7	4.6	4.6

Source: (own elaboration based on: the surveys of 225 students of Logistics performed in years 2014–2016)

The lower ratings for the subject Warehouse Management may result from the fact that this is the first laboratory faced by the students with more stringent defined requirements concerning systematic work, participation in classes, the necessity to make up the material after any absence and delay in processed material before next lesson.

The second study included a group of 35 students. They assessed the knowledge and skills acquired at various types of activities. This time assessment covered no specific courses, but the professional competences. In Tables 3 and 4 are the results of these research.

Table 3. Evaluation of various forms of learning in the field of acquired knowledge

Field	Lecture	Exercise classes	Computer laboratory	Warehouse laboratory
demand forecasting	3.1	3.9	4.3	4.5
logistics processes modeling	3.1	3.8	4.2	4.3
application of bar codes in logistics	3.2	3.2	3.9	4.1
selection of warehouse equipment	3.5	3.8	4.1	4.0
fixing of orders size	2.9	3.6	4.6	5.0
transport fleet management	2.3	2.3	4.0	–
functionality of ERP systems	4.0	4.3	4.6	5.0
application of RFID technology	4.0	3.8	4.5	4.5

Source: (own elaboration)

The research indicated that for the students it is difficult to separate the knowledge from the acquired skills. However, they pointed out that the assimilation of knowledge increases during laboratory classes, when systems or devices allow or not allow to perform certain operations.

Table 4. Evaluation of various forms of learning in the field of acquired skills

Field	Lecture	Exercise classes	Computer laboratory	Warehouse laboratory
demand forecasting	2.7	3.2	3.8	4.3
logistics processes modeling	3.1	3.5	4.0	4.3
application of bar codes in logistics	4.0	4.0	4.3	4.4
selection of warehouse equipment	3.1	3.6	4.7	4.8
fixing of orders size	3.5	3.4	4.3	4.0
transport fleet management	3.1	3.8	4.9	–
functionality of ERP systems	4.0	4.3	4.8	5.0
application of RFID technology	–	3.0	5.0	4.7

Source: (own elaboration)

In the field of skill differences are even bigger. Particularly stand out skills concerning use of ERP systems and RFID, as well as fleet management and selection of warehouse equipment.

In the last part of the study, students evaluated the accuracy of the statements (Figure 2).

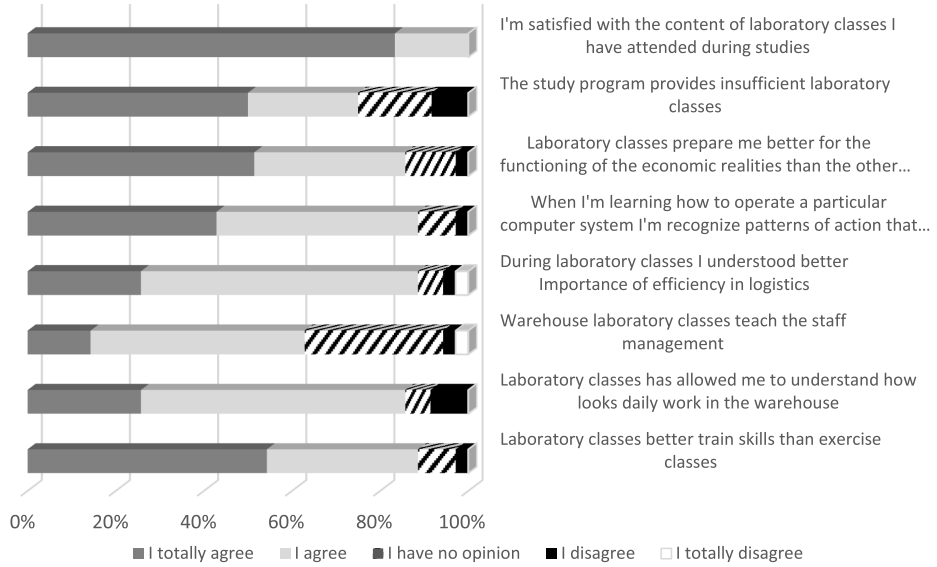

Figure 4. Evaluation of the presented statements accuracy done by students of third year of Logistics
Source: (own elaboration)

The results presented on Figure 4 show some lacks in the existing curricula. There are signalized the limited approach to staff management, which influenced on the loss of meaning the relation and responsibilities of employees of higher and lower rank. The classes are focused on the use of systems and realization the given by the teacher instructions, what isn't enough to simulate various management situations. To solve this problem, it is propose i.e. to introduce the roles splitting between students during the warehouse classes (typical for warehouse operation) and evaluate the achieved results including the relations between employees, communication channels). The second element to strengthen is the analysis of reports and reasoning based on them.

Part of the evaluation are also positive news coming from the labor market (feedback from students and graduates). Students thanks to the knowledge of IT systems and practices in the logistics operation gained practices, internships and/or jobs in companies such as DHL, PGE, BKF, Castorama, Arvato, Raben and Leroy Merlin.

Conclusions

Considering the information coming from the labor market, standards and students surveys it is recognized that the introduction of practice at fields of study (even at general academic profile) is a desirable trend. The use of computer laboratories, thematic workshops (e.g. warehouse) and didactic games is fully justified.

Simulations have on aim to prepare students to work in economic reality, allow to avoid common mistakes and/or solve encountered problems, as well as stimulate their creativity and analytical skills.

Achieving a fully operational logistics laboratory was not an easy task. It required:

- the wide analysis of modern technologies and software in case of supporting the different fields of logistics;
- extraction of the directions, "competency islands", that complement the university courses;
- elaboration of the consistent concept of the laboratory;
- preparation of the specification of equipment and software that should me bought;
- analysis of achieved from providers offers;
- implementation of the physical laboratory;
- redefinition of the curricula.

The whole implementation process shows, that the technical changes must go hand in hand with organizational change – modification of effects, content and forms of education and preparation of adequate teaching staff. Only dual path of actions ensured the effectiveness of the courses.

Evaluation of the existing courses conducted in the "LogLab" laboratory helped to indicate additional challenges, that need to be taken for further increase of the education process efficiency. The future work predicts the necessity of hardware and software integration, as well as improvement of the functionality of IT solutions. Quite important for the students and their future employers is also the ability to certificate the level of software facilities recognition and the acquired competences. It should also be strengthened the soft aspects during laboratory classes, which are staff management and communication systems.

The process of implementing laboratory classes and changing the curricula is still ongoing. However the "LogLab" laboratory gave the ability to refresh and remodel the learning process, it became the stimulator to further ideas concerning the research and infrastructure development. The concept predicts the creation of the complementary laboratory "LeanLab", that lets to analyze and simulate the production processes and lean management.

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Corresponding authors

Mariusz Jedliński can be contacted at: mariusz.jedlinski@wzieu.pl
Magdalena Malinowska can be contacted at: magdalena.malinowska@wzieu.pl
Andrzej Rzeczycki can be contacted at: andrzej.rzeczycki@wzieu.pl

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Maciej Mindur

The International University of Logistics and Transport in Wroclaw

STUDY OF THE LINKS BETWEEN THE DEVELOPMENT OF THE WORLD ECONOMY AND TRANSPORT IN 1995–2015[1]

Abstract

The article provides a synthetic analysis of the interrelationships between economic development, the primary economic measure of which is the size of Gross Domestic Product, and the volume of transport work measured in tkm and pkm. The study was conducted over a 30-year time series based on the polynomial curves of the most-developed economies (the United States, Japan, China and EU-28) and Russia, the largest area of the world, with large natural resources and significant military industry, and constantly increasing since 2004 GDP. The research shows that GDP in the whole period (1995–2015) in the United States, Japan and the European Union is growing rapidly, significantly ahead of the tkm and pkm transport indicators. In China and Russia, GDP growth has been increasing since 2003, while the dynamic growth of transport (in billion tkm) in 1995–2015 is well ahead of economic growth (GDP). In Poland, trends in the development of the GDP measurement and transport indicators (tkm and pkm) are similar to those of Russia and China.

Keywords: The USA, Japan, EU-28, China, Russia, Poland, economy, transport

Introduction

The article presents research showing how the economy and transport changed over the years 1995–2015. The development and needs of the economy determine the size and mode of transport. The importance of transport (its functions and links with other sectors of the economy) to economic development, as well as the interdependence between transport and the economy, have also been analyzed.

The study has included the most advanced economies, which have been the world's leading economies for the past few decades, forming the bulk of world

[1] The article was based on: Mindur (2010).

GDP and setting the trend for the modern world – the United States of America, Japan and the European Union. There are also two countries with enormous potential, the largest area, significant natural and military resources, rapidly developing in recent years – Russia and China (the world's most populous country, developing continuously for more than thirty years, according to some reports, contributing more to global GDP than Japan).

The article also presents Poland. Its economy (in terms of size) cannot be compared with any of the economies of the countries concerned, therefore the analysis of the economic situation has been compared to macroeconomic size comparisons but to the development of economic processes. The polynomial curves were used for the study.

1. The United States of America

Figure 1 shows the development of the economy between 1995 and 2014 and the carriage of cargo and passengers between 1995 and 2015 in the United States of America[2].

Macroeconomic variables and transport measures are characterized by steady growth, with the largest increase being the polynomial curve describing GDP, followed by the passenger transport curve and at the lowest level there is a trend showing the freight movement. The pace of GDP changes compared to the measures presenting transport during the period under review steadily increased (a decline occurred in 2009, which quickly disappeared), indicating a faster growth of the economy than transport, and a decrease in the share of transport in GDP in the US economy.

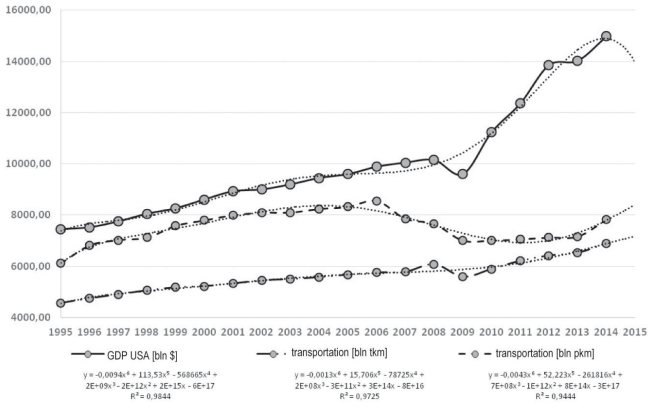

Figure 1. Economic macroeconomic indicators (GDP) and transportation measures (tkm and pkm) in the United States of America
Source: (own elaboration based on: Mindur, 2010)

[2] The variables in the drawing were developed in real data based on the polynomial curve. As the R2 indicators indicate, polynomial curves well describe the real development of the economy and transport.

2. The European Union (EU-28)

The polynomial curve representing the basic variables that characterize the economy and the transport measures in the EU-28 was developed in the same way as for the United States. All three variables in the European Union have a growing trend. The highest growth rate was the curve of GDP polynomial. In the next place there were curves describing passenger transport and cargo handling in the transport of cargo.

The differences between Figures 1 and 2 presenting the basic economic macroeconomic variable and transportation metrics (tkm and pkm) in the United States of America and the EU consisted in the spread between the GDP curve and the indicators characterizing transport. The spread in the EU was much higher, and the baseline levels (1995, 1998) and the course throughout the period under review were considerably lower. This means that the GDP level in the EU-28 compared to the US GDP was lower[3].

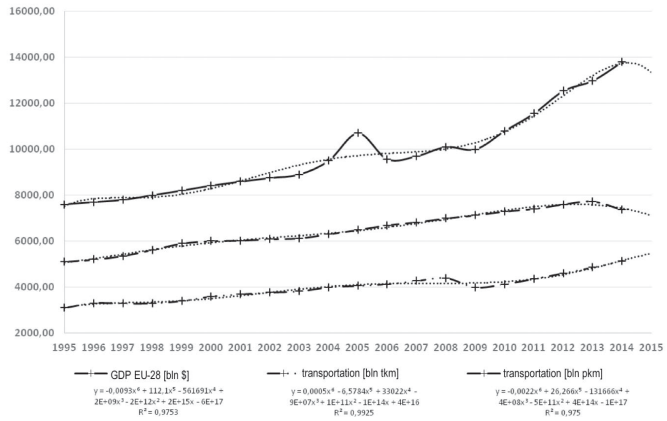

Figure 2. Economic macroeconomic indicators (GDP) and transport measures (tkm and pkm) in EU-28
Source: (own elaboration based on: Mindur, 2010)

[3] Using the GDP meter and comparing its level in the USA and the EU-28, in 2014 it was 54 thousand USD and 36 thousand. USD per capita – the conclusion is that the level of economic development in Europe was as high as in America 15 years earlier (then US GDP was $ 36.000), and now US per capita GDP is almost 50% higher. Although this reflects an increase in the level of income and the rate of change, it does not mean that this gap in the level of economic growth in the USA and in the EU was due to better labor productivity and productivity in the United States, as both sides of the Atlantic increased at a comparable pace – It was rather a result of a different approach to sharing efficiency gains. In Europe, a significant portion of this has been devoted to shortening working hours, while Americans have chosen to "divert" labor productivity growth to higher incomes. The difference between the US and the EU is therefore the result of societal preferences rather than economic efficiency, yet such a significant difference in GDP levels does not translate into such a large difference in the standard of living of the population. More in: Kołodko (2008, p. 222 et seq.).

Likewise, transports in pkm and tkm (respectively, the curves started at a lower level and did not have such a high rate of growth). The EU-28 recorded high R2 compliance curves for polynomials with real execution.

3. Japan

The polynomial curve representing the GDP trend in Japan in 1995–2015, deviating from the whole of the analyzed period, showed a slight increase (Figure 3). Its high initial level indicates that the Japanese economy achieved a high degree of development as early as 1995 (Compare: Mindur, 2012, p. 437 et seq.).

The variables representing the overall volume of mass transit in billion pkm (1995–2015) and the tkm (1995–2015) transport volume were mostly straight lines at a lower level than the GDP curve. In recent years there has been an increase in the passenger transport curve and a slight decrease in the freight curve. This means that, despite systematic small economic growth, there was no increase in cargo traffic in tkm, and economic development took place with a constant share of the volume of transport services. On the other hand, the relatively stable and increasing level of the polynomial curve describing the trend of passenger transport may indicate the almost complete attainment of public transport capacity in Japan by the means of transport necessary to meet the needs.

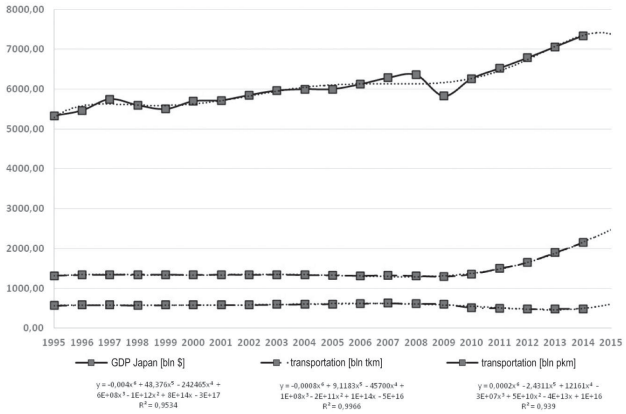

Figure 3. Economic macroeconomic indicators (GDP) and transportation measures (tkm and pkm) in Japan
Source: (own elaboration based on: Mindur, 2010)

4. China

The variable representing GDP growth and the cargo and passenger traffic measures showed an upward trend in the period under study (Figure 4). The highest growth was achieved by the polynomial curve of transport in billion pkm. The real compliance with the polynomial curve was R2 = 0.9874. In another

place, the dynamic tendency of growth and consistency of the actual execution with the polynomial curve R2 = 0.9963 was GDP. At the lowest level with a tendency to slight deviations of the actual performance from the curve estimated on the basis of the polynomial and a clear increase since 2013, the work of transporting loads in tens of millennium was formed.

The distribution of these last two discussed curves proves that consistent and dynamic economic development was taking place regardless of the volume of transport capacity involved. This may be due to the gradual change in the structure of the economy – from industrial production to the emerging service sector.

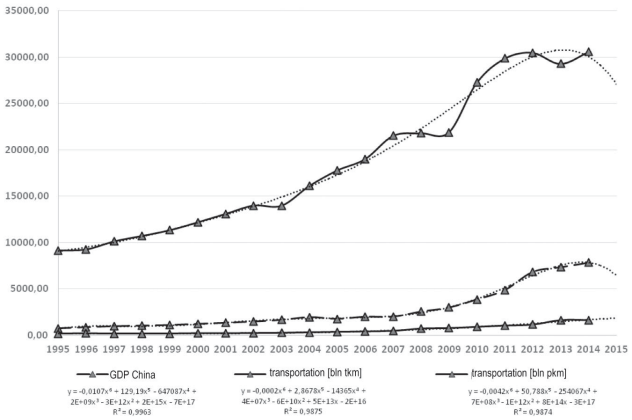

Figure 4. Economic macroeconomic indicators (GDP) and transport measures (tkm and pkm) in China
Source: (own elaboration based on: Mindur, 2010)

5. Russia

Long-term analysis (1995–2015) of the distribution of variables characterizing economy and transport in Russia (Figure 5) indicates the largest increase in cargo traffic (tkm) with a significant drop in 2008–2010, which was triggered by the economic crisis. The increase in the polynomial curve representing the trend of cargo traffic in Russia was due to the raw material nature of the economy and to the favourable situation on these raw materials on the fuel market. The significant share of oil and petroleum products in the development of the Russian economy is driving increased transport. This is also confirmed by the dominant role of pipeline transport in this country (Mindur, 2012, p. 319 et seq.). At the lower level – with the decline in the years 1999–2001 and 2008–2010, and with a slight upward trend – the polynomial curve shows the course of changes in GDP, i.e. the development of the Russian economy. On the other hand, the polynomial curve representing the trend of passenger transport during the period under review was systematically decreasing. This indicates a decrease in these transports – what (as previously mentioned) could have an impact on the development of individual transport.

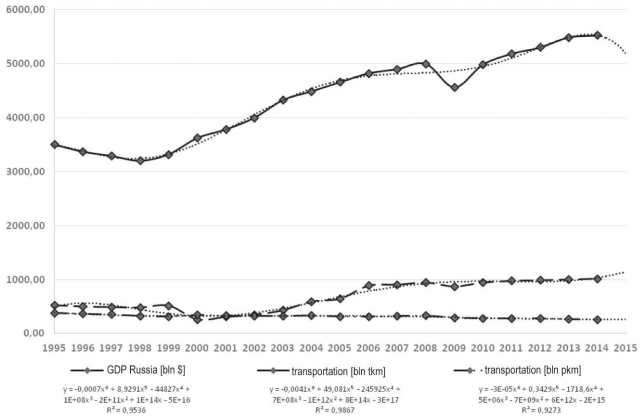

Figure 5. Economic macroeconomic indicators (GDP) and transport measures (tkm and pkm) in Russia
Source: (own elaboration based on: Mindur, 2010)

6. Poland

In Poland during the period considered, the polynomial curves representing the cargo movement (with significant deviations) were subject to a spike in growth (Poland's accession to the EU and to the Schengen area was significant). The polynomial curve representing GDP growth was growing (despite the decline in 2008–2011), indicating a systematic development of the economy. The cargo handling work also clearly increased. However, the polynomial curve representing the collective passenger carriage ran at a relatively even level – showing a slight upward trend in recent years. This could have been due to the involvement in the development of passenger transport and, at the same time, the increased capacity of individual transport.

The analysis of basic macroeconomic variables indicates that in the USA, Japan and the EU-28, the pace of economic growth is greater than the rate of growth of freight – both cargo and passengers. In China, also economic development is greater than the development of transport of goods, and less than the development of passenger transport. The situation is different in Russia, where by 2002 the pace of development of tkm and pkm transport was higher than the pace of economic development, and from that point onwards the level of economic development was higher than that of passenger transport – but still lower than the transport of cargo. There were quite different tendencies in Poland, where high rates of development showed freight transport, the economy was lower (but its growth was growing dynamically), and passenger transport showed a constant trend.

The above facts may indicate that the economic growth of the transport sector has slowed down in the three most economically developed countries in the world (USA, Japan and China) and in the EU-28.

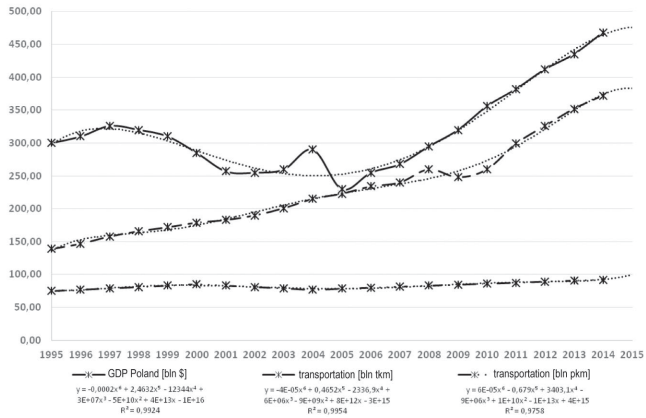

Figure 6. Economic macroeconomic indicators (GDP) and transport measures (tkm and pkm) in Poland
Source: (own elaboration based on: Mindur, 2010)

Conclusions

The volume of world shipping (as the basis for the growth of US, EU and China transport growth, and consistent in Japan), as well as the world economy, is showing an upward trend. This confirms the close link between economy and transport. Transport is an important production division of any economy, an important factor in technical and economic progress and a primary production tool. Securing the right – to meet the needs of the economy – capacity needs a smooth freight subsystem. This subsystem should be systematically improved through the use of modern transport and handling technologies, telematics and IT systems, management methods etc. Logistics centres and a wide range of logistics solutions are very important in rationalizing freight traffic. The most important importance (in the efficient service of the transport economy) is the adaptation of transport activities to the structure and specificity of the economy and the nature of its production, e.g. the modern economy of the United States and the need to secure its transport needs have made transport of the USA regarded as the most modern, environmentally friendly and human. In general, the US plays a dominant role in rail transport, i.e. the most environmentally friendly. According to the research conducted (Mindur, 2010), intermodal transport and bulk use of containers are the highest in US transport. On the other hand, the development of Russia's economy, which is based mainly on the extraction and export of raw materials fuels, has made transport of pipelines the most important. China's economic growth, based mainly on the export of industrial goods, has had an impact on the strong development of maritime transport in containers. This is confirmed by the fact that among the fifteen largest container ports in the world, six (including three

of the largest container transshipments) are Chinese ports. Land transport in China is dominated by inland waterway transport, which results from the favourable natural conditions and the expansion and improvement of the water network by the government of this country.

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Corresponding author

Maciej Mindur can be contacted at: mmindur@vp.pl

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Bartłomiej Buczek[1]

Department of Logistics, Faculty of Economics, University of Gdańsk

PASSENGER LOGISTICS CENTERS PRESENTNESS AND FUTURE

Abstract

This article is dedicated to the role of passenger logistics centers in passenger logistics support systems. Presentations were made through the prism of defining the role of passenger logistics support systems. In today's conceived economic reality, the rules of logistics also apply to everyday human activities. People have to meet their needs and move around. In this perspective, man becomes a resource. There must therefore be passenger logistics support systems, the key elements of which are passenger logistics centers. They fulfill the key logistic functions and enable the achievement of the logistics objectives (5 "W"). The article attempts to describe the present and future role of passenger logistics centers. Information on these centers has been collected, based on scientific achievements of specialists in this field (including M. Chaberek), on railway infrastructure managers and on the author's experience. Finally, conclusions were drawn, in which direction should be assessed both passenger logistics support systems and, above all, passenger logistics centers. An attempt was also made to determine the postulated future role of passenger logistics centers in the logistics system of the country.

Keywords: logistics, passenger, passenger logistic centers, logistics support systems

Introduction

Contrary to popular opinion, logistics is not a human activity typical of activities related solely to production, storage or forwarding. Logistics occurs in every sphere

[1] The author is a master of economics, graduate of the Faculty of Economics of the University of Gdańsk. Currently he is a member of the Management Board and the Director of Transportation at PKP Szybka Kolej Miejska w Trójmieście Limited.

of human activity including "flows" of human streams. According to M. Chaberek (2002, p. 7), logistical tasks have always accompanied human beings. They are ubiquitous, both for a single person and for any economic, social, cultural, health or military organization etc. (Chaberek, 2002) These flows are thus implemented as one of the components of the main process, which can be defined as a set of actions taken by people to meet their needs. M. Chaberek argues that human resources are subject to logistical activities in relation to various needs of human life such as professional work (commuting to work, business trips), running a household, family and social life, health care, tourism and recreation (Chaberek, 2013, p. 25). Due to various human needs, the task of logistics systems is to provide technical and organizational capabilities for implementation of logistics processes enabling interested parties to be at the right time and in the right place, so the process of providing human resources is carried out at an appropriate level of quality and at an acceptable cost (Chaberek, 2013, p. 25).

It is necessary to explicitly separate logistics processes from basic processes. In the case of issues discussed in this paper, basic processes require an infrastructure and subinfrastructure environment for their existence, that would be a logistics support system for a region, subregion or country etc. (Chaberek, 2013, p. 25).

Places between which the flows of human streams take place can be defined as centers of satisfying needs. Passenger logistics systems are used for the described process. In turn, a logistics process can be carried out in the field of transport by different means/branches of transport. A logistic system together with a logistic process create a logistic support system.

It should be emphasized that in recent years logistical tasks related to logistics handling of people, especially those of public service, have become the subject of social policy for central, regional and local governments. Under this policy, solutions are sought for construction and financing of infrastructural elements of logistics systems for cities and regions. There are solutions for financing activities of carriers performing public service obligations aimed at improving the competitiveness of public transport in respect of private transport, including in particular private motor vehicles.

Passenger logistics centers are the elements of the logistics system specialized in passenger handling, which are contact points/interfaces between various subsystems of a logistics support system.

The purpose of this paper is to present the process of crystallization of logistics concepts and their application on a basis of practical solutions that have been implemented in rail transport in Poland. However, this article is focused on passenger logistics, which is more and more often shaped according to general logistics objectives, while taking into account the possibility of practicing its synergistic functions.

It will also demonstrate that the use of the logistics approach to handling passenger needs has already brought and will deliver the desired results. It should be noted here that in the public space there are already more and more architectural, functional and organizational solutions fulfilling the role of logistics centers in the field of passenger transport. These are integrated passenger service centers, check-in and change-over locations along with a wide range of accompanying services.

1. Characteristics of passenger logistics systems

Passenger logistics systems are meant to support the implementation of the logistics processes that contribute to the functioning of the whole society. These processes include all activities related to life and functioning of people such as work, school, university, health care, tourism and recreation. Correct and unhindered satisfaction of these needs is largely dependent on the ability of people to move freely and smoothly between different places. In addition, it is often necessary to gather at the right place and time the right number of people to meet their needs at a reasonable cost. Thus, man in this view becomes a resource[2] that must be available for the execution of certain processes and to fulfill the five goals of logistics: "the right resource", "at the right time", "in the right place", "just the right number" and "at the right cost". These processes require logistics support with the use of dedicated logistics systems.

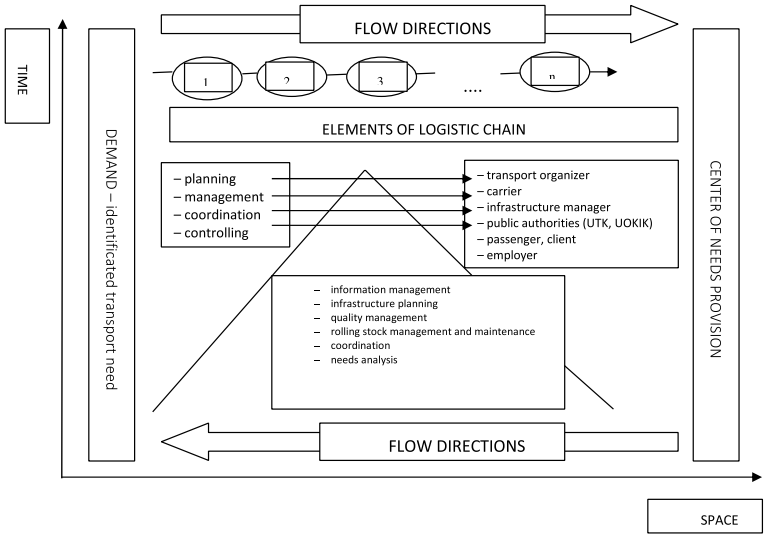

Figure 1. A model example of passenger logistics support systems
Source: (own elaboration)

Passenger logistics support systems usually consist of the following elements:

– infrastructure, including stations and stops along with depots located on some of them; some of these facilities perform the function of passenger logistic centers;
– informatic, telematic and telemetric systems, and other digital tools for the implementation of the passenger logistics process, e.g. systems enabling remote access

[2] Given rather specific nature of "human resources", it seems more appropriate to replace the term "resource" ("human resource") with the term "group" or "stream" and the term "resource flow" with the term "group movement", "flow of streams" or "flow of people".

to travel information, use of loyalty programs, conclusion of a transport contract, modification of a transport contract and withdrawal from a transport contract;
– roling stock enabling the movement of passenger streams;
– institutions regulating the transport market;
– public transport associations (e.g. Metropolitan Public Transport Association of Gdansk Bay, GOP Municipal Transport Association), associations of transport market stakeholders (e.g. passenger rights ombudsman, passenger federations, unions of road, railway and air carriers) inter alia responsible for enforcing a proper quality of transport services;
– public authorities at self-government and state level appointed to act as transport organizers.

In accordance with provisions of the Act of 16 December 2010 on Collective Public Transport, the transport organizer is any competent local government unit or the minister competent for transport ensuring the functioning of collective public transport on a given area. The management of public transport by the transport organizer consists in particular of negotiating and approving changes to a contract with an operator. The operator is a carrier carrying out transport services on the basis of the contract concluded with the transport organizer for the performance of public service obligation. These services are in principle of a general nature and therefore their price cannot be set at the level that covers operator's total costs incurred in carrying out transport services and a reasonable profit. Thus, a compensation paid to the operator by the transport organizer is the difference between the revenue from the provision of transport service and the actual costs incurred for its creation, including reasonable profit[3] (so called "net contract"), or in its entirety covers the whole carrier's costs incurred for service creation including reasonable profit (so called "gross contract"). The transport organizer has also the following tasks:
– evaluation and control of the implementation of the public service contract by the operator;
– control of compliance with rules governing public transport by the operator;
– collaboration in updating timetables to improve operations of public services;
– analysis of the fulfillment of the transport needs arising from the performance of transport services under the public service contract;
– making changes to the existing lines of communication;
– approval and updating of timetables for transport performed on the basis of a confirmation of a carriage declaration;
– administration of a passenger information system.

In this case we are dealing with an important role of the transport organizer in the logistic support system. It performs the coordinating function by planning, organizing, supervising and controlling operations of this system.

A market regulator is an institution appointed by a state authority to oversee a specific market. Regarding the rail market, the President of the Office for Rail

[3] The concept of reasonable profit was included and explained both in the provisions of the Collective Public Transport Act and in the Regulation of the European Parliament and of the Council of 23 October 2007 No. 1370/2007 on public passenger transport services by rail and by road and repealing Council Regulations (EEC) Nos 1191/69 and 1107/70.

Transport acts as the market regulator. As regards technical conditions of operation of a certain equipment subject to technical supervision in transport, regulatory functions are performed by the Transport Technical Supervision Authority. In turn, the President of the Office of Electronic Communications fulfills regulatory functions in regard to telecommunication and information technology equipment and systems, whereas a proper sanitary-epidemiological station supervises hygiene and sanitary conditions etc. Logistics processes related to activities of people implemented with the use of passenger logistics systems.

The impetus for creation of passenger logistics systems is the need to make use of these logistics processes to meet needs of the population. Contact points of particular transport systems are components of the above-mentioned passenger logistics systems of high importance. They enable passengers to change a means of transport and ensure a complex service, including a number of travel related matters. Passenger logistics centers play this role. They enable to fulfill crucial logistic functions such as coordination and maintenance. The first of these functions is accomplished by coordinating the flow of passengers between particular subsystems of the passenger logistic support system (e.g. from road to rail, from Park & Ride to tram, from train to airport terminal). Very often the coordination function of passenger logistics systems displays in correlation of timetables or even in correlation of point infrastructure objects (e.g. tram and bus stops, common platforms for rapid urban railway and trams). The better is the coordination, the higher is the efficiency of the system. It should me mentioned that time with which the concept of coordination is necessarily related, is a quite specific resource because it cannot be accumulated[4]. The second one is realized by the fact that passenger logistics centers are ancillary to the flows. They enable a smooth change of particular subsystems of the logistic system, fulfilling the function of interfaces in the process of passenger flows.

Passenger logistic centers enable achieving five goals of logistics:

1) "appropriate resource" – a quality of passenger logistics centers' infrastructure should enable a journey of an optimum quality; in principle, passenger logistics centers must ensure that passengers travel smoothly between a point of arrival with one means of transport (communication line) and a point of departure by another means of transport (or respectively another communication line in the same transport branch) and satisfy other needs related to a realized journey; this includes creation of access to information systems, WiFi, access to: service network, service offices, luggage storage, luggage boxes, waiting rooms, vending machines, etc.;
2) "in the right place" – two or more transport systems (subsystems of logistic system) come into contact with each other at the most optimal location, allowing smooth flow between them;

[4] From an economical point of view, time is a useful resource, one of limited ones. It is a specific good. While the position of matter in space is static, time always shows dynamics. It never stands in place. Moreover, the time consumed to perform every activity, even the most useful, is always a lost good. From a logistics perspective, time should be defined as the actual good needed to do something. See: Tarski (1976, pp. 11–13, 23–32).

3) "at the right time" – coordination of timetables enables to optimize travel time, eliminating unnecessary waiting time or inefficient travel time between an ending point of a journey of one means of transport and a starting point of a journey by another means of transport (Tarski, 1976, pp. 33–36);
4) "just the right amount" – on the one hand, passenger logistics centers enable integration of a necessary (and therefore proper) number of transport systems, on the other hand the movement between passenger subsystems of the logistic system of an appropriate number of passengers;
5) "at the right cost" – as interfaces, they enable to optimize travel time, reducing its alternative cost; a journey becomes shorter than if a traveler had to make additional journeys (transfer, walk) between contact points of the particular transport systems, and thus total time of a journey becomes shorter; thanks to that fact a passenger gains an opportunity to spend the saved time on his or her other most useful activities; furthermore, eliminating travel between system contact points and the aforementioned avoidance of additional transfers or walks allows to optimize travel costs by eliminating unreasonable expenses.

It follows from the foregoing that the quality of the logistics processes depends to a large extent on both existence and quality of passenger logistics centers; these objects, as previously indicated, are interfaces between individual subsystems, most often designated by transport branches of a given logistic system, and at the same time provide comprehensive service to passengers.

2. Passenger logistics center

In logistical sense, passenger logistics centers must fulfill integration functions, what can be achieved by applying the system approach. Therefore, to acknowledge a railway station, bus station or stop as a logistics center it is first necessary to determine whether a given facility fulfills the integration function from the logistical point of view. The following analogy can be used here: a warehouse where there is only unloading or loading is not a logistic center. It becomes such a center when apart from the characteristics of the warehouse it fulfills also the integration and service tasks/functions. In other words, it should allow to unload, sort and repack goods, perform other services, and then load them to another means of transport. It looks similarly in the case of passenger logistics centers. They must not only enable the exchange of passengers from the means of transport understood as a part of the logistics support system. First of all, in the passenger logistics center, the passenger has the opportunity to change means of transport and to take advantage of comprehensive travel support services (such as above-mentioned WiFi access, shopping centers, information points, luggage boxes etc.). Intrinsically, this is a place where changes of means of transport takes place. A passenger has also here the opportunity to meet other need related directly or indirectly to a journey. By implementing integration functions, passenger logistics centers enable to continue journey by another means of public transport such as train, plane, urban, suburban or intercity bus etc. This group of passenger logistics centers mainly include

interchange railway stations and airport terminals. In principle, these facilities also enable to make use of car parks or parking spots such as Park & Ride, Bike & Ride and Kiss & Ride. Passenger logistics centers based on a railway system are most often larger railway stations and stops, especially in urban agglomerations, suburban areas within the zone of large cities, as well as in junctions and final stops where such car parks or parking spots are located. Passenger logistic centers enable passengers to make use of comprehensive travel services such as conclusion of a transport contract, its modification or after sale services in offices and other dedicated posts. The scope of services provided in this area includes, in particular, acquisition of information prior to travel, conclusion of a transport contract or its modifications according to given circumstances and wishes of passenger, lodging complaints after travel, assistance and any other services during a journey. This group of services also includes help for people with disabilities and people with reduced mobility.

The legacy of earlier periods is functioning of many other terms used for passenger logistics centers (look at the Figure 2). This nomenclature is often accidental and totally devoids of merit. These faicilities are named as interchange stops, integration nodes, passenger terminals, stops, stations or tangent station. The main weakness of these terms is that they function in complete isolation from the concept of logistic perception concerning the problem of passengers streams movement that touches public transportation. It is also a mistake to tie this issue only in the sphere of transport, not to mention naming these facilities as "elements of integrated systems".

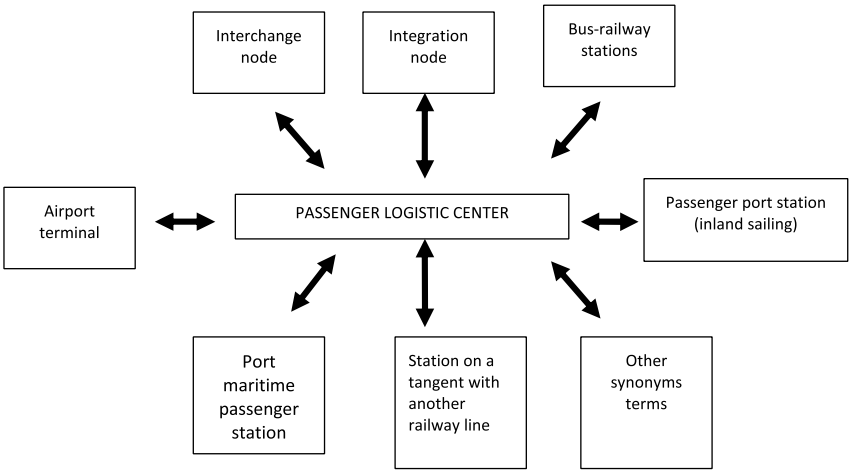

Figure 2. Various terms of passenger logistics centers
Source: (own elaboration)

It should also be stressed that many railway stations, as elements of the railway system, have the characteristics of passenger logistics centers or could achieve them after appropriate adaptation. These facilities have functioned from a long time as interfaces enabling passengers to change the means of transport and deal

with other travel related matters (as described in more detail in the next section). After their proper equipping into modern passenger information and monitoring systems, WiFi access, equipment for automatic sales, and building in their surroundings parkings for cars and bicycles, and other facilities for travelers they will meet the functional requirements of modern type of these objects.

2.1. Retrospective conceptualization

Most of the objects mentioned above have functioned in a traditional model for many years. It means that a given object was primarily intended to handle a particular transport branch. Nevertheless, already in the early 1970s, the attention was paid to the need of synchronizing timetables for different transport modes and to integrate different transport systems (see for example Romanowicz, 1970, p. 9).

Traditionally, the railway station has performed the following functions:

- it was a place to get information about a timetable, including communication with other trains; in principle, larger railway stations have provided comprehensive information on domestic and international communication, whereas smaller ones have provided more or less limited information on domestic communication;
- it was a place to get information on ticket prices;
- it was a place of conclusion, modification and withdrawal of the contract of carriage;
- it was a place to attest different circumstances affecting a course of a journey, inter alia traffic stop, train delay, loss of connection with another train;
- it was a place to make a complaint concerning concluded transport contract as well as to get an insight into applicable regulations and transport tariffs[5];
- it was a place providing a possibility of sending luggage and so called express delivery;
- it was a place where many other services were provided, e.g. restaurants, post offices, florists, etc.;
- it was a place where some authorities were located, e.g. customs office, public order authorities responsible for safety at railway area;
- it was a place to wait for train arrival to receive a passenger by a person waiting for him/her;
- it was a starting and ending point of a journey;
- it was a place of transfer to other trains and other means of transport; however it should be noted that in many cases there have been inconveniences related to this, e.g.:
  a) relatively large distance from the end of a train journey to the starting point of a journey realized by another means of transport,

[5] Based on Article 4 and 11 of the Act of 15 November 1984 on Transport Law (Journal of Laws of 2015 No. 915), the carrier is obliged to make public the transport regulations and his own regulations and tariffs. The Transport Law applies to all modes of transport, excluding air, sea and horse transport.

b) architectural obstacles in moving between the end of a train journey and the starting point of a journey realized by another means of transport,
c) different quality of timetables of particular means of transport,
d) lack of possibility or difficulties in purchasing a ticket for travel by other means of public transport at a railway station,
e) lack of coordination of timetables and communication systems between different means of transport,
f) lack of parking spaces or their insufficient quantity,
g) no place for a convenient place for a passenger car or a taxi to enable a passenger to pass to the railway station or in the contrary direction,
h) insufficient number of security workers focusing their activity mainly on railway area and, in principle, leaving passes leading to stops of other means of transport unattended.

Figure 3. Example of bus-station. Traditional frame
Source: (www.visitprzemysl.pl [Accessed 16 November 2016])

Figure 4. Railway station – traditional frame
Source: (www.historia.beskidia.pl [Accessed 16 November 2016])

Figure 5. An example of bus-railway station
Source: (www.skyscrapecity.com [Accessed 16 November 2016])

Therefore, a railway station has performed logistics functions related to services and integration but not to the full extent. It should be then appreciated that they were properly implemented at stations, keeping in mind that the technology of the 70s and 80s of the last century was not as developed as nowadays (absence of the internet, relatively small development of data transmission devices essentially limited to analogue telecommunications).

Traditionally, bus stations for intercity and regional transport have performed the following functions:

– provided an opportunity to obtain information on timetables, ticket prices, tariffs and price-lists set by carriers;
– was a place of conclusion, modification and withdrawal of a transport contract;
– was a starting point of a journey;
– was a changeover point to another regional or intercity bus or train transfer;
– was an ending point of a journey.

These facilities also fulfilled logistics functions concerning service and integration adequate to the technology of the last three decades of the 20th century.

It is important to note that some bus stations are located quite accidentally in relation to railway stations. Częstochowa, where the bus station is located around 1 km from the railway station is a good example for that. Another example is Bydgoszcz, where distance of 2 km between railway and bus station requires the use of urban public transport. Warsaw Stadium Bus Station is also located around 2 km from the nearest railway station serving long distance trains (Warsaw East Station). However, there are examples as Olsztyn where the railway station is also the bus station and Gdańsk Główny or Warsaw West Station where the bus station is located in the immediate vicinity of the railway station.

Urban public transport stops have fulfilled the smallest logistical functions. They were places at which a journey began and ended, and also places of transfer to another means of public transport (such as train, bus, plane) or other communication line. They usually enabled to get information on timetables and much less often about ticket prices or rules used by a given carrier.

2.2. Impact of EU and national regulations on shaping and development of passenger logistics centers, based on modern railway stations

Penetration of logistical concepts with regard to public transport is a tendency observed over the past few years. Transport is not seen anymore as an end in itself but as a means to handle logistics needs of passengers. From 2011, the Act of 16 December 2010 on public transport is applied in the polish national legal system (Journal of Laws, 2015). The implementation of this law is the consequence of the entry into force of the Regulation (EC) No. 1370/2007 of the European Parliament and of the Council of 23 October 2007 on public passenger transport services by rail and by road and repealing Council Regulations (EEC) Nos 1191/69 and 1107/70. The scope of this act decisively differs significantly from traditional understanding of passenger transport (Chaberek, 2013, p. 26). Amongst other things, thanks to the aforementioned law, the integration function of logistics began to materialize in Poland. It covers such issues as planning, building and organization of so called integrated interchange nodes being actually passenger logistic centers. In turn, a passenger logistic center is a place for a convenient change of means of transport, equipped with infrastructure necessary for comprehensive travel services. It includes in particular: parking spaces for passenger cars and bicycles, stops of other means of transport, passenger checkpoints, passenger information systems, shopping centers, WiFi access, etc. The increase in number of railway stations with full features of passenger logistics centers is observed over the last years under the new EU and national regulations. It is done by converting existing traditional railway stations into modernized or new facility, meeting the role of interfaces between rail transport and other transport sectors, and also by creating new logistics centers. It should be emphasized that the aforementioned weaknesses of public passenger transport point infrastructure, together with technological delay and so called functional wear of stops and station buildings are one of reasons for the reduction of the competitiveness of public transport in relation to private motor vehicles which make possible to travel "from door to door". It should also be noted that the tasks of the station as a passenger logistics center, have undergone some modification in respect to tasks carried out by these facilities over the past dozen or so years.

Obligatory implementation of the regulation (EC) No. 1371/2007 of the European Parliament and of the Council of 23 October 2007 on rail passengers' rights and obligations[6] introduced the obligation to provide travelers with:

– comprehensive travel information, including up-to-date and complete reporting of traffic disruptions or missed connections;
– possibility of access to a ticket distribution and reservation network without hindrance, unauthorized privileges and discrimination;

[6] Regulation (EC) No. 1371/2007 of the European Parliament and of the Council of 23 October 2007 on rail passengers' rights and obligations, and Commission Regulation (EU) No. 1300/2014 of 18 November 2014 on the technical specifications for interoperability relating to accessibility of the Union's rail system for persons with disabilities and persons with reduced mobility (PRM TSI).

– right to assistance from a carrier or infrastructure manager, including station manager, in case of disruptions resulting in a need for long-lasting stay at the station – over 1 hour; care and assistance should be ensured especially when disruptions or delays result in a need to stop travel and accommodate passengers in a hotel;
– protection and assurance of safety of both passengers and their luggage.

These regulations oblige both carriers, infrastructure managers, ticket sellers and tour operators, in particular to provide care and assistance to disabled persons and persons with reduced mobility. This includes, first and foremost, a need to provide travel assistance, current travel information, support for the disabled during their journey (from entry to the station to departure from the station). Community legislation obliges particular railway market undertakings to eliminate technical and technological obstacles (especially architectural), impeding or preventing persons with disabilities and persons with reduced mobility from freely traveling by train, including transfer into another train or other means of transport or simple movement within the area of depots and stations (see UTK, 2013).

It cannot be overlooked that provisions of community law, both existing and planned for implementation (including provisions of the so called Fourth Railway Package) introduce solutions that significantly enhance visions of the logistic approach to passenger handling. It is evident that it means realization of the integration function of logistics, both for branch and interbranch integration. Moreover, it contributes to integration of whole chains of passenger flows as well as to infrastructure, information and tariff-ticket integration. It is therefore possible to consider every traffic junction, railway station correlated with urban public transport (tram, bus, trolleybus, metro), airport with its rail services or urban public transport, as passenger logistic center. They fulfill basic functions of logistics: integration and service functions (Chaberek, 2013, p. 28).

In the case of passenger logistics systems in agglomerations, the creation of new logistics centers is the operation of the organizers of these systems to increase the efficiency of urban public transport while reducing the negative impact of private motor vehicles on these agglomerations (e.g. congestions, air pollution, traffic accidents). Warsaw Chopin Airport railway station which has a common infrastructure with airport terminal, Gdańsk Śródmieście railway station with close correlation of commuter trains and urban public transport, or particular stops on the line of Pomeranian Metropolitan Railway are the examples of newly created passenger logistic centers. In relation to the latter system, practically every stop is a passenger logistics center. Most of these stops have their own Park & Ride parkings and each of them create a common infrastructure with urban public transport. Gdańsk Brętowo stop (the Figure 6) has a railway and tram platform, and Gdańsk Port Lotniczy stop has a direct connection of platforms with operating terminal of Gdańsk Lech Wałęsa Airport.

Good examples of the discussed solutions of passenger logistics centers are Warsaw East Railway Station with the interchange node, Wrocław Główny Railway Station, Poznań Główny Passenger Logistics Center, as Poznań Interchange Node, Kraków Communication Center located on the basis of Kraków Główny Railway Station and the passenger logistics center created on the basis of the railway station in Tczew.

Figure 6. Gdańsk Brętowo stop
Source: (www.wikimedia.com [Accessed 16 November 2016])

Warsaw East Railway Station and its interchange node provide daily 400 suburban trains, 400 long-distance trains, 500 city and intercity buses, and over 500 trams. The bus loop consists of 5 platforms and is entirely roofed with a special lightweight synthetic fiber membrane. On the area of the loop there is also a passenger service point of the Municipal Transport Management in Warsaw, including ticket offices, waiting rooms and toilets. The building of the railway station was modernized for nearly 60 million PLN, while modernization improved its functionality and esthetics, and it was adapted to the needs of people with disabilities and people with reduced mobility. During the modernization of the E65 railway line, the platforms have been comprehensively modernized. It improved their functionality and adapted them to the needs of people with reduced mobility. Platforms were covered by video surveillance and dynamic passenger information systems, improving the security of their users and access to information.

Wrocław Główny Railway Station has been also modernized. Its interior space has been redesigned, improving its functionality and adapting the building to the needs of people with reduced mobility. A dynamic passenger information system and modern video surveillance system were built. Wrocław Główny Passenger Logistics Center integrates railway lines with urban trams, city and intercity buses. In the east part of the railway station there is a taxi rank. The railway station has also underground parking for 217 parking places. The entire investment was made for a net amount of 293.5 million PLN.

Poznań Główny Passenger Logistic Center, also known as Poznań Interchange Node, is an object of modern architectural form. It includes railway station, bus station, public transport stops, office facilities, parking, taxi rank, shopping gallery and hotel. The value of this investment was 160 million PLN.

Kraków Communication Center enables passengers to use railway, long distance and regional buses, public transport, including Kraków Speedway Tram. It provides a railway connection with Kraków Balice Airport. There is a shopping gallery located in the building and parking spaces for cars and bicycles. In turn, the passenger logistics center in Tczew integrates rail transport, urban transport and regional bus transport. The facilities were built on the area of about 5 hectares. Tczew Railway Station is the place with about 2.5 million of travelers every year. For this purpose a car park for 252 car was built. The net cost of the investment amounted to over 30 million PLN (Chaberek, 2013, p. 29).

It should be then stated that passenger logistics centers enable:

- coordination of various transport systems including correlation of timetables;
- possibility of free movement of travelers streams to change means of transport;
- implementation of repetitive standards for dynamic passenger information systems for each means of transport;
- implementation of common ticket distribution channels, e.g. in the case of Tricity or Warsaw there is a possibility to purchase railway tickets and urban municipal transport tickets in the same ticket machine; in the case of PKP Szybka Kolej Miejska w Trójmieście Limited it is possible to purchase tickets for this carrier and other urban public transport tickets, including tickets of the Metropolitan Public Transport Association of Gdansk Bay, at the same ticket offices;
- implementation of architectural and technical facilities helping the movement within the object, especially in the case of change of means of transport; these include elevators, platforms, escalators, ramps, visual signage of access roads;
- use of a range of facilities for people with disabilities and people with reduced mobility; these are, for example, dedicated cash desks or service desks with sign language staff or virtual interpreters; these facilities also include special pathways for visually impaired persons, acoustic information and visual information for the deaf; when moving persons with disabilities and with reduced mobility are assisted by workers of an operator or infrastructure manager;
- protection of travelers, including CCTV monitoring system and technical solutions to quickly detect and respond to the threats and to prevent them from spreading;
- functioning of a number of commercial service establishments enabling handling of various travel related matters;
- establishment of food service centers such as restaurants, bars, coffee shops offering high standards of service; very often these objects are part of larger networks, what additionally guarantees a relatively high and above all repetitive service standard;
- free access to a broadband internet (WiFi);
- continuing cleaning service ensuring that the facilities maintain a high level of purity and sanitary parameters twenty four hours a day seven days a week.

Figure 7. Example of passenger logistic center – one of Pomeranian Metropolitan Railway stops
Source: (www.trojmiasto.pl [Accessed 16 November 2016])

Figure 8. Example of passenger logistic center – one of Pomeranian Metropolitan Railway stop
Source: (www.trojmiasto.pl [Accessed 16 November 2016])

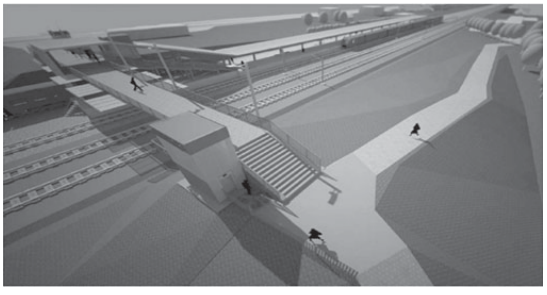

Figure 9. Example of a passenger logistics center – visualization of currently-modernized PKP SKM stop in Rumia Janowo
Source: (materials of PKP SKM w Trójmieście Sp. z o.o.)

Figure 10. Infrastructure of a passenger logistic center adapted to service passengers with reduced mobility – one of the metro stations in Warsaw
Source: (materials of ZTM Warsaw)

It should be added that it is increasingly common to build such facilities as Bike & Ride parkings or city bike stations in the immediate vicinity from passenger logistics centers. For most of european countries there is a network of "rent a car" facilities on large stations. It is also a common practice to build facilities like Park & Ride in the vicinity of passenger logistics centers or directly connected with them.

The practice of linking passenger logistics centers with commercial complexes is becoming increasingly popular. In Poland, good examples of such practices are:

– Sopot railway station, where the railway infrastructure is connected to a hotel and service complex with a large underground car park;
– Kraków Główny railway station;
– Warsaw Wileńska railway station where the infrastructure of the passenger logistics center has been integrated into a commercial gallery area;
– Warsaw Central Station, where the railway station is connected with the adjacent city bus station, with commercial gallery called "Złote Tarasy".

3. Development trends and an assumed role of passenger logistic centers in the perspective of the coming years

It should be assumed that the above mentioned trends in creation of passenger logistics centers will be the subject to further development and improvement in the years to come. Increasing demands of a passenger as a consumer will be geared towards obtaining a comprehensive service of a competitive quality in relation to private motorization. Obviously, the quality of these services is influenced not only by the quality of logistics centers, nevertheless these facilities are often

the first point of contact between a passenger and a public transport system. Combined with good quality of other elements of logistics processes such as staff, regularity, punctuality, safety and comfort conditions, they create synergies resulting in a competitive advantage of public transport in regard to private motor vehicles. Furthermore, the quality of passenger logistics centers that become city showcases also result in a better perception of these cities by visitors.

It should be then assumed that further development of passenger logistics centers should aim to:

- further integration of point infrastructure (it should be assumed that the traditional model of separate stations and stops will be replaced by the model of integrated facilities, acting as interfaces between particular transport systems perceived as subsystems of the passenger logistic system);
- integrate passenger logistics centers with commercial, service and business office support objects etc.;
- continue to implement common standards in terms of visual form and functioning of dynamic and static passenger information systems; regardless of the means of transport, these systems should have common characteristics, including presentation of a place of destination (stop or station), planned and actual departure time, delay time and other information related to a given journey;
- construct common ticket distribution networks, including distribution of tickets in common cash windows or service offices; in the end common ticket offers should be implemented;
- develop such solutions as Park & Ride, Kiss & Ride, Bike & Ride, bikesharing or carsharing;
- coordinate timetables so that the waiting time for a change of means of transport is optimal;
- supervise the timetable process, so that the planned timetables for communication carried out in the area of passenger logistic centers are guaranteed;
- create architectural and technical solutions guaranteeing the continuity of travel without leaving the station infrastructure; a good example of this can be the Paris Metro (metro + RER), where interchanges take place without leaving communication line objects dedicated to a given line;
- improve standards in handling of people with disabilities and people with reduced mobility;
- provide access to a free internet (WiFi);
- ensure a network of catering, service and shopping facilities enabling that number of issues can be carried out during a journey.

Passenger logistics centers functioning together with intelligent transport systems should be well constructed because as it was mentioned before, they play a significant role of interfaces. They integrate different transport branches or communication lines perceived as elements of the logistic system of a given area (country, agglomeration etc.). A development of these facilities will therefore contribute to the efficiency of relevant logistics systems, which will definitely improve the quality of these systems and thus the attractiveness of the region or locality concerned.

An undisputable advantage of passenger logistics centers is shortening travel time and, as noted above, increasing efficiency of collective public transport journeys. The strength of solutions used to integrate logistic centers with service facilities is the ability to carry out a number of matters during a journey. Passenger logistic centers have a clear positive impact on improving the competitive advantage of broadly understood collective transport.

Conclusions

A well-thought-out and well-designed development of passenger logistics centers will contribute to construction of modern passenger logistics systems, improving the quality of transport services as part of the logistics process. This will result in an increase in the competitiveness of public transport compared to the significantly less efficient logistic effectiveness of private motor vehicles. The main aspects of creation, evolution and operation of passenger logistics centers, as well as the outlined directions for their development, discussed in this publication clearly demonstrate that logistics centers have a proper effect of each passenger logistics system. What is worth emphasizing, they are only one of the factors influencing the level of this efficiency. In order to increase the efficiency of the systems, synergy of many elements is required, including the quality of rolling stock and service standards.

It is noteworthy that high-efficiency passenger logistic centers affect the efficiency of the entire logistics system of a given region or locality. Due to mutual correlation of the quality of passenger logistics systems with the pace and quality of development of cities or regions, the development of passenger logistics centers is an important factor influencing dynamics and quality of development of individual administrative units of the country.

Logistics is not a human activity typical of activities related solely to production, storage or forwarding. It occurs in every sphere of human activity including "flows" of human streams. Logistical tasks have always accompanied human beings. They are ubiquitous, both for the individuals and for any organization: economic, social, cultural, health, military etc. These flows are thus implemented as one of the components of the main process, which can be defined as the set of actions taken by people to meet their needs.

For a dozen or so years, logistical tasks related to the movement of people ("flows of passenger streams") are the subject of social policy of both central and regional authorities. This issue is perceived by the prism of logistics. Regulations of the law, both european and national ones clearly uphold the logistic nature of the solutions. Such an approach makes possible to find solutions related to construction and financing of infrastrucutre elements of logistic systems (of country, region, subregion, city, voivodeship etc.).

Nowadays, activities undertaken for the construction of passenger logistics centers aim to treat them not only as the place where it is possible to start and end a journey or change a means of transport but also as the place where comprehensive

travel services are provided. These facilities are intended to provide the possibility of entering into a transport contract, its modification, after-sales service and handling of a number of travel related matters. Passenger logistics centers are designed to fulfill the basic functions of logistics: maintenance and integration. These objects influence the increase in the efficiency level of the entire logistics system of an administrative unit. Due to the mutual correlation of the quality of passenger logistics systems with the pace and quality of urban or regional development, the development of passenger logistics centers is an important factor influencing the dynamics and quality of development of particular administrative units, and their high quality influences the increase in popularity and efficiency of public transport.

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Corresponding author

Bartłomiej Buczek can be contacted at: bbuczek@skm.pkp.pl

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Maciej Ruciński

Attorney at law Adwokaci i Radcy Prawni "Urbański, Ruciński, Majcher-Borkowska" Sp.p.

RAILWAY TRANSPORT UNDER POLISH LAW

Abstract

The article presents an outline of the law governing railway transport in comparison with the regulations for road transport. The comparison shows that railway entrepreneurs are much more encumbered with legal obligations than road carriers, which in part is due to the specificity of this branch of transport. The essential constraints to the competitiveness of railway transport relate to the cost of access to railway infrastructure and its condition. The article also points out the faulty legislation, disadvantageous to both modes of transport, and attempts to determine the impact of legal solutions for the development of rail transport.

Keywords: railway transport, railway infrastructure, carrier, carriage, forwarding, passenger

Introduction

The aim of the present paper is to provide a description of the legislative environment of railway transport in Poland and to attempt to assess the impact of the said environment on the development of railway transport. Although the main focus of the paper is railway transport, for the purpose of comparison it also considers road transport, given the competition between them.

In the first part of the article there's a description of the law regulating transport in Poland. The following parts cover the comparisons of administrative provisions for railway infrastructure and for road infrastructure, for railway carriers and for road carriers, and also presentation of the civil law concerning transport. Second to the last part concerns rules for passenger transport services. In the last part of the article there are conclusions.

The article is mainly addressed to those who are involved in management, organization, legal assistance, legislation and study of railway transport.

1. Legal System

Railway and road transport fall within the sphere of a common transport policy of the European Union, pursuant to Articles 90 and 100 (1) of the Treaty on the Functioning of the European Union (consolidated text: Official Journal of the European Union, C 326/01, 26 October 2012). Each of these branches of transport is regulated by a large number of Community legal acts, national legal acts, and international conventions (not including local and ministerial legislation). This amounts to over a hundred acts for each mode of transport, with some of these acts – civil law regulations of national transport and regulations regarding public collective transport in particular – governing both modes of transport.

To describe the system of law of transport by road and rail, it is necessary to provide a list of the key acts. Among the regulations of the most practical significance for both modes of transport we can list:

1) Act of 15 November 1984 – Transport Law (consolidated text: Dz. U. [Journal of Laws] 2015, item 915, as amended);
2) The Civil Code (consolidated text: Dz. U. [Journal of Laws] 2017, item 459);
3) Regulation (EC) No 1370/2007 of the European Parliament and of the Council of 23 October 2007 on public passenger transport services by rail and by road and repealing Council Regulations (EEC) Nos 1191/69 and 1107/70 (Official Journal of the European Union, L 315/1, 03 December 2007) as amended by the Fourth Railway Package in Regulation (EU) 2016/2338 of the European Parliament and of the Council of 14 December 2016 amending Regulation (EC) No 1370/2007 concerning the opening of the market for domestic passenger transport services by rail (Official Journal of the European Union, L 354/22, 23 December 2016);
4) Act of 16 December 2010 on Public Collective Transport (consolidated text: Dz. U. [Journal of Laws] 2016, item 1867).

The most important regulations exclusively on railway transport include:

1) Act of 28 March 2003 on Railway Transport (consolidated text: Dz. U. [Journal of Laws] 2016, item 1727, as amended);
2) Act of 8 September 2000 on Commercialization and Restructuring of the State Enterprise "Polskie Koleje Państwowe" (consolidated text: Dz. U. [Journal of Laws] 2017, item 680);
3) Regulation (EC) No 1371/2007 of the European Parliament and of the Council of 23 October 2007 on rail passengers' rights and obligations (Official Journal of the European Union, L 315/14, 03 December 2007).
4) Convention concerning International Carriage by Rail (COTIF) of 9 May 1980, as modified by the Protocol for the modification of the Convention concerning International Carriage by Rail of 3 June 1999 (consolidated text: Dz. U. [Journal of Laws] 2007, No 100, item 674).

The most important regulations exclusively on road transport include:

1) Act of 6 September 2001 on Road Transport (consolidated text: Dz. U. [Journal of Laws] 2016, item 1907, as amended);

2) Act of 21 March 1985 on Public Roads (consolidated text: Dz. U. [Journal of Laws] 2016, item 1440, as amended);
3) Act of 27 October 1994 on Toll Motorways and the National Road Fund (consolidated text: Dz. U. [Journal of Laws] 2015, item 641, as amended);
4) Regulation (EU) No 181/2011 of the European Parliament and of the Council of 16 February 2011 concerning the rights of passengers in bus and coach transport and amending Regulation (EC) No 2006/2004 (Official Journal of the European Union, L 55/1, 28 February 2011);
5) Regulation (EC) No 1071/2009 of the European Parliament and of the Council of 21 October 2009 establishing common rules concerning the conditions to be complied with to pursue the occupation of road transport operator and repealing Council Directive 96/26/EC (Official Journal of the European Union, L 300/51, 14 November 2009);
6) Convention on the Contract for the International Carriage of Goods by Road (CMR) (1978 – Geneva, 19 May 1956 as amended by Protocol to the CMR, Geneva, 5 July, 1978 (Dz. U. [Journal of Laws] 1962 No 49, item 1727).

The number of legal acts governing each of the two modes of transport is similar, as is the frequency of their amendments. For example, since the day of Poland's accession to the European Union, i.e., 1 May 2004, the Act on Railway Transport has been amended 62 times (not counting the amendments that have come into force since 1 May 2004). Since 1 May 2004, the Act on Road Transport has been amended 72 times. The Act on Public Roads has been amended 48 times in this time period.

It should nevertheless be noted that the purpose of the amendments made regarding railway transport is to support the realization of a deep reform introduced in the European Union by the so-called railway packages. Their aim is to establish a single railway area characterized by compatible technical solutions and safety requirements (interoperability) that would ensure freedom of economic activity and fair competition (Świątecki, 2013, pp. 49–51).

The main Community Directives concerning rail transport are following:

1) Directive 2012/34/EU of the European Parliament and of the Council of 21 November 2012 establishing a single European railway area (recast) (Official Journal of the European Union, L 343/32, 14 December 2012);
2) Directive 2008/57/EC of the European Parliament and of the Council of 17 June 2008 on the interoperability of the rail system within the Community (Recast) (Official Journal of the European Union, L 191/1, 18 July 2008);
3) Directive 2004/49/EC of the European Parliament and of the Council of 29 April 2004 on safety on the Community's railways and amending Council Directive 95/18/EC on the licensing of railway undertakings and Directive 2001 /14/EC on the allocation of railway infrastructure capacity and the levying of charges for the use of railway infrastructure and safety certification (Official Journal of the European Union, L 164/44, 30 April 2004).

Described above directives were transposed into Polish law by Act on Railway Transport.

Directives and Regulation of the fourth railway package are waiting for entry into force:

– 1 January 2019 Amendment for Directive 2012/34/EU by Directive (EU) 2016/2370 of the European Parliament and of the Council of 14 December 2016 amending Directive 2012/34/EU as regards the opening of the market for domestic passenger transport services by rail and the governance of the railway infrastructure (Official Journal of the European Union, L 352/1, 23 December 2016);
– 24 December 2017 Amendment for Regulation (EC) No 1370/2007 by Regulation of the European Parliament and of the Council (UE) 2016/2338 of 14 December 2016 (Official Journal of the European Union, L 354/ 22, 23 December 2016);
– 16 June 2020 – Directives 2008/57/EC and 2004/49/EC will be replaced by Directive (EU) 2016/797 of the European Parliament and of the Council of 11 may 2016 on the interoperability of the rail system in the European Union European Union (Official Journal of the European Union, L 138/44, 25 May 2016) and by Directive (EU) 2016/798 of the European Parliament and of the Council of 11 May 2016 on railway safety (Official Journal of the European Union, L 138/102, 25 May 2016).

2. Rail and Road Transport Infrastructure

The key legal issues relating to transport infrastructures are associated with the management of the infrastructure and infrastructure charges.

A common feature of road and railway infrastructure regulations has become a separation of infrastructure management and transport services. While such an arrangement was natural for road transport, for rail transport it is a consequence of the reform in Community legislation carried out as part of subsequent railway packages.

In Polish law, the differences in road and railway infrastructure management are fundamental. The task of building and managing public roads lies, depending on the category of a road, within the competence of the government or local authorities (Article 19 of the Act on Public Roads). The use of roads is, generally speaking, free of charge, with the exception of motorways, pursuant to the Act of 27 October 1994 on Toll Motorways and the National Road Fund and with the exception of electronic toll collection system, pursuant to Articles 13 ha *et seq.* of the Act on Public Roads (via TOLL).

The situation of railway transport is much more complicated. Railway infrastructure is managed by commercial companies. In Poland, there is one main manager of national railway infrastructure (PKP Polskie Linie Kolejowe S.A.) and several smaller ones. However, a significant part of railway infrastructure – the traditional energy supply system – is administered by an entity independent from PKP PLK S.A.

Now that the Act on Railway Transport has been amended by the Act of 16 November 2016 Amending the Act on Railway Transport and Some Other Acts (Dz. U. [Journal of Laws] 2016, item 1923), the number of infrastructure managers of publicly available railway infrastructure is going to increase due to the fact that some railway sidings are going to be converted into railway lines, and others are most likely going to become part of the publicly accessible railway infrastructure.

As a rule, there are partial non-cost-recovery charges for the use of railway infrastructure. In the remaining scope, maintenance, construction, expansion, and renovation costs should be covered from public funds transferred on the basis of relevant agreements. This significantly complicates the financing of railway infrastructure, i.a. due to the risk of violating the principles of authorized state aid, especially in the case of smaller managers. A difficulty is also pointed out in reconciling the mission of PKP PLK S.A., which is to ensure the functioning of railway infrastructure of social and economic significance, with the commercial principles of entrepreneurial operations (Lesiak, 2013, pp. 104–110).

The problem which, despite the passage of time, has still not been definitively solved, is the regulation of the legal status of the land beneath the railway tracks. The land beneath the roads, on the other hand, is, depending on the category of a road, the property of either the State Treasury or a local governmental unit (Article 2a of the Act on Public Roads). In the case of railway, labour-intensive and time-consuming "enfranchisement" procedures have been implemented. The slow progress in the regulation of the legal status of the land made it necessary to implement special legal solutions which move away from the *superficies solo cedit* principle and were supposed to transfer the ownership of railway tracks without transferring the ownership of the land (Article 17, Section 5 of the Act on Commercialization and Restructuring of the State Enterprise "Polskie Koleje Państwowe")[1]. What is worse, as a result of errors made in the provisions on communalization, part of the land beneath railway tracks passed to the ownership of *gminy* [communes][2].

It should be noted that a railway infrastructure manager is obliged to adjust to the interoperability requirements and to apply security principles much more elaborate than public roads managers.

It has been pointed out that the cost of accessing railway infrastructure is generally higher than the cost of accessing road infrastructure and that railway infrastructure is in bad condition, which translates into low average speed of freight trains. This significantly decreases the interbranch competitiveness of railway transport relative to road transport (Stawiński, 2016).

3. Carriers

There are significant differences between providing railway transport services and road transport services.

Apart from a licence, a railway carrier must have a safety certificate, pursuant to Articles 17e and 18b of the Act on Railway Transport. A safety certificate is a document confirming that the carrier has a safety management system approved by the President of the Office of Rail Transport and is capable of meeting the safety requirements (Article 4, Point 18a of the Act on Railway Transport).

In order to be able to pursue their occupation, road carriers are also obliged to meet certain requirements pursuant to Articles 5, 5a and 5b, 7a *et seq.*, as well

[1] Explanatory memorandum on a draft, p. 24 – Paper 908 of 4th-term Sejm.

[2] Cf. Resolution of Supreme Administrative Court, 7 judges, 27 February 2017, I OPS 2/16.

as Article 37 *et seq.* of the Act on Road Transport and Articles 3–8 of the Regulation (EC) No 1071/2009. They are, however, incomparably less burdensome than those imposed on railway carriers.

According to the list published by the Office of Rail Transport on its website (www 1) as of 28 February 2017, 118 rail transport licences have been issued in Poland, including 39 to perform passenger transport. According to the report published by the Main Inspectorate of Road Transport on its website (www 2) as of 31 December 2016, with regard to international road transport alone, 33.136 entrepreneurs have been issued a freight transport licence and 3.156 entrepreneurs have been issued a passenger transport licence. These data therefore indicate that the operations of railway carriers and road carriers are incomparable. The occupation of a railway carrier is much more resource-intensive, requires technical facilities, higher-qualified employees, and a more developed organization; it is also far more complicated, especially in terms of access to infrastructure (Articles 29 *et seq.* of the Act on Railway Transport), staff training (Articles 18d and 22 of the Act on Railway Transport), and meeting the requirements related to rolling stock maintenance (Articles 20 and 20a of the Act on Railway Transport) and safety.

At the end of this section one should mention the railway service facility, which are used to supply the services referred to in point 2 of Annex 2 to the Act on Railway Transport. Even if the owner of such a facility is a rail carrier, he has an obligation to share it with other carriers and to separate in its own structure operator of service facility. The source of this obligations is Directive 2012/34/EU. Similar obligations do not have the road carriers.

4. Civil Law Regulations

Pursuant to the provisions of Article 775 of the Civil Code on carriage contracts and the provisions of Article 795 of the Civil Code on forwarding contracts, the provisions of their respective titles shall apply only insofar as they are not governed by separate provisions. Until the end of the 1980s, regulations were based on the orders issued by the competent minister in charge of transport which specified the rights and obligations of the parties in fair detail.

In terms of forwarding, the regulation contained in the Civil Code, which was supposed to perform merely an ancillary function, is currently the only one in force. Such a situation is conducive to exposing the imperfections of the said regulation, of which one of the most grave is the difficulty in distinguishing a forwarding contract from a carriage contract, especially when dealing with a so-called contracting carrier. Considering the radically limited burden of responsibility of a forwarder in comparison to a carrier, it constitutes an incentive for most carriers to apply a forwarding contract instead of a carriage contract at the expense of customers and *bona fide* competitors (Ogiegło, 2011, p. 908).

Carriage contracts and forwarding contracts are often distance contracts, entered into electronically, and establish only the most important provisions. As a result, there is a lack of detailed regulation. The Polish Chamber of Forwarding and Logistics

undertook to fill this gap by publishing Polish General Forwarding Rules; however, even regardless of their shortcomings, they cannot replace a legal act.

A peculiarity of transport law are periods of limitation. In civil law, as a rule, a limitations period, pursuant to Article 120, Section 1 of the Civil Code, is calculated from the date on which the claim became due, and for claims connected with conducting business activity, pursuant to Article 118 of the Civil Code, it is three years.

The provisions of Articles 77 and 78 of the Transport Law Act provide three limitations periods: two months, six months, and one year, with six different starting dates for the last one. The two-month limitations period is the shortest limitations period known to Polish law. For the six-month limitations period, applicable to claims of a carrier against other carriers who participated in the transport of a consignment, two different staring dates have been provided, and the claim may become time-barred before it becomes due.

This issue is regulated differently by Articles 32 and 39 of the CMR Convention, which provide two limitations periods: one year and three years, with three different starting dates.

Different still are the limitations periods specified by the COTIF Convention. Limitations periods regarding passenger transport established in this convention are also applicable to domestic transport services, pursuant to Article 11 of the Regulation (WE) 1371/2007. They run for either one, two, three, or five years, with three different starting dates for one-year and two-year limitations periods.

Separate limitations periods are provided by the provisions of Articles 803 and 804 of the Civil Code for claims under a forwarding contract. These limitations periods run either for a year or for six months, with several different starting dates.

The complicated legal status creates a risk for both carriers and their customers. It is difficult to find a justification for such short and differing limitations periods and for so many different starting dates (Szanciło, 2015, p 12).

5. Passenger Transport

For years now the application of the Regulation (EC) No 1370/2007 of the European Parliament and of the Council as well as the Act on Public Collective Transport, which supports its implementation in domestic legislation, has been of major significance for the legal issues of railway passenger transport. This Regulation lays down the so-called competition mechanisms (Jarecki, 2013, pp. 38–44). While introducing a general requirement of awarding contracts in tendering procedures, it also allows for a number of exceptions.

Less than seven years since the Regulation (WE) No 1370/2007 came into force, a far-reaching amendment of this Regulation has been made, as part of the fourth railway package, by the Regulation (UE) 2016/2338 , with the aim of gradually limiting the permitted exceptions to tendering procedure.

These changes are intended to increase competition between passenger carriers having regard to British solutions. However, the study of the European Commission

Directorate General for Mobility and Transport "Study on the price and quality of railway passenger services" (www 3) shows that ticket prices in the UK are among the highest in Europe (point 3.7 of the Study). From 2004 onwards, these prices have increased by over 60% (point 2.22 of the Study). The relation between cost of travel by rail and cost of travel by car or coach in the UK is the worst in Europe (points 5.4–5.5, 5.16–5.18 of the Study). Punctuality of local and regional trains in the UK is lower than in Poland, while higher of long-distance trains (point 7.28 of the Study). According to Network Rail Monitor, 20 July 2017 published by Office of Rail and Road on its website (www 4), punctuality of trains in the UK from the beginning of 2012 to the end of 2016 has worsened by 4.9% (point 3.1).

Moreover, Article 5a of the amended Regulation contains recommendations for organizers with regard to ensuring access to rolling stock for the operators participating in a tendering procedure. The proposed solution, which consist in acquiring the rolling stock by the organizer, gives rise to doubts, as it is discriminatory towards carriers who provide their own rolling stock and overlooks the fact that rolling stock is an element of the carrier's competitive strategy (Jarecki, 2013, p. 79). A guarantee to procure the rolling stock for one of the tenderers introduces an inequality to the conditions of tendering.

One could think, that these measures are aimed at strengthening the competitiveness of small railway companies by eliminating the barrier to entering the market created by the lack of rolling stock. However, as has been indicated above, railways carriers, unlike road carriers, must have extensive structures at their disposal. The reason is that railway is a very complicated system – and its very complexity constitutes a major barrier to entering the market for small enterprises. It is therefore doubtful that increased accessibility to rolling stock would eliminate the barriers to entering the market for small enterprises.

It can, however, intensify the competition between carriers that have previously been operating in other areas. For such enterprises, facilitated access to rolling stock minimizes the risk connected with engaging into new transport undertakings. Thus, paradoxically, it may turn out that facilitating access to rolling stock will favour the expansion of large carriers. For such expansion the opening of the market for domestic passenger transport services by rail accordingly to Directive (EU) 2016/2370 will be helpful. The Regulation (WE) 1371/2007 introduced elaborate rail passengers' rights protection rules. Among others, passengers are entitled to compensation for train delays, which amounts to 25% of the ticket price in the case of 60- to 119-minute delay and 50% of the ticket price in the case of a delay of 120 minutes or more (Article 17 (1) of the Regulation). It should be emphasized that the carrier is obliged to carry out transportation and to pay compensation.

Under the Regulation (EU) No 181/2011 on rights and obligations of passengers in bus and coach transport, which was issued several years later, passenger rights are less protected. For instance, it does not provide for any compensation for delay.

The above-described differences in passenger rights protection confer an advantage on road carriers.

With regard to the issue of passenger transport we can also note the problem of repeated fare evasion. It is a problem which both modes of transport share.

Although railway carriers and road carriers should be protected from repeated fare evasion under the provisions of Article 121, Section 1 of the Code of Petty Offences (consolidated text: Dz. U. [Journal of Laws] 2015, item 1094), due to faulty construction it does not fulfil its function (Krajewski, 2015, p. 36).

Conclusions

Generally speaking, transport legislation is significantly dominated by provisions of Community law. In the remaining scope it is a rather chaotic conglomerate of solutions from different time periods. In certain areas it is overregulated, while in other it remains underregulated. It undergoes frequent amendments. It requires reorganization.

In particular, with regard to civil law regulations, the simplest solution would be to model the provisions of Polish law after the international conventions in force, considering that it would be difficult to change the conventions. The provisions of the CMR Convention should be applied to road transport, and the provisions of COTIF Convention should be applied to railway transport. Moreover, the provisions on forwarding contracts should be better specified.

Increasing the interbranch competitiveness of railway transport requires improving the condition of railway infrastructure and establishing such access charges to the said infrastructure so as not to discriminate railway carriers. The question of whether it is possible to achieve this goal without reorganizing the national railway infrastructure management, however, raises some doubts. The legal discrimination of rail carriers should also be eliminated, for example the obligation to pay compensation to passengers, resulting from the article 17 of Regulation (EC) 1371/2007, which has no equivalent in road transport.

With regard to railway passenger transport, it is recommended to analyse the influence of the fourth railway package on railway passenger carriers in the longer run and to make preparations to cope with competition, which is most likely going to increase in the future. However, it does not mean that the competitiveness of rail transport compared to road transport will be increased.

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Corresponding author

Maciej Ruciński can be contacted at: mur@radcysp.pl

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Adam Bogusz

Department of Finance and Management in Bydgoszcz, WSB University in Toruń

GROWTH OF LNG GAS MARKET AS ALTERNATIVE FUEL IN TRANSPORT

Abstract

The aim of the article is to present the possibility of reducing the negative impact of vehicles on the human environment. The article presents the directions of the development of methane storage and transport technology as a fuel for the supply of vehicles of different branches of transport.

Keywords: alternative fuels, natural gas, environment pollution

Introduction

The internal combustion engines of vehicles emit considerable quantities of harmful substances in the exhaust during their operation. Burning of fossil fuels in internal combustion engines is one of the three major sources of air pollutants in urbanized areas, along with energy industry, the municipal infrastructure and households. Particularly dangerous are diesel exhaust gases as multi-component mixtures of chemicals produced by the combustion process of complex, multi-molecular hydrocarbons. In addition to polluting the environment with combustion products, heavy vehicles emit significant amounts of noise – a factor that also has a negative impact on the human body. The aim of the article is to present the possibility of using natural gas as fuel for motor vehicles. The first part of this article shows the compressed natural gas CNG and its properties. The second part of the paper discusses liquefied natural gas LNG. The third part discusses the possibilities of LNG market development and liquefied gas infrastructure investments.

1. Compressed Natural Gas (CNG) as a fuel for motor vehicles

One way to reduce harmful emissions is to use alternative fuels that surpass the conventional fuels in purity. Popular in many European cities is supplying their municipal transport vehicles with methane (natural gas, biogas). Gas fuel has the characteristics of excellent fuel for vehicles. Methane-powered engines do not emit harmful substances. Natural gas buses meet the strictest exhaust gas standards (Euro 6 and EEV).

Natural gas is used as a compressed CNG (Compressed Natural Gas) fuel. For storage and transport of fuel, fuel tanks are used to store fuel at a working pressure of 200–250 MPa.

Natural gas available on the Polish market contains not less than 92% by volume of methane. Other minor ingredients are: saturated hydrocarbons of high molecular weight, nitrogen, carbon dioxide, hydrogen sulphide, water and other constituents in trace amounts. The composition of natural gas, which determines its physiochemical properties, makes it an excellent motor fuel without the need for further modification and processing. Engines powered by compressed natural gas emit much less harmful substances into the atmosphere than traditional liquid fuel engines. The emission of harmful substances is so low that CNG buses meet the current and future environmental standards in force in Europe (Table 1).

Table 1. Emissions of pollutants from the Cursor 8 CNG engine (200 kW) from Irisbus

	Emission g/kWh			
	NO_x	CO	NMHC	CH_4
EURO3	5	5.45	0.78	1.6
EURO4	3.5	4	0.55	1.1
EEV	2	3	0.4	0.65
CURSOR 8 NGV	0.43	2.16	0.004	0.015

Source: (Manufacturer's Information Materials)

Apart from the undoubted advantages of protecting the natural environment, the use of natural gas as fuel also has other advantages. An important factor influencing the decision to use gaseous fuel in fleet vehicles is the economic factor. For every public transport company, the cost is the cost of fuel used. Natural gas is much cheaper than liquid fuels, and its price on the international markets is much more stable than the price of oil.

The third factor that allows the use of natural gas in urban transport is the fact that methane is one of the safest fuels used in automotive. Its physicochemical properties are influenced by the degree of gas safety. Methane – the main natural gas component has a relatively high flash point of about 650°C. It is also a lighter gas than air. In the case of unsealing of the gas tank, it will evaporate without creating an explosive mixture. Modern technology of high pressure tanks makes it possible to safely store gas even under 700 bar pressure. Working pressure in car tanks does not exceed 250 bar. If such a tank will pierced for some reason, the construction of such a tank guarantees that it will not break and will not explode. Gas flows out

of the defective tank and the pressure drops causes the temperature to fall, which in turn prevents the flash point.

Despite the undoubted advantages of natural gas, the development of the CNG market faces serious barriers. The main problem at the initial stage of market development is the lack of a gas refuelling network. There are only about twenty filling stations in the country where you can buy natural gas. The development of infrastructure limits the significant costs of building such a station. They fluctuate in the range of PLN 0.5–2 m per unit depending on the efficiency of the station. At the moment, it is a problem to pass any route in the country only on gas fuel.

2. Liquefied Natural Gas (LNG) as a new technology to power vehicles

Newer technology is the use of LNG (Liquefied Natural Gas) as a technology for the storage and transportation of methane in motor vehicles. Liquefied methane is characterized by the following characteristics: colourless liquid consisting of 90–97% methane, density of 430–470 kg/m^3, evaporation temperature at atmospheric pressure –166°C to –157°C, combustion temperature: 39.1–40.9 MJ/m^3. From 1 m^3 LNG can be obtained about 600 m^3 of gas in normal conditions. LNGs allow to limit the size of fuel tanks built in buses. These tanks, however, have to be adapted to maintain low methane storage temperatures. A methane-fueled vehicle combines the features of an ecologically-friendly CNG vehicle and a conventional car powered by liquid fuel. Industrial-grade liquefied natural gas was developed at the beginning of the 20th century to store and transport gas over long distances. The dynamic development of LNG technology is due to the ease of use of this form of transport, with different locations for natural gas deposits and potential customers. Particularly popular in the second half of the 20th century was the sea transport of methane specially designed for this purpose (Figure 1). The widespread use of this method of natural gas transport has led to a dynamic development of the global market for this fuel. Major LNG export terminals are located on the coast of North Africa, Gulf of Venezuela and South East Asia. The number of regasification terminals worldwide has already exceeded 50 (including 24 in Japan, 4 in Korea, 12 in Europe and 5 in the US).

The first experience with the use of LNG gas in Poland began in the 70s of the last century. The first installation of the so-called denitrogenation gas station was built in Odolanów. The liquefied gas from Odolanów was introduced to the Scandinavian market in the 1990s. The first Polish customers received LNG gas in 2002. In 2012 the Odolanów plant could offer 15 000 tons of LNG per year. The second installation of natural gas denudation in Grodzisk Wielkopolski will be able to produce about 10 000 tons of gas per year. These installations are owned by PGNiG S.A., the national tycoon of natural gas extraction and marketing.

Figure 1. Ship to carry liquefied methane
Source: (http://gazownictwo.wnp.pl/gazoport-w-szczecinie-bez-statkow-do-transportu-lng,73824_1_0_0.html [Accessed 2 April 2017])

3. Terminal in Świnoujście – an investment that creates the LNG market in Poland

On the end of 2015 on the Polish market there is also available liquefied natural gas delivered via the Gazoport terminal in Świnoujście. This is an investment that diversifies the direction of the supply of the blue fuel to Poland and enables the use of world's natural gas resources. The decision to build a terminal allowing the supply of natural gas from other directions than the traditional eastern one was taken in 2008. On 19 August this year, the Council of Ministers adopted a resolution in which the construction of the LNG terminal was considered a "strategic investment in line with the plans for the diversification of sources and routes of natural gas supply and the guarantee of Poland's energy security" (http://www.polskielng.pl/lng/).

Terminal LNG is a highly specialized industrial plant for the reception and regasification of natural gas in liquefied form. For the purpose of this investment, pipelines for the reception of liquefied petroleum gas, LNG tanks and regasification installations were constructed. The regasification process consists in restoring gas from liquefied to gaseous form. In this form, the gas is sent through the gas pipeline to the customers. It is also possible to transport the liquefied natural gas into the tanker and deliver it directly to the customer having a regasification plant or equipment and technologies using directly liquefied methane. Based on the analysis, the choice of such location was determined by the following factors: the regulated legal situation of the land for the construction of the terminal (sites are owned by the port, municipality and forest district and free of third parties rights); lower costs than other locations; bigger demand for fuel in North-western region of the country (http://www.polskielng.pl/lng/).

In the first stage of operation, the LNG terminal will receive 5 billion cubic meters of natural gas per year. In the next phase, depending on the increase in gas demand, it will be possible to increase the shipping capacity to 7.5 billion cubic metres without having to enlarge the area where the terminal will be built. The LNG terminal in Świnoujście plans to build two standard-size vessels – such as those used in other terminals in the world, i.e. with a capacity of 160 000 cubic metres.

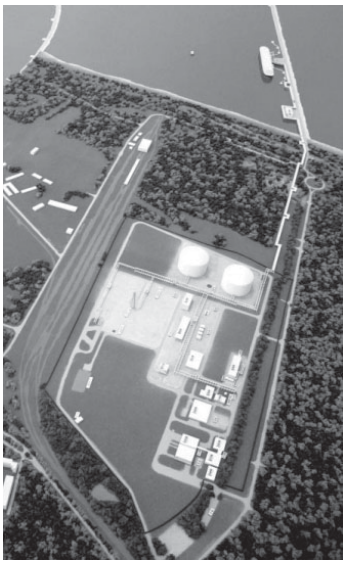

Figure 2. LNG Terminal in Świnoujście
Source: (http://www.polskielng.pl [Accessed 2 April 2017])

On 22 March 2017 another LNG vessel came to the LNG Terminal. From the first delivery in December 2015 we have already imported more than 2.5 m cubic metres of LNG by sea.

Thus, after the regasification – a process of changing the state of the raw material from liquefied to gaseous – the total of 1.5 billion cubic meters of natural gas was delivered to the national natural gas transmission system. This represents about 10% of the total demand for this raw material in our country. Ships that carry LNG are Q-flex. Liquefied natural gas is transported in membrane tanks using the ship's hull as a support structure. Ships are 315 meters long and 50 meters wide. Every time they supply over 200 000 m^3 of LNG. The liquefied form after regasification reaches the national transmission system in the amount of more than 120 million cubic meters of gas. After checking at the metering station, the gas is already in the gas form directly to the Świnoujście-Szczecin gas pipeline, from where it is then sent to the remaining GAZ-SYSTEM transmission infrastructure and further to customers throughout the country.

4. Characteristics of LNG as a technology to power bus engines

Vehicles fuelled with LNG must have a cryogenic tank that stores fuel at very low temperatures. Because of the significant energy storage in one litre of liquefied gas, fuel tanks are three times smaller than compressed gas tanks. With the benefits of CNG (high purity, low fuel price), the LNG drive eliminates the problem of large roof tanks and longer refuelling times. LNG is also a safe fuel. From the damaged CNG vehicle tank almost pure methane is released, which under normal pressure and at a relatively high ambient temperature begins to boil by becoming gassed. As the gas lighter from the air, methane is rapidly dispersing very rarely, creating a cloud of explosive mixture. The first moment of passing methane from liquid to gas when the gas is very cold may be disputable. Until the gas temperature rises in the first seconds, very cold methane is heavier than air and can begin to accumulate in the ground hollows. This effect is very short and is important for a damage to large tanks or LNG pipelines. Famous in the world are the events of the emergence of large clouds of cold methane, which ignited causing great damage. In the case of small fuel tanks installed in passenger cars and buses, the safety of using LNG can be considered almost identical to compressed gas. This solution is not yet widely used by bus manufacturers. LNG vehicles are rare in the offer of companies producing public transport vehicles. As one of the few companies on the European market, Solbus offers Solcity 12 LNG. These vehicles are equipped with Cummins ISLGeEV 320 engines with a capacity of 8.9 dm^3. Cart Ferrox is the supplier of cryogenic tanks. The Solbus company in cooperation with the fuel supplier Gazprom Germania, organized a series of test drives in Polish cities interested in modernizing their rolling stock in April and May 2012. The aim of the test program was to present LNG vehicles under operating conditions of Polish cities. The bus manufacturer presented vehicle refuelling technology, maintenance procedures and collected data on fuel consumption and vehicle refuelling Two LNG buses operated in Wałbrzych were available for testing on the streets of Gdynia, Katowice, Olsztyn, Toruń and Warsaw. After testing, companies operating passenger services in cities where LNG vehicles have been given preliminary data to consider the possibility of purchasing these vehicles.

Conclusion

Natural gas as fuel for vehicles has been present in Poland for several years. This type of fuel reduces the pollutants emitted to the atmosphere by internal combustion engines. CNG vehicles also have significant limitations primarily due to the limited amount of fuel stored under pressure in large and heavy tanks. The development of liquefied natural gas technology can eliminate these inconveniences. The prospect of developing the LNG market in Poland with the main investment of the "gazoport" construction in Świnoujście allows us to assume that the fuel in this form will soon be much more accessible throughout the country. The first attempts by manufacturers of buses to install cryogenic tanks on their

vehicles hope the LNG will soon be more accessible, as has happened with CNG buses. All these facts allow us to look optimally at the prospects for the development of the market for liquefied and compressed methane vehicles.

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Corresponding author

Adam Bogusz can be contacted at: adam.bogusz@wsb.bydgoszcz.pl

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Stanisław Krzyżaniak

Institute of Logistics and Warehousing

AN ATTEMPT TOWARDS A MODEL APPROACH TO THE TOTAL COST OF STOCK REPLENISHMENT, MAINTENANCE, DEFICIT AND EXCESS

Abstract

It is commonly assumed that random variability of demand in a stock replenishment cycle must be taken into account primarily from the perspective of service level (availability). It is related to the probability of occurrence of demand which is larger than assumed. In certain cases, however, the risk of occurrence of demand which is lower than assumed may be of significance. It leads to temporary stock excess causing specific consequences, including the ones pertaining to costs. The premise for discussing the subject was the fact that in presently applied models of costs related to stock renewal, the costs of stock deficit are taken into account in the first place, alongside stock replenishment and maintenance costs. They are calculated on the basis of dependencies defining the stock deficit occurrence probability in a replenishment cycle or expected stock deficit amount in a given cycle. The amounts depend on the parameters which control stock replenishment, and on the type of demand distribution. However, attention should be drawn to that fact that random variability of demand in a stock replenishment cycle is linked to the probability of occurrence of both higher and lower demand volumes. In the first case, there is a risk that a stock deficit might occur, which – as it has been indicated above – it is commonly taken into account. It is related to the notion of services level measured with stock availability. The second possibility (demand lower than expected) may, however, bring specific organisational and financial consequences. The article discusses them and presents a cost model comprehensively covering stock replenishment, maintenance, deficit and excess costs.

Keywords: logistics, model, stock

Introduction

Commonly applied models of costs related to stock cover their three groups: stock replenishment, stock maintenance and stock deficit costs (e.g. Beyer et al., 2010; Korponai et al., 2017; Serrano et al., 2017). It allows optimising the value of parameters controlling stock replenishment (e.g. Samak-Kulkarnia, Rajhansb, 2013). For instance, for a system based on reorder level, it refers to: the quantity of orders (here, the optimisation is based on the minimisation of the total cost of maintaining and replenishing cycle stock) and on the level (point) of reorder (optimisation based on the minimisation of the total cost of carrying the safety stock and stock deficit – in a probabilistic and quantitative approach). These models, however, do not provide for costs which may result from temporary stock excess, being the consequence of a fact that demand, in accordance with its random nature, may be temporarily lower than assumed upon order placement. The consequences of stock excess resulting from the absence of synchronisation between deliveries and consumption are usually discussed in terms of quality, not quantity (e.g. Singhal, 2005). However, it is not only about the cost of maintaining the stock, but also about additional costs related to the very fact that the phenomenon occurred and to the obligation to store every excessive stock unit. Such a perspective results in the need to complete the model of total costs related to stock with stock excess costs as a function of the volume of the excess – both in a probabilistic and quantitative approach. It is fully analogical to the phenomena accompanying increased demand and stock deficit risk, which is its consequence.

1. Premises for broadening the model of costs with stock excess costs

On developing the broadened model of costs, willing to take the cost of temporary stock excess into account, the following assumptions were adopted:

1) The considerations concern stock replenishment (BQ – ELA, 1994) based on reorder point B, with fixed delivery quantity Q.
2) Apart from costs resulting from stock deficit, stock excess costs were also taken into consideration.
3) A certain allowed level of allowed stock (SA), which, when exceeded, results in specific cost-related consequences, is adopted.
4) Similarly to the case of determining stock deficit costs, we assume two types of cost:
   – cost which is independent of excess volume, resulting from the very fact of its occurrence (e.g. the cost of renting an additional warehouse). The suggested model assumes that the cost (amounting to ce_1) refers to the replenishment cycle in which excess occurred;
   – a cost dependent on excess volume (in accordance with the adopted unit) The unit cost is ce_2, and the cost's volume for a specific replenishment cycle is $ce_2 \cdot ne$, where ne is the excess amount in adopted units. The cost may

result from renting additional warehouse area (of the size corresponding to the excess), withstanding means of transport etc.

2. Methodology

For the purpose of developing a comprehensive model of stock costs, providing for excess stock apart from the cost of replenishment, maintenance and shortages in the stock, previously developed models of costs related to stock were used (e.g. Krzyżaniak, 2014).

The model applies the following designations related to demand, costs and service level:

D – demand in a time unit (e.g. daily/weekly demand);
σ_D – standard deviation of demand in an adopted time unit;
$\sigma_{D,LT}$ – standard deviation of demand in a stock replenishment cycle of mean LT;
D_p – total demand in the analysed period (e.g. a year);
cc_p – stock carrying cost coefficient for the adopted period;
αSL – service level (probability of non-occurrence of stock deficit in its replenishment period, probability to serve demand in a cycle), corresponding to safety coefficient ω treated as an independent variable;
Q – order/delivery quantity;
c_r – unit cost of stock replenishment (cost of order, organisation and execution of a single delivery);
cd_1 – cost related to stock deficit occurrence during the stock's replenishment cycle;
cd_2 – cost related to the occurrence of deficit of one piece of stock item during the stock's replenishment cycle;
ce_1 – cost related to stock excess occurrence after the next delivery – "assigned" to a completed stock replenishment cycle;
ce_2 – cost related to the occurrence of a excess of one piece of stock item during the stock's replenishment cycle;
p_u – purchase price (variable production cost) of a unit of the discussed assortment item;
nd_p – number of orders (deliveries) for the discussed assortment item in the adopted period.

The considerations concern stock replenishment on the basis of reorder level, with fixed delivery quantity. A model of costs covering the stock replenishment, stock carrying and deficit of stock will be the starting point.

$$TC = \frac{D_p}{Q} \cdot c_r + \frac{1}{2} Q \cdot p_u \cdot cc_p + \omega \cdot \sigma_{D,LT} \cdot p_u \cdot cc_p + cd_1 \cdot [1 - F(\omega)] \cdot \frac{D_p}{Q} + cd_2 \cdot I(\omega) \cdot \sigma_{D,LT} \cdot \frac{D_p}{Q} \quad (1)$$

Overall cost | Periodical (e.g. annual) replenishment cost | Average cost of carrying cycle stock | Periodical (e.g. annual) cost of carrying safety stock | Stock deficit cost resulting from stock deficit occurrence probability in a replenishment cycle | Stock deficit cost resulting from deficit volume

Coefficient ω occurring in the part of formula (1), pertaining to the carrying of safety stock, is here called the safety coefficient, and it depends on adopted service level understood as the probability to serve the entire demand in a replenishment cycle αSL (Tempelmeier, 2000), and on the type of demand distribution.

Standard deviation in a stock replenishment cycle $\sigma_{D,LT}$ is generally calculated with the following formula:

$$\sigma_{D,LT} = \sqrt{\sigma_D^2 \cdot LT + \sigma_{LT}^2 \cdot D^2} \tag{2}$$

where:
σ_D – standard deviation of demand in an adopted time unit,
LT – mean stock replenishment cycle time,
σ_{LT} – standard deviation of replenishment lead time.

Amounts F(ω) and I(ω) present in formula (1) and used for calculating stock deficit cost are:
F(ω) – distribution function related to the distribution of demand observed in a stock replenishment cycle, equal to service level αSL,
I(ω) – standardised number of deficits; expected volume of deficits in a cycle is calculated with the following formula: $I(\omega)\cdot\sigma_{D,LT}$.

Standardised number of deficits may be calculated as follows (Ronald, 2009; Krzyżaniak, 2011):

$$\mathrm{I}(\omega) = f(\omega) - \omega \cdot [1 - F(\omega)] \tag{3}$$

3. Determining the risk of stock excess occurrence and its expected volume

The article approaches stock excess as a part of stock exceeding assumed limit of stock, bringing specific, also cost-related, results.

The cost dependent on excess volume (according to the adopted unit) depends on "excess coefficient" ε:

$$\varepsilon = -\frac{S_\varepsilon}{\sigma_{D,LT}} \tag{4}$$

where:
Sε – allowed "reserve" of warehouse capacity, assigned to the item in question:

$$S\,\varepsilon = SA - Q - SS \tag{5}$$

SA – stock amount, the exceeding of which results in costs which are the consequence of ce_1 and ce_2,
Q – delivery quantity,
SS – safety stock ($SS = \omega \cdot \sigma_{D,LT}$).

On the basis of formula (4), formula (3) may be written as follows:

$$\varepsilon = -\frac{S_\varepsilon}{\sigma_{D,LT}} = \frac{SA - Q - SS}{\sigma_{D,LT}} = \frac{SA - Q - \omega \cdot \sigma_{D,LT}}{\sigma_{D,LT}} = \frac{SA - Q}{\sigma_{D,LT}} - \omega \tag{6}$$

The above issue has been shown in Figure 1. It presents the rules of calculating the probability for the occurrence of stock deficit in a specific replenishment cycle:

$$1 - F(\omega) = 1 - F\left(\frac{SS}{\sigma_{D,LT}}\right)$$

and the probability for the occurrence of stock excess:

$$F(\varepsilon) = F\left(-\frac{S_\varepsilon}{\sigma_{D,LT}}\right)$$

On the basis of the same demand distribution curve in a replenishment cycle.

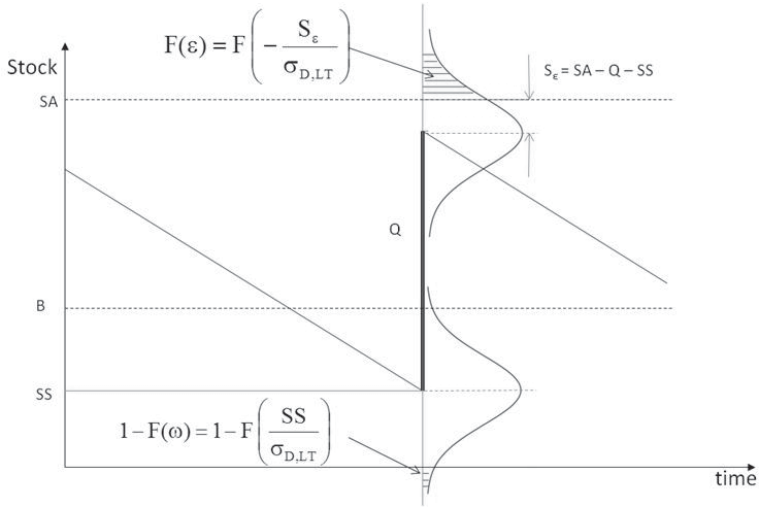

Figure 1. Illustration of the rule of determining excess coefficient ε
Source: (own elaboration)

Attention should be drawn to the fact that while analysing stock deficits allows assuming any values of safety coefficient ω, in the event of stock excess, which "happens" on the left side of the distribution, negative values of demand should be excluded. It is possible to achieve by introducing the so-called truncated distribution.

Probability of stock excess occurrence (PSE) in a specific delivery cycle:

$$\text{PSE} = F(\varepsilon) \tag{7}$$

where:

F(ε) – distribution function related to the distribution of demand observed in a stock replenishment cycle,

Expected (mean) stock excess volume (ne) in one delivery cycle:

$$\text{ne} = I(\varepsilon) \cdot \sigma_{D,LT} \tag{8}$$

Standardised amount of stock excess I(ε) is calculated as follows:

$$\mathrm{I}(\varepsilon) = \int_{-\infty}^{z=\varepsilon} (\varepsilon - z) \cdot f(z)dz = \varepsilon \cdot \int_{-\infty}^{z=\varepsilon} f(z)dz - \int_{-\infty}^{z=\varepsilon} z \cdot f(z)dz \tag{9}$$

where f(z) is the probability density function.

Transformations leading to the determination of expected excess amount, with demand, as a random variable, being subject to standard distribution, have been presented below.

1)
$$\int_{-\infty}^{z=\varepsilon} f(z)dz = F(\varepsilon)$$

2)
$$\int_{-\infty}^{z=\varepsilon} z \cdot f(z)dz = \int_{-\infty}^{z=\varepsilon} z \cdot \frac{1}{\sqrt{2 \cdot \pi}} e^{-\frac{z^2}{2}} dz$$

$$after\ introducing\ \frac{z^2}{2} = t\ ,we\ get\ zdz = dt$$

$$Thus\ \int_{-\infty}^{z=\varepsilon} z \cdot f(z)dz = \frac{1}{\sqrt{2 \cdot \pi}} \int_{-\infty}^{t=\frac{\varepsilon^2}{2}} e^{-t}dt = -\frac{1}{\sqrt{2 \cdot \pi}} \left(e^{-\frac{\varepsilon^2}{2}} - 0 \right) = -f(\varepsilon)$$

In view of the above, formula (8) may be written as follows:

$$\mathrm{I}(\varepsilon) = \varepsilon \cdot F(\varepsilon) + f(\varepsilon) \tag{10}$$

4. A comprehensive model of stock replenishment, maintenance, deficit and excess costs

Suggested extension of formula (1) provides for costs related to the occurrence of temporary stock excess. The word "temporary" is crucial, as stock excess may also be of permanent nature, as a consequence of unjustified increase in safety stock. In such case, however, the related cost results exclusively from stock carrying.

Additional cost-related magnitudes complementing formula (1) are:

– Stock excess cost resulting from the fact of its occurrence:

$$CE_1 = ce_1 \cdot F(\varepsilon) \cdot \frac{D_p}{Q} = ce_1 \cdot \left[F\left(\frac{ZD - Q}{\sigma_{D,LT}} - \omega \right) \right] \cdot \frac{D_p}{Q}$$

– Stock excess cost resulting from its amount (a number of units in excess).

$$CE_2 = ce_2 \cdot I(\varepsilon) \cdot \sigma_{D,LT} \cdot \frac{D_p}{Q}$$

Having considered dependencies of (6) and (10), a comprehensive model of stock replenishment, maintenance, deficit and excess cost may be expressed in the following formula:

$$\begin{aligned}\mathrm{TC} = {} & \frac{D_p}{Q}\cdot c_r + \frac{1}{2}Q\cdot p_u\cdot cc_p + \omega\cdot\sigma_{D,LT}\cdot p_u\cdot cc_p + cd_1\cdot[1-F(\omega)]\cdot\frac{D_p}{Q} \\ & + cd_2\cdot[f(\omega)-\omega\cdot(1-F(\omega)]\cdot\sigma_{D,LT}\cdot\frac{D_p}{Q} + + ce_1\cdot\left[F\left(\frac{SA-Q}{\sigma_{D,LT}}-\omega\right)\right]\cdot\frac{D_p}{Q} \\ & + ce_2\cdot\left[\left(\frac{SA-Q}{\sigma_{D,LT}}-\omega\right)\cdot F\left(\frac{SA-Q}{\sigma_{D,LT}}-\omega\right)+f\left(\frac{SA-Q}{\sigma_{D,LT}}-\omega\right)\right]\cdot\sigma_{D,LT}\cdot\frac{D_p}{Q}\end{aligned} \tag{11}$$

Table 1 presents descriptions of all of the model's elements.

Table 1. A description of elements comprising the model of stock replenishment, maintenance, deficit and excess costs

Stock replenishment cost	$\frac{D_p}{Q}\cdot c_r$
Cost of maintaining the rotating part of stock	$\frac{1}{2}Q\cdot p_u\cdot cc_p$
Cost of maintaining the safety part of stock	$\omega\cdot\sigma_{D,LT}\cdot p_u\cdot cc_p$
Stock deficit cost (consequence of an event)	$cd_1\cdot[1-F(\omega)]\cdot\frac{D_p}{Q}$
Stock deficit cost resulting from the number of missing units	$cd_2\cdot[f(\omega)-\omega\cdot(1-F(\omega)]\cdot\sigma_{D,LT}\cdot\frac{D_p}{Q}$
Stock excess cost (consequence of an event)	$ce_1\cdot\left[F\left(\frac{SA-Q}{\sigma_{D,LT}}-\omega\right)\right]\cdot\frac{D_p}{Q}$
Stock excess cost resulting from excess volume.	$ce_2\cdot\left[\left(\frac{SA-Q}{\sigma_{D,LT}}-\omega\right)\cdot F\left(\frac{SA-Q}{\sigma_{D,LT}}-\omega\right)+f\left(\frac{SA-Q}{\sigma_{D,LT}}-\omega\right)\right]\cdot\sigma_{D,LT}\cdot\frac{D_p}{Q}$

Source: (own elaboration)

It should be worth noting that function TC has the form presented in formula (11), i.e. it is a function of two variables: order/delivery quantity Q and safety coefficient ω. It allows minimising total cost by means of Q and ω optimisation.

While the reduction of costs related to stock deficit is possible mainly by regulating safety stock, or, indirectly, safety coefficient ω, it is possible to affect the cost of temporary stock excess by means of changes to: safety stock (safety coefficient ω), delivery quantity and allowed stock amount level.

Figure 2 shows different possibilities to influence the excess occurrence risk (and, indirectly, its volume):

a) by lowering the level of safety stock (SS). However, it negatively affects service level;
b) by reducing delivery quantities (Q), which might result in higher stock replenishment cost as a consequence of a larger number of deliveries;
c) by increasing allowed stock amount level (SA), which requires organisational improvements, or even capital expenditures.

In practice, if such a need occurs, a combination of all three possibilities should be taken into consideration

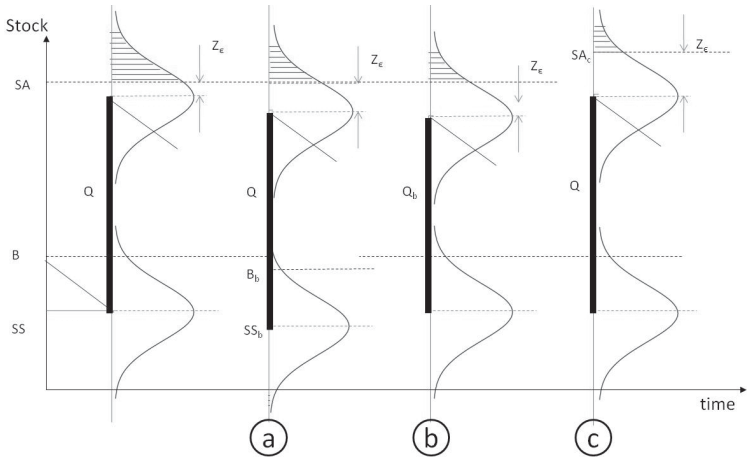

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Figure 2. Illustration of the possibility to reduce excess occurrence risk by: a) lowering safety stock level SS, b) reducing delivery quantities Q, c) increasing allowed stock amount level SA

Source: (own elaboration)

Conclusions

The presented model of costs includes, alongside stock replenishment and maintenance costs, not only the cost of a possible stock deficit, but also the cost of temporary stock excess. The rule for determining stock excess occurrence risk and stock amount is essentially the same as in the case of calculating stock deficit occurrence risk and amount (influencing service level understood as stock availability), with

a difference that it concerns the "other" side of the demand distribution curve. Formulas for the suggested model have been presented for normal demand distribution, characteristic for fast-moving goods. The model is a function of two variables (delivery quantity Q and safety coefficient ω, which depends on service level, which, in turn, is closely related to reorder point B). Such a form allows attempting (resorting to numerical methods) at the optimisation of both controlling parameters (B and Q) ensuring minimum level of total costs.

As every model, the presented model has limited application. The major limitation is the demand distribution type applied to calculate all components of the model related to the risk that stock deficit or stock excess might occur, and expected value of its deficit or excess. The article presents a solution for normal distribution, usually used to describe the distribution of demand for fast-moving goods. The general form of the model and assumptions accepted for its construction, however, allow broadening the scope of applications to other distributions. Another limitation are the matters related to the accuracy of estimating cost elements the models are composed of (e.g. the cost related to the deficit or excess of a stock unit).

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Corresponding author

Stanislaw Krzyżaniak can be contacted at: stanislaw.krzyzaniak@ilim.poznan.pl

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Joanna Krzywda[a)], Dariusz Krzywda[b)]

a) Częstochowa University of Technology
b) Częstochowa University of Technology

THEORY OR PRACTICE? THE CONCEPT OF LABORATORY IN THE TEACHING PROGRAMME IN THE FIELD OF LOGISTICS

Abstract

This paper presents the concept of setting up a packaging laboratory in the field of studies of logistics. The springboard for the discussion is an assumption that now with an increasingly demanding job market and much sought-after hands-on experience in candidates for jobs in logistics there is a need to increase the number of hours of experiential learning classes for students of logistics. Since it is not always possible to establish professional laboratories, which require significantly high financial means, it should be considered how to provide for the basic objectives which a laboratory should offer when having much more modest financial means. This is the reason why this paper defines what can be expected from practical classes and what type of classes should be conducted in a laboratory. The discussion also included an analysis of a short pilot study of experiential learning classes conducted in a laboratory of packaging materials.

Keywords: laboratory, study of logistics, practical knowledge

Introduction

A number of noticeable changes occurring in the present-day economy including globalization, rising expectations on the part of customers, and a risk increase are reflected in a dynamic development of logistics. It responds with progressive individualization and specialization of services, and when combined with the development of new technologies, growing customer expectations, globalisation, emphasis on cost reduction, changing availability of information as well as sustained development (Kadłubek, 2015) Current economic reality is becoming increasingly

difficult for companies due to a synergy of larger complexity and growing dynamics of business processes (Kisperska-Moroń, 2010). This brings on a new challenge for universities and schools of higher education providing degree courses for future logistics managers who will be expected to satisfy increasingly high demands of the market.

The aim of this article is to present an idea for courses in a packaging laboratory, which are included in the undergraduate course curriculum in logistics. The idea was based on the assumption that students who are to become managers in the future should not only be familiar with relevant technologies and computer programs, but also be equipped with very practical, even manual, and technical skills. The article presents the theoretical background of this idea and the way of its implementation. Within the scope of the research during their classes students were presented with specific tasks which they were supposed to perform and next they were given a short open-question survey in which they assessed those classes. The results of the survey are also presented in the article.

1. Theoretical foundations

For a number of years now the research into logistics education has shown that it should aim at equipping students with skills and abilities which are sought after on the job market and that it is needed to fill gap between the coverage of logistics courses and the needs identified by practitioners, which can be observed in a number of countries and schools of higher education (Lutz, Birou, 2013; Wong, Grant, Allan, Jasiuvian, 2014). Efforts aiming at enhancing the quality of logistics education do affect logistics performence (Spekmann, Kamauff, Spear, 2002; Yildiz, 2015, p. 266). On the other hand, it is often emphasized in research that a shortage of skills is recognized as a major source of risk in supply chain networks (Rameshwar, Gunasekaran, Childe, Papadopoulos, 2017). The element which is supposed to help to bridge the gap between education and the job market is student internship. Internships, also often referred to as practical placements, are highly popular with students as they are beneficial to them because they provide them with an opportunity of acquiring specific job related skills (Hergert, 2009). Similarly, it has also been recently emphasized in Poland that schools of higher education do not prove to be very effective when preparing future employees to enter the job market and they are criticized in the public discourse for "producing the unemployed" (Bachmann, 2012). What is more, academic research suggests that developments of higher education have led to a decrease in quality and a devaluation of higher education (Kot, Ślusarczyk, 2014). The basic objection raised here is that the qualification which a graduate holds on graduating is – rather unfortunately – not connected with his/her practical skills. Due to this employers need to provide training for new employees, which actually means that those are not ready to carry out their responsibilities in full until several months after commencing an employment. Another truly significant barrier in commencing an employment is a lack of experience, which can be defined as insufficient – widely

understood – practical skills. Such situation is undoubtedly a great challenge for entities of higher education. In order to improve their efficiency and effectiveness within the range discussed above schools of higher education should focus on practical activities, such as relating the teaching program to the labor market reality, making adjustments to the demands present on the job market, increasing the number of practical classes, providing more internships i.e. practical placement opportunities, and collaborating with successfully operating companies and firms. Students themselves are prepared to have the number of practical classes increased in their curricula and would be eager to have those more closely related to the market requirements (Start na rynku pracy, 2016).

One of the ideas how to solve this particular problem is to expand educational offer by including practical classes, which would ultimately provide students with basic skills and abilities. In the case of logistics it is logistic laboratories, which are actually being established more and more frequently.

This kind of laboratory is being established in the Institute of Logistics and International Management at the Faculty of Management at Częstochowa University of Technology. Since a modern and professional logistics laboratory requires significant financial means, which are not available at present, it has been decided to set up a more modest laboratory – under a working name of *packaging laboratory* – where it will be possible to conduct classes on one particular subject "Product Packaging and Identification". Hence, it was necessary to address the question of what constitutes the core of this kind of laboratory and which aspects should be emphasized there in order to achieve the objective of providing students with the most professional, detailed and practical knowledge on packaging.

2. Theory and practice

Laboratory is meant to provide hands-on experience i.e. practice, thus it is necessary to define what practice means. As seen by students as well as by the general public practice is opposite of theory. Generally, theory is in opposition to practice as it is cognition gained through consideration (thinking) while practice is knowledge gained through experience. Theory provides a picture (a model) of reality which forms a basis for predictions about future. It also provides descriptive and explanatory statements. Reflection on the connection between theory and practice shows the three most significant stereotypes: a) unproductiveness of theory, b) apotheosis of practice, and c) distance between theory and practice (Żywczok, 2010, p. 23). As it is commonly perceived people divide into theoreticians and practitioners, i.e. those who reach conclusions through thinking and those who need to act in the process of cognition. Generally, the confrontation of theory and practice shows that theory enjoys a rather bad reputation.

Students in particular seem to be sensitive to these issues and our observations show that it is especially the case of the students of logistics, which is an exceptionally practical field of study. That is the reason why it is very important to maintain the right balance between theory and practice in this degree course. Not only does

such discord concern a general perception of theory and practice but it also concerns discrepancies between theory and practice in the learning process, which is one of the dilemmas in management (Niedzielski, 2015, p. 25). There are a rather high number of the areas of such discrepancies between theory and practice and they result from a variety of reasons (e.g. different understanding and inappropriate use of the expression of management – for example in relation to one-man companies, uncertainty, future, chaos in culture, health, career or in other individual, abstract unaffected beings (Niedzielski, 2015, p. 25). There are also other indications of clashes between theory and practice.

However, the principles followed in education emphasize that it is necessary to combine theory with practice. This principle, mentioned by a number of academics specializing in the theory of teaching, e.g. Okoń, Kupisiewicz, or Półturzycki, says that combining theory and practice makes those who are learning convinced that knowledge is useful and it is the basis of the cognitive process. When the principle of combining theory and practice in teaching and learning is not followed, it results in situations when students are not able to use what they have learnt in practice. The necessity to combine these two in teaching in the degree course in logistics has become unobjectionable.

Management didactics has long pointed to the need to combine theory with practice, especially with business and the gap existing between them (Valentín, 2000; Slack, Bates, 2004). In the teaching of operations management, for example. The consultancy module is said to extend the traditional learning boundaries between students and lecturers to a tripartite grouping of students, university and industry (Bak, 2011, p. 205).

It is beyond doubt that the use of practical tools gives very good results, which is also confirmed by academic research and papers. For example, working with computer software provides very good experiential learning results when developing skills in supply chain management (Sweeney, Campbell, Mundy, 2010). Active training and educational methods like case studies, educational games, computer-based simulation games are widely used at the DMS for teaching logistics simulation and management. Courses are supported by modern software, which has several advantages in both practical and pedagogical aspects.

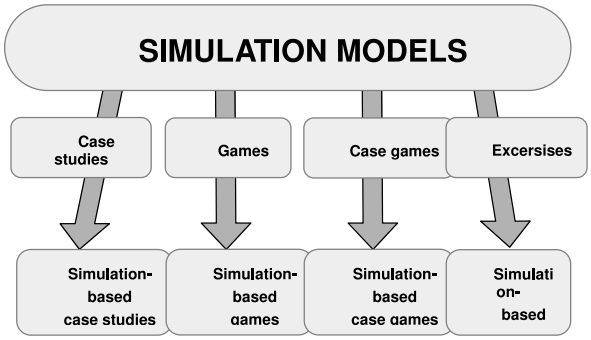

Figure 1. Active educational methods
Source: (Sosko et al., 2005)

It needs to be noted that teaching practical aspects in the way described above could provide an opportunity to develop soft competences – a large group of skills and abilities being in high demand on the job market, which are not usually well developed in graduates. Education lacking in those competences as well as their great importance is highlighted in the literature on the subject (Cottrill, 2010; Chmielecki, 2012; Dittmann, 2012; Kemp, Kopp, Kemp, 2013; Rodney, 2014; Wawer, 2014; Antonowicz, 2016). It is also affirmed by a study conducted by the authors of this paper, which involved an analysis of job advertisements.

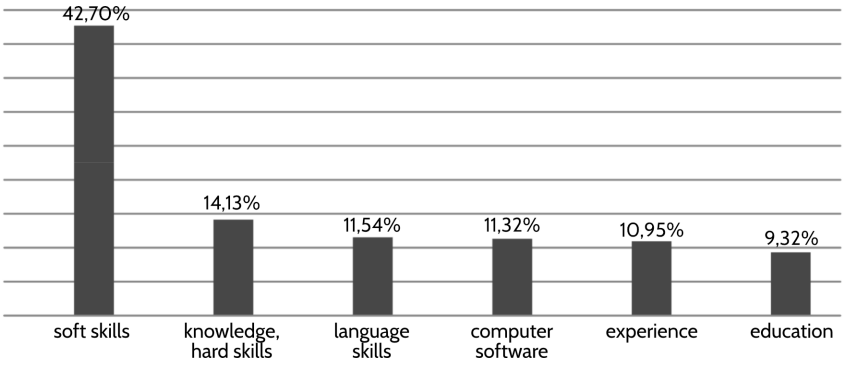

Figure 2. Requirements categories in job offers in logistics
Source: (authors' own study on the basis of job offers)

The analysis has shown that soft competences like, for example, communication skills, critical-thinking skills, organizational skills and problem solving-skills include the largest group of competences which are expected of candidates for jobs in logistics. Thus, the requirements related to soft competences in the case of logistics are in line with the concept of the 21st century skills. They belong to Domain Learning and Innovation Skills, one of the four Domains also including Life and Career Skills, Traditional Core Skills and Digital Literacy Skills

Thus, soft competences should be included in the program of studies. However, since it would be rather difficult to teach them within individual subjects focused on them separately, it seems to be a good solution to incorporate teaching them into teaching of practical aspects. Creating in classroom an authentic situation and a specific problem needed to be solved provides a suitable opportunity for interaction with other classmates and developing a significant group of soft competences.

3. Packaging laboratory

The classes in the laboratory are conducted within the scope of the subject "Product Packaging and Identification Systems" during a part of the course devoted to packaging and comprise 15 hours of workshop classes and 15 hours of lectures. These classes are conducted during the third year of licencjat and inżynier (equivalent to BSc and Engineer) degree courses for two specializations, namely *transport*

engineering and management and *logistics systems*. The lectures are conducted in line with a traditional (teacher-centered) method with the use of multimedia; however, the methodology of teaching in the practical classes has been evolving for some time now. Originally, in these classes students were passive recipients of specific knowledge provided by teachers while now there is more stress on learner-autonomy through activating students and providing them with experiential learning. The classes are conducted in a room whose furnishing is intended to include warehouse shelves, means of transport, worktables, and packaging materials. The learning process involves laboratory methods in which students independently carry out experiments and trials using authentic materials while being instructed and supervised by the teacher. The program of teaching provides for students being familiarized with a variety of packaging and auxiliary materials and it also aims at developing competences required in a packaging process, i.e. being able to choose appropriate kind of packaging (material, parameters and the quality-price ratio) depending on what a particular material is intended for, means of transport, etc. Being able to choose from various packaging and auxiliary materials will help students realize the differences between those materials, time needed to complete a packaging process as well as cost per unit, and also process completion time sheets.

The springboard for developing the concept of classes, according to which students are to be furnished with the ability of solving very practical problems was the characteristics of the graduate of the first-cycle studies in logistics, i.e.:

"Characteristics of a graduate with qualification in logistics (qualification: engineer): Graduates are furnished with general knowledge and skills required in operational logistic management within departments functioning in economic entities. They are familiar with the core issues of modern organization management and logistic principles driving economic entities. They understand the meaning of system and process approach in logistics, management principles of information, financial means, human and material resources flows, as well as the importance of customer service logistics".

At the operational level in the packaging process students should solve clearly defined problems. Examples of such problems are shown in the Table below.

Table 1. Example tasks to be carried out within the experiential classes in the laboratory

Item	Sample class activities	Activity objective	Participants	Instruments, tools
1.	familiarizing student with various packaging materials	extending hard compences	groups of 2–3 students	Strapping and packaging tape PE and stretch films
2.	calculating costs per unit for particular types of packaging	drawing attention to logistic costs	individual work	PP/PSM tapes, BOPP tapes
3.	making real parcels/ units and palletizing	acquiring skills in operating packing equipment	individual work	Pallets, Euro pallets, cardboard boxes, stretch film, BOPP tapes
4.	external classes	learning about present packaging systems in modern companies	group trips	Forklifts, pallet trucks, goods handling systems

Source: (authors' own study on the basis of job offers)

The tasks which students are faced with include decisions about choice of packaging for a particular product (also in situations when the range of packaging is limited), choice of auxiliary material (packaging tape), cost analysis for the chosen packaging and auxiliary material, and stacking goods and products on pallets in different ways (palletizing). Tasks to be carried out should be brief and very concrete while students should be given a hands-on opportunity to try a variety of solutions including those which might seem impractical or in which they happen to ruin some packaging materials, etc. since it is assumed that advanced conceptual (intellectual, theoretical) tasks require practical knowledge of an issue and its basics. The fundamental knowledge of competencies is viewed at three levels, namely: 1. knowledge as perceived generally (declarative knowledge – "I know what"), 2. skills and abilities (procedural knowledge i.e. action sequences in processes – "I know how and can do it"), and last but not least 3. attitude ("I want to and am ready to use the knowledge I have") (Kossowska, Sołtysińska, 2002, p. 14).

Thus, a logistician (system and logistics operation designer qualification obtained on completion of the second-cycle studies) is supposed to know processes and operations all the way from the very beginning. Metaphorically speaking, operations form the roots of a process, which then are expected to constitute the system.

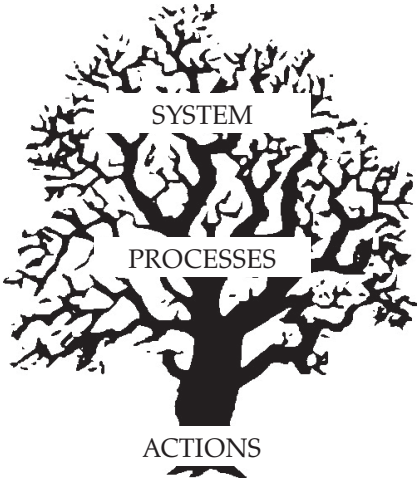

Figure 3. Metaphorical perception of the operation – process – system relationship
Source: (own elaboration)

In other words, designing logistic systems requires knowledge of processes, which subsequently requires knowledge of basic activities at the level of operational management. For example, the manager of the distribution department in an enterprise should know how particular products are packaged and what packaging is used for them. It is debatable whether he/she should be able to pack the product himself/herself using the right tools. Such issues remind of the dilemma whether a Mechanical Engineering graduate should or must be able to weld, in other words whether a logistician really has to be able to perform uncomplicated basic

operations. This question actually deserves a positive answer, especially when considering the fact how specific in terms of age and representing Generation Z are students for whom those classes are intended. Gen Z, also called the iGeneration or Post-Millenials, are the people born in Poland after the year 2000 who use technology as the main tool for acquiring knowledge. In contrast to the previous generation, which is often referred to as Generation Y, the digital world has been with them ever since they were born whereas Gen Y representatives were exposed to the digital technology gradually. Gen Z people are a generation thought to be spending little time in the real world and who cannot do without access to the Internet and social media websites where they share their knowledge round the clock. They are people who gain their knowledge through the internet and are focused on searching for and finding information quickly. They also need to stay in touch with their peers, show resourcefulness and have great plans for their future (Skrzydłowska-Kalukin, 2015). At the same time, their competence is lacking in hands-on experience. They are open, including being open to new experiences and are eager to take part in experiential learning processes as those are novelty to them. They are situations in which they have to show their manual skills and quite often start perceiving with the use of different senses. Post-Millenials heavily rely on electronic devices, which strongly affects their inability to perceive reality through experience and drawing inspiration from practice. At the moment enterprises can be divided into a number of logistic fields, in which particular tasks are performed. Most iGeneration people are able to take on jobs involving the computer and working using specialized software. Gaining practical skills needed in logistic operation during experiential classes in a laboratory might enable them to become active and dynamic managers or engineers solving problems and perceiving their company's potential for development through practical perception of logistic processes. Their work will be seen as distinctive, creative and showing unique solutions, which is bound to become inspirational for other colleagues.

4. Initial evaluation and experiences

With the aim of improving the conducted classes a study was carried out in order to evaluate the classes and obtaining feedback on the classes from the students. The conducted study involved focus group interviews with the students and a short questionnaire. During the interviews the students were asked questions about their expectations related to the program of teaching in the field of logistics. The study has shown that their expectations are partly the same as those of employers. They, most of all, emphasize that they are interested in gaining practical – hands-on – knowledge. This statement is present in students' remarks all the time. More-detailed questions have made it possible to define what the students mean by "practical knowledge", i.e. operating various equipment, being able to use various software, being familiar with different documentation, finding out about true, authentic/real problems and being able to solve them as well as wanting to be in touch with practitioners and learning about logistic problems "in the field". When asked

what they would like to achieve through that, they answer that they would like to improve their opportunities on the job market. This results from an assumption, which is frequently noted in the students' comments, that the most important characteristic of a candidate for a given job is hands-on experience. This has actually been proved by the study conducted by the authors of this paper which has shown that a special category among other requirements is experience in a similar position. In a different study, which has been mentioned herein, this requirement was present in 94% of the job adverts and the higher the position which the advert is for, the higher the percentage is. This situation looks quite the same in the common-sense observations when running a company. When one does not know the core issues in company operations and is not familiar with the basics, then he/she cannot have the right competences, which is bound to result in taking bad decisions. For example, when the person responsible in the Purchasing Department is not able to assess the parameters of packaging required in his/her company, then he/she is likely to make a decision exclusively on the basis of its price.

The interviews have shown that the students need to act effectively and they need satisfaction drawn from solving problems on their own. They are convinced that this is the way in which they will gain experience. A short introductory questionnaire shows that the students appreciate practical tasks and leaving theory aside. The questionnaire included 34 students who assessed the classes on the scale from 1 to 5, and the average was 5.0. Next, the students were asked to define what they liked best in the classes, which was an open question. However, the answers given were so similar that it was possible to group them in the following way (the students were allowed to provide more than just one answer).

Table 2. Answers to the open question "What did you like the most in the practical classes in Product Packaging and Identification?"

The classes were practical	32
The teacher is an active practitioner and shares "real knowledge" with us	25
I have learnt things about packaging which I wasn't aware of before	25
I have been able to prepare something myself/with my own hands	24
I have learnt something which is likely to be really useful	18
I have been able to see things with my own eyes which I learnt about earlier	8
I have seen how packaging affects costs	6
The atmosphere in the classes has been very good	5

Source: (own elaboration)

The answers given by the students clearly show that the practical aspect is of the highest importance to them. They definitely appreciate the possibility of learning something in conditions reflecting real-life conditions.

Conclusion

When summing up the considerations above it can be said that even those undertakings with relatively low financial means should be likely to succeed as long as they aim at the experiential learning concept and preparing future graduates for solving practical problems in the future and increasing their opportunities on the job market. The shorter the course is and the poorer the technical facilities are, the more difficult it becomes to choose problems and practical tasks for solving so as to make them as representative and universal as possible for a particular group of operations. Such selection cannot be anything but very subjective, and this is the reason why it is imperative that the teacher conducting such class be an experienced practitioner.

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Corresponding authors

Joanna Krzywda can be contacted at: jkrzeminska@interia.pl
Dariusz Krzywda can be contacted at: kaeil@interia.pl

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Grażyna Chaberek-Karwacka

Department of Spatial Management, Faculty of Oceanography and Geography, Institute of Geography, University of Gdańsk

THE NEW URBANISM APPROACH IN CITY LOGISTICS PLANNING AND DEVELOPMENT. SEARCHING FOR SOLUTIONS ON THE GOTHENBURG AND GDANSK CASE STUDIES

Abstract

Cities nowadays, "contaminated" with motorization have become an area of contradictory traits: on the one hand, they are still centers of economic and social development, on the other hand their space has become unfriendly and even dangerous to residents and users. In the face of such problems, solutions must be taken to transform the cities' spaces into friendly and livable along with improving the quality of citizens' life. Unfortunately, the simplest and cheapest solutions can even have the opposite effects if they lead only to limiting the free flows of resources within urban space. The aim of the article is the comparative analysis of two cities Gdansk and Gothenburg to demonstrate the differences in the streets structure of both cities, and to demonstrate the solutions which make up Gothenburg's public space, indeed public, and thus allow to all users for coexistence without limiting logistics of economics and social processes. Comparative analysis was done using a local vision and analysis of available literature sources. The article presents the infrastructure's and organizational solutions used at the center of Gothenburg. Comparative analysis showed the differences in space with similar functions in Gdansk and Gothenburg. Analysis showed how people function within the space unfriendly for pedestrians and how space can change in favor of the inhabitants without losing its functions after applying various infrastructural and organizational solutions.

Keywords: city logistics solutions, city infrastructure, new urbanism, livable and human-friendly cities

Introduction

Cities are perceived as a link of development and social and economic growth. The global trend is intensified urbanization. The attractiveness of cities is constantly growing and attracting people to their educational, economic, social and cultural services (O'Sullivan, 2012). But, cities are also perceived like too burdensome or "unfriendly" places for people to live. Cities have been criticized and treated like the cause of climate change and the lack of suitable conditions for a happy life. According to conservative estimates, the cities emit more than 40% of all major greenhouse gases (Rosenzweig, 2011). If we add to this account consumption of electricity, the consumption of food and other goods, which production relates to burning of fossil fuels, this value increases to 80% (Hoornweg et al., 2011).

City problems are nowadays extremely burdensome for local communities. Most of these problems, are related to the motorization of people mobility and urban freight. Urban space has been dominated by cars' infrastructure, and by cars and trucks, pushing away pedestrian traffic. Dominance of cars has caused problems in many respects, both ecological, social, but also urban. In an area where most people are moving their own cars, anonymity predominates, resulting in increased crime, noise, accidents, air pollution, congestion on roads that cause stress and frustration, and the reluctance of street users (Gehl, 2014). These urban problems have also been identified by the European Commission, which in the Green Paper – Towards a new culture for urban mobility (2007) outlined the EU policy guidelines on improving quality of life in European cities. This situation had to bring changes in thinking about the city, its functions and role of residents and users, and thus changes in thinking about organizing their space.

Space in cities is a public space. Streets are for everyone. A user moving his own car or a company which buys goods for its needs takes public space for its private purposes. Obviously, cities are a collection of units and individual goals, but a five-passengers-car used only by the driver, or a truck with used only 60% (or less) of its capacity, takes the limited and valuable space in the city streets without paying for it. In such cases, the hosts of the area with the executive power entrusted by the inhabitants, are obligated to the proper distribution of public space among their residents and other users. Using the spatial management tools cause changes in the way people use urban space so that cities become more and more accessible and friendly to everyone. The importance of public spaces within the streets is concentrated by many researchers, especially urbanists and architects. Good examples are research conducted by Jan Gehl (2014) or Barbara McCann (2013). The simplest and cheapest are the regulatory solutions which lead to limitation of access for car users to individual city zones. However, such solutions, cause many problems for the functioning of the entire urban organism, because the urban environment is an environment of innumerable logistical processes related to provide the usability of time and space for all kinds of goods and human resources. Maria Lindholm and Behrends Sönke (2012) confirm that in order to reach attractive urban areas, it is needed to integrate freight transport planning with people mobility planning and land-use planning. The main problem faced by cities is the reconciliation

of traffic congestion while ensuring efficient logistics in all areas of the city. That is why there is a need to cooperation in logistics infrastructure planning among local authorities, urbanists, architects, companies, local society and scientists interested in urban logistics. Although such cooperation seems difficult, is possible. In cities where such cooperation has been undertaken, good examples of realization of all social, economic and political demands can be observed. Despite that every city is different and specific it is worth to recognize good examples and follow them or just be inspire by them in city planning and development.

The aim of the article is a comparative analysis of two cities Gdansk and Gothenburg to demonstrate the differences in the streets structure of both cities, and to demonstrate the logistics solutions which make up Gothenburg's public space, indeed public, and thus allow to all users for coexistence without limiting logistics of economic and social processes.

1. Methodology

The study was system analysis and deduction method based on the literature and real-life examples. To compare the characteristic of chosen streets were used the local vision and taken by author photographs. The method of examining the structure of streets based on the photographs analysis is a method adopted by urban morphologists (McCann, 2013; Baharuddin at al., 2016; Del Monte at al., 2016; Oliveira, 2016). The local vision and photographs were taken in the city of Gothenburg and Gdansk in November 2016. Additionally, analysis was based on the interviews with local researchers.

Gdansk is a city located in Northern Poland with a current population of 463.754 (Gdańsk w liczbach, 2016). However, it is the capital of an agglomeration consists of many other cities. In total, the entire agglomeration has the size of over 1.2 million inhabitants (Bank Danych Lokalnych, 2016). This is important because when speaking about Gdansk's logistics, it is also necessary to consider users who move within the city area during the day, even though they are registered and officially reside outside Gdansk. Gothenburg is a city in developed country. Swedish society is much more aware of a need for sustain development. Gothenburg, ten years ago had similar problems like Gdansk today. Then city's authorities understood the need of changes in city logistics and started implementing variety of new solutions. Gothenburg is good benchmark because of its similarities with Gdansk. Gothenburg is a city on the west coast of Sweden. It has 533.300 inhabitants, but it covers the local labor market with a potential of a total of 1.1 million inhabitants (Andersson, 2016). Gothenburg has a similar climate (climate-data.org), although even less favorable than Gdansk, there are more rainfalls yearly and it is cooler. It has similar land differentiation (topographic-map.com). Those characteristics have meaning when we compare the mobility ways chosen by inhabitants. As it is shown in next chapters, we can observe much more bicycles and public transportation users within the city space of Gothenburg than in Gdansk.

The examples of comparing spaces in these two cites were taken from the districts and streets having similar meaning and usability. That means, compared spaces fulfill the same functions within analyzed cities. Base on that analysis some characteristics of Gothenburg's streets were pointed as factors which correspond to "new urbanism" demands. The characteristics of Gdansk which are now barriers for proper city development were pointed to show the areas which should be prioritizing in future city's investments.

2. The new urbanism approach vs city logistics needs

Current demands towards cities have been defined by the United Nations during the Habitat III – Conference on Housing and Sustainable Urban Development in October 2016. According to United Nations, cities should "fulfil their social function, including the social and ecological function of land, with a view to progressively achieving the full realization of the right to adequate housing as a component of the right to an adequate standard of living, without discrimination, universal access to safe and affordable drinking water and sanitation, as well as equal access for all to public goods and quality services in areas such as food security and nutrition, health, education, infrastructure, mobility and transportation, energy, air quality and livelihoods". Meeting all these demands was a statement, that urban development must be people-centered development (United Nations, 2016).

The idea of people-centered development is directly connected with taking people needs and their quality of life as a main determinant in decision making in city planning. Many cities compete in the rankings, in which the main criterion is the quality of life (Majer, 2014). They use the phrase 'livable', means 'city of the good life'. Criterion 'livable' is a comprehensive evaluation of the quality of life in the city. Is the answer to the questions: whether the city is a good place to spend your life in it; whether it is safe and its people are friendly; whether all social and ages groups easily move around it; and whether in this city is easy to take care of your health. This category consists of many factors. The concept of a 'livable' city connects directly with the concept of 'soft city'. 'Soft city' is a city where people can see and meet other people on the streets and squares instead of cars and individual units behind the wheel. The experience of inhabitants and users in a city is radically different when they can meet people in public spaces, not only cars (Zakowska, 2013).

However, it is very important that the solutions adopted do not adversely affect the possibilities of carrying out logistical services of economic processes within cities. Particularly important is the part of logistics that is involved in the physical delivery of goods. Maria Lindholm (2012, p. 4) outlined the problem clearly. "Goods are important for the quality and livability of the urban area, since without goods transport, there would be no shopping, no offices, no restaurants, etc. goods transport is a driver of the urban economy but also an issue that is important from an emissions perspective, where statistics show that freight transport has

an important role regarding sustainability (...). Furthermore, vehicles serving urban delivery operations are a well-established contributing factor to urban traffic congestion (...). Freight transport is a part of the many different transport operations performed. Cycling, walking, public transport and private car use are among the means in use. During the day, most of the transport operations performed involve moving people from one place to another (...). However, both people and freight need to use the same infrastructure". As long as urban freight transport is important component for economic vitality of cities but also is responsible for a number of negative impacts, the only way of its development within the city structure is sustain development. However, this is the least feasible aspect of urban space management (Sönke, 2011).

3. City's space unfriendly for people – Gdansk example

Unfriendly city is a city which space does not encourage spending time within it. In such a city, people are just passing through the traffic, do not want to spend time in the public space more time than the minimum necessary. Streets of such a city are characterized by continuous movement and are only places of flows in different directions. Streets dominated by motorization are uncomfortable and dangerous. According to the researches, even greater discomfort than the pollution causes noise (Nicchi, 2014). Car traffic also causes a high risk of accidents. The consequences of such risks are fences and strict separation of pedestrian routes from the carriageway (Figure 1). Technical barriers for walking and bicycling are fences, hurdles, rails, green belts, high curbs and light signals. Separating pedestrian traffic increases drivers' confidence and driving speed. The increase in speed results in a further solution for pedestrian safety such as, underground passageways or pedestrian traffic lights (Figure 2). Unfortunately, all these solutions, which seem to provide users with security, only cause huge barriers to movement. This leads to the necessity of overtaking the road, extends the time and distance of travel, the need to constantly stop and wait for lights changes, the need to climb the numerous stairs. Such conditions discourage users to move on foot or even by bicycle.

Figure 1. Gdansk, Grunwaldzka street, November 2016
Source: (Author owns collection)

Figure 2. Gdansk, pedestrians tunnel in Nova Słowackiego street (upper) and pedestrians tunnel in main railway station area (below), November 2016
Source: (Author owns collection)

The present structure of Gdansk's tissue is a consequence of many factors, especially its territorial postwar development was shaped by the ideas of socialism and mono-functional urbanism (Słodczyk, 2012). In addition, the geographical location of Gdansk has caused many years of limited development opportunities. Development of Gdańsk was limited by bay, harbor and the shipyard on the north, and by moraine hills and protected forests of Trójmiejski Landscape Park. The Gdansk structure was also shaped by the development of the entire agglomeration dominated by location of urban rail (SKM) network (Koźlak, 2017). Under such topographical conditions, the railways infrastructure was leaded along the coast. Newly established housing estates and towns focused around the railway network. The second direction of development after 1990 was the completion of East-West route. This route divided the city's districts, limiting the people flows. Gdansk's spatial development was also limited by the west bypass route, which became the main communication barrier for settlements located on the other side. Because of all these determinants, Gdansk consists of many monofunctional districts spread out linearly and satellite housing estates connected by urban "freeways". These roads have 2–3 lane. Additionally, despite of they are in the center of the built-up area, the permissible speed exceeds to 60–80 km/h (although the speed in the built-up area in Poland is 50 km/h). These urban "freeways" and the urban rail line constitute barriers and factors disintegrating the city. These lines intersect the structure of individual districts by limiting the ability to move only to designated passages with traffic lights, tunnels and bridges (Figure 3).

Consequently, the Gdansk tissue is characterized by very wide arteries, with separate lanes for each type of communication (car, tram, bicycle, walking). The city is characterized by very large walking distances, which is quite a barrier for pedestrians and cyclists. According to the research, the comfort and time are the main factors of choosing means of transport in daily commuting to work (Gdańskie Badanie Ruchu, 2016).

Figure 3. Streets within the Gdansk's tissue with the characteristics of speedways
Source: (Author's own work using Google Open Street Map)

4. Logistics solutions in Gothenburg

Gothenburg's development for decades has been limited to a centrally located harbor, which has now moved out of the city center, giving the city great potential for attractive sites in the center and in the waterfront area. Gothenburg 10 years ago faced similar problems like Gdańsk. Crowded by cars city center did not encourage spending time within it. However, the actions taken over the past ten years have led to a change in its image today (City of Gothenburg. Environmental Programme, 2015; The innovative delivery, 2015).

There were two most important projects in the city. First it was introducing charges for enter cars and trucks to the city center. Already this activity significantly reduced the nuisance of motoring in the center. Additionally, The Urban Transport Administration continuously works on improvement of the freight distribution in the City. The Concept of "Smart Deliveries", launched in 2012, is based on the main idea of consolidated deliveries with electric powered vehicles. It consists of four projects: 1) Stadsleveransen, consolidated deliveries of goods in the city center; 2) Cargo bikes, electric assisted bikes for deliveries; 3) Lindholms Leveransen, combining goods and waste handling and 4) Fiskleveransen, demonstration of new fields of applications. The main objectives of that concept were to reduce congestion, increasing safety, creating more attractive urban environment and reducing environmental impact. The most significant, "city's Stadsleveransen system pools deliveries for 500 shops and businesses – drastically reducing shopping center traffic and freeing up once-congested streets for pedestrians and cyclists" (The innovative delivery system, 2015). Figure 4 shows the area of city center which is totally closed for truck traffic and location of the consolidation center for deliveries of goods. Freight transport from the consolidation center to the Stadsleveransen zone is support only by small electric vans (Figure 5), bikes and six-wheeled cargo

bike. The cars are stretching 14ft long but only 34 inches wide (The innovative delivery, 2015). The project assumed common goods reception for shops and offices in the city center; one last mile operator for transport companies; reception check and consolidation of goods; handling of small shipments (packages); deliveries according to time schedule; trained personnel managing the reception/registration and the deliveries, operated by a local company specialized in distribution with electric vehicles (City of Gothenburg. In the front edge..., 2015).

Figure 4. Gothenburg – the Stadsleveransen zone
Source: (Author's own work using Google Open Street Map)

Figure 5. Electric vehicle using for delivery in Stadsleveransen zone, November 2016
Source: (Author owns collection)

Additionally, the DB Schenker in cooperation of City of Gothenburg and Stena Recycling AB introduced its own pilot project of distributing goods and packages in central Gothenburg. DB Schenker settled its own little hub (size of container) just next to the "City delivery" area (see Figure 4). Instead of using vehicles driving from store to store they unload goods in early morning to this little hub and then with the help of newly developed electric pallet truck, they distribute deliveries on foot (DB Schenker).

Activities undertaken by the City of Gothenburg for the past 10 years have led to the changes in the structure and function of the streets. Gothenburg streets are multifunctional and free of technical barriers for pedestrian and bicycle traffic like curbs and hurdles, reduced number of traffic lights (Figure 6).

Figure 6. Gothenburg streets in the central districts
Source: (Author's own work using Google Open Street Map; Author owns collection)

5. Comparative analysis of Gothenburg and Gdansk

The comparative analysis of two cities was based on a comparison the streets system solutions of comparable importance in both cities. Photographs were taken in the working day in week, at time 1 pm–2 pm, before peak hours.

First pair of compared streets create space in front of the central rail station (Figure 7). For both streets, dominant function is to support the communication of the central rail station with other areas of the cities. Pictures were taken across the street opposite the buildings of rail station. The difference is noticeable. Access for pedestrians is much easier for Gothenburg users. The street's facilities make the square with easy approach to every kind of public transportation, convenient for walking and cycling. In Gdansk, access from one side of the street to opposite side is only by underground tunnel. Pedestrian tunnel offers some small purchases, like snack, press. The access to the tunnel is by stairs. There is no elevator from the tram platforms to the tunnel. Space for walking is narrow. Bicycle roads conflict with sidewalks and bus stops.

Figure 7. The Gothenburg central Rail Station and Burggrevegatan (upper) and the Gdansk Central Rail Station and Waly Jagielonskie street (below)
Source: (Author's owns collection)

Second pair of photographs (Figure 8) presents one of the main junctions in both cities. Both junctions have similar functions. They are located near the railway main station, so must handle streams flow of every kind of public transport forms as well as huge pedestrian and bicycling flows. The most noticeable is the space division and many cars on the pictures which shows the priority. In Gdansk, every kind of flows have exactly dedicated lines: sidewalks, marked pedestrian crossings and bicycle roads, separated by fences tram-lines. For comparison in Gothenburg the whole junction space is perfectly available for every kind of users. There are no marked pedestrian crossing or even curbs. Cars, trams and bicycles move within the same space with pedestrian and bicycles priority. While the Gdansk's pedestrians must wait in full-cycle traffic lights and then must try cross the huge space between both street sides in very short time (which makes usually stress and need of running at the end of the green light cycle), in Gothenburg pedestrians and cyclists can move in every needed direction without stopping and waiting.

Figure 9 shows the examples of streets which are connectors between the districts. Both streets are surrounded by park area and some academic facilities. The pictures and maps show the priorities on both streets. While the road in Gdansk is dominated by six lines for cars and separated by fence tram line along the axis of the street, in Gothenburg the main part is sidewalk and cycling road. Additionally, tram lines both way with dedicated bus lines. Transport lines are narrow, safe, with easy access for pedestrians.

Figure 8. Drottningtorget junction in Gothenburg (upper) and Hucisko junction in Gdansk (below)
Source: (Author's owns collection)

Figure 9. Vasagatan in Gothenburg (upper) and Zwyciestwa street in Gdansk (below)
Source: (Author's owns collection)

Conclusions

According to the analysis, the improvement of the situation in cities is based primarily on the transition from mono-functional space to space with many functions. It is important in the cities to offer space for each type of user. The best results can be achieved when users share the same space without dominating any group over another. The essence of quality of life in cities is not just to create the restricted zones. It is important to organize the space and create an infrastructure that will limit walking and cycling barriers and will not push to the margin any of the groups.

The analysis covered the space including logistic infrastructure, especially the streets. Streets should be multifunctional spaces. It is important that pedestrians and cyclists can move on one level. Using stairs or lifts for these groups involves additional effort and time, which creates costlier alternative for moving (with higher alternative cost). Streets dedicated to pedestrians should consist multifunctional squares. Squares can also perform additional cultural or service functions just to encourage people to stay in the city space, not just to flit away.

A city where people are seen in the streets, not only in daily traffic but also present, spending time within public spaces, fulfills all economic, social and ecological functions. Such space organization also creates greater social sensitivity, builds civil society, leading to reductions in crime, pathology and segregation. That is why it is so important to take it into consideration by local authorities during city logistics infrastructure planning and development.

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Corresponding author

Grażyna Chaberek-Karwacka can be contacted at: geogk@ug.edu.pl

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Natalia Jagodzińska

BTCH Management Systems Gdansk

APPLICATION OF FOOD SAFETY SYSTEMS IN THE TRANSPORT INDUSTRY

Abstract

The purpose of the publication is to demonstrate the application of food safety management systems in the transport industry. Identify the food safety management standards and their choice and use in the area of food transport. Indication of food safety management standards and their choice and application in the area of food transport. A set of standards slightly different from each other and their use in the transport industry will be presented. The summary will highlight the benefits of the implementation and certification of the management system in the transport company. The benefits of the implementation and certification of the management system in the transport company will be presented.

Keywords: transport, food safety management systems

Introduction

The transport sector associated with the food service area is an inseparable link in the food production cycle "from the farmer to the table". At each stage of food production there is transport, and therefore in this area may be exposed to contamination of food. In order to ensure food safety, management standards have emerged that ensure the safety of products through control and monitoring mechanisms. Hence, for complete safety, food safety management systems should and should be implemented in transport enterprises.

1. Management systems in the area of food safety

The implementation of management systems into the company's corporate culture is generally voluntary, but sometimes forced by customer, market or even law. This principle also applies to food safety management systems. There are a couple of food safety management systems relating to, inter alia, Transport industry. Obligatory system is a HACCP system, required by Polish law in the entire food sector. Amendment of the Act of 30 October 2003 – Act on health conditions of food and nutrition of 11 May 2001. It clearly and unequivocally states that every company connected with Production, transport and storage of food is required to implement the HACCP System. The requirements for this basic system are specified directly in the law[1]. However, the source code for the collection of food safety rules was launched by the Codex Alimentarius (June 1997). Historically, due to the lack of an ISO standard for food safety management systems, many transport companies in Poland have begun to implement and certify the HACCP system based on the Danish 2002 Code – DS 3027E:2002: Management of food safety based on HACCP[2]. Historically looking at the lack of ISO standards As a consequence, the ISO standard ISO 9001 Quality and Food Safety has been translated into ISO – EN ISO 22000[3]. HACCP is the only required management system. It needs to be implemented but no certification is required. It turns out that large food industry markets, when analyzing food contamination, came to the conclusion that the HACCP system was not demanding enough, resulting in industry/corporate, more demanding management standards like GlobalGAP[4] For agricultural food producers, standard GMP + Standard for Good Manufacturing Practice and Transport of Feed[5], system BRC Global Standard for Food Safety[6] Developed by the UK or system IFS[7] worked out by manufacturers in Western Europe. However, what is most relevant to the transport industry is the standard developed in 2003, namely IFS Logistics, currently in version 2.1 of 2014. This is a standard for food safety requirements for companies that provide food storage and transport services. This standard was developed by French and German commercial food companies. It is essential to establish, maintain and certify IFS Logistics 2.1. The system is based on the following requirements: systematization of logistics (freight transport), taking preventive actions to ensure food safety, supporting the legality of origin of products, Communication in the supply chain and increased trust between suppliers, consumers and inspection authorities. This system covers storage areas, temporary storage, transportation, loading and unloading and related logistic operations. The above-described standards are in many sources of literature in a single context,

[1] Ustawa o warunkach zdrowotnych żywności i żywienia z dnia 11 maja 2001 r. wraz z późniejszymi poprawkami (Dz. U. z 2003 r. Nr 208, poz. 2020).
[2] DS 3027E:2002 – Management of food safety based on HACCP – Requirements for a management system of food producing organizations and their suppliers.
[3] PN-EN ISO 22000:2006 – Food Safety Management Systems – Requirements for any organization in the food chain.
[4] GlobalGAP, version 2.1 (2004).
[5] Transport GMP+B4 (March 2013).
[6] BRC, version 7 (January 2015).
[7] IFS Food, version 6 (since 2012).

indicating that the standardization of certain management areas in a food contact establishment allows for a significant increase in the quality of food (Barendsz, 1998; Beardsell, Dale, 1999).

2. The requirements of the food safety management system

The above mentioned systems basically have one thing in common – systematically ensuring food safety. This translates into establishing food safety policy and setting goals and objectives for improving food safety. A team is responsible for overseeing the system. A number of procedures and instructions are in place for effective surveillance of the safety of food storage and transport processes. Record keeping and documentation supervision is to ensure systematic and systematic checks to ensure food safety. Very often in transport companies is established so. A Food Safety Plan containing a lot of information about food organization in the transport process. Oftentimes, as a result of these activities, transport companies identify additional legal requirements for foods that were not previously considered. Conduct a systematic assessment of the conformity of their actions with respect to the ever-changing law. Introduction of food safety management standards has prompted carriers to thoroughly analyze potential food contamination risks, such as the use of a vehicle with adequate transport temperature, vehicle hygiene, monitoring of transport parameters, etc. Identification of hazards and prevention has resulted in procedures for preventing accidents and responding to accidents. Carriers have also developed critical control points that must be strictly monitored to ensure food safety. The technical tool and transport equipment are also widely available. Depending on the management system, not only periodic vehicle inspections are established, but also technical condition, sanitary status and monitoring level. To reinforce the importance of the use of management systems in transport, it should be emphasized that the rankings of large corporate transport companies are maintained, where one of the evaluation criteria is not the mere possession of the management system but its effectiveness.

It is also worth noting that standard owners increasingly place emphasis on outsourced processes in the production chain, ie all relevant services including Storage and transport. Hence, there are more specific management standards for logistics such as IFS Logistics, FSSC 22000 Packaging and BRC Global Standard for Packaging and Packaging Materials.

3. Standardization of management in the transport industry

The concept of HACCP, BRC, IFS, or ISO management systems is based on the concept of standardizing some general practices, giving mutual benefit to both suppliers and consumers. Referring to management theory J. Zymonik (1997), rightly pointed out that the norms translate into practical language some ideas of continuous improvement. In recent years there has been a noticeable

increase in improvements in the transport industry in the field of food safety. L. Wasilewski (2002) emphasizes that the basis of management systems is the TQM philosophy (Total Quality Management), commonly known as the complex management of quality, in this case, the case of transport companies the quality of food safety. However, it should be noted that TQM is not another standard, management method – it is more – philosophy, idea, full management concept. So H. Wojciechowski's (2000) theory that quality is all that is understood by the customer, thereby confirms that the market and the customer will verify the effectiveness of the management system, including in particular the safety of the foodstuffs being transported.

As a result of market observation, it is clear that the transport industry not only introduces food safety systems required by law or by large companies, but also other management systems. The most commonly implemented and certified systems in addition to food systems are quality management systems ISO 9001[8], environmental management ISO 14001[9] or work safety management OHSAS 18001[10]. An important element to bear in mind is that more and more ERP systems are being implemented in the transport industry, either built on or based on predefined food safety management standards. However, remember that standards in the form of management system guidelines are a set of food safety principles, and IT management systems are only a tool for organizing work and monitoring food safety. The collection and a rational summary of the application of management systems in the food industry is published by Michalis Efstratiadis, Argiro C. Karirti, Ioannis S. Arvanitoyannis (2000) who point out that management systems cover all areas of the food industry not only production but also supplies of raw materials and transport to customers. The monitoring tools imposed by the control systems effectively improve food quality and safety at every stage.

4. Benefits of implementing a food safety management system in the transport industry

It is difficult to disagree with H. Wojciechowski's theory (2000), From a practical point of view, the application of any rules of management or quality or food or other safety not only brings the company direct benefits, but also mobilizes significant awareness of cost and risk management. Hazard identification and risk considerations are important for the organization, its customers, suppliers and consumers. An analysis of the effectiveness of the food safety management system has a significant impact on revenue and costs. Through an improperly managed system, you can end up with additional losses by losing market share, losing your consumer confidence and destroying your company's image.

[8] PN-EN ISO 9001:2015 – Quality Management System – Requirements.
[9] PN-EN ISO 14001:2015 – Environmental management system – Requirements and guidelines for use.
[10] OHSAS 18001:2007 – Occupational Health and Safety Assessment Series.

There are significant benefits to be gained from the implementation of food safety management systems in the transport area. These include internal and external confirmation of compliance with the law, establishing processes to ensure the safety of transported food, eliminating hazards and actions that threaten food safety, significantly improving the quality of transport services offered and a clear increase in customer/corporate/consumer confidence. What has been indicated as a benefit not only in Poland but also in the UK markets, as Lokman Zaibet, and Maury Brendahl (1997) claim. Observing the food safety management system (on a sample of 11 transport companies), tangible benefits of management systems have been confirmed. Beneficial elements of the implementation of the food safety management system are the introduction by transport companies of the mechanisms for tracking, analyzing and evaluating risks in the area of food safety. In addition, the spleen is constantly being involved in counterfeiting, counterfeiting, and intentional incidents. As a result of monitoring, data analyzes are undertaken to implement preventive actions that in the majority of certified management systems have a significant positive impact on the safety of transported food. For good reason, the benefit of finalizing the implementation of the management system is its certification. This is a certificate that is a measurable aspect of food safety assurance. Its getting often to transport companies opens the door to new contracts. What has been Systems Certification is important for large corporations, they require their suppliers to confirm the compliance of quality procedures. Often without a certificate, the manufacturer does not have the ability to deliver their products to the distribution network, which is also confirmed by Liesbeth Dries, and Johan Swinnen (2004). It is also worth stressing that apart from the benefits of implementing management systems, there are also difficulties in implementation. Both the literature of Silke Boger (2001), Jon H. Hanf, and Agata Pieniadz (2006) as well as the experience of the author's observation resulting from the audit of food companies, are the most important obstacles to the introduction of the system. Entrepreneurs often point to the high cost of the implementation process of the management system (training costs, consultant costs) and certification costs. However, it is worth pointing out that the owners of the surveyed companies indicate that these costs are very fast and "double". Firstly, they significantly reduce the "bad quality" costs, i.e. errors, the amount of non-compliant products, etc. Secondly, entrepreneurs increase the number of customers. Having a certificate allows them to build an image of a reliable partner.

Conclusions

In Poland after 1994, the development of management systems began not only in large companies but also in small and medium-sized companies. In recent years, companies from different industries have implemented their own management systems. This also reflects companies in the transport sector. Larger transport companies are implementing advanced food systems such as IFS or BRC, and their paths start with the HACCP system and ISO 9001. However, it is important that

since the establishment of industry food safety systems for transport and storage increased food security. The requirements of the companies obliged transport companies to systematically work in the area of hazard identification, communication and incident response. These good systemic practices have made it increasingly possible to prevent the consumption of spoiled food and, as a result, increased the confidence of the consul in food manufacturers.

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Corresponding author

Natalia Jagodzińska can be contacted at: natalia.jagodzinska@outlook.com

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Agata Krzemińska

CPIM, Department of Logistics and Transport, Faculty of Management, Poznań University of Economics

NEW PRODUCT INTRODUCTION PHASE IN RELATION TO SUPPLY CHAIN PLANNING PROCESSES

Abstract

The article presents the role and importance of sharing information about new product implementation by sales, marketing and R&D departments with supply chain part of the organization. In the introduction has been showed conventional attitude to the new product development phase. Then has been presented modern collaborative approach which allows to include new products in short-term and long-term plans of the company. Next, a detailed, theoretical and practical characterization of planning processes has been made with products being taken into account which become the part of a finished goods portfolio. Then, basing on examples taken from FMCG company the long term results of not including new products in plans on time have been shown. To conclude, a short summary has been made.

Keywords: new product development, planning processes, short-term and long-term plans, demand and supply planning, planning KPIs

Introduction

In a conventional "silo" approach work on new products is usually reserved for such departments in an organization such as Research & Development, Marketing and Sales. Author who worked for head quarter of more than 40 beverages companies in Europe and Asia made case study – checked ways of working on NPD in these plants. Most of them still work in conventional way or just make first steps in collaborative direction. Meaning, supply chain – Planning, Production, Warehousing departments learn about an introduction in a last phase, sometimes later than customers, by receiving customer orders to be realized. Certainly a new

product of a new brandin a company portfolio which needs e.g. a new production line cannot be launched without production engineers but there are a lot of examples from the practice within mentioned FMCG companies which allow to think that minor adjustments made to a product, including new packaging, ingredients or changes within the same brand do not require involving supply chain departments. In collaborative holistic approach all functions are informed at the right time, decision is aligned cross-functionally in parts affecting a specific department. It's important for two main reasons. First, to confirm by all that it is possible to launch a new product as planned. Second, to take action and ensure that:

– raw materials and packages will be prepared based on given specification and delivered by suppliers on time (Procurement),
– initial unconstrained demand planned by sales analysts will be reworked by demand planners which gives input to production planners to check available capacity which is constrained (Planning),
– there are product specification and skilled employees to manufacture a new product in place (Production),
– there is a decision taken about the way of distribution and transportation,
– there is a prepared place in a warehouse.

The main goal of the article is to show how important is to include newly developed products into short-term and long-term plans in supply chain processes which in turn have influence on accuracy of Sales & Operations Planning or other similar processes. In the following chapters the author will try to explain that lack of including new products into plans at an early stage can cause imbalance between demand and supply but also shift the focus of planners only onto short-term planning, continuous replanning instead of using resources for accurate middle- and long-term planning and setting strategic priorities.

A new product development phase and Product life cycle management have been widely described in marketing and sales books, but not in supply chain guides e.g. recommended by APICS organization (the association for supply chain management), where this topic has been only mentioned like in books added for references for this article . Apart from showing way of forecasting new products, information about demand instability and participative design/engineering including suppliers and customer integration into process with focus on external suppliers there is nearly no detailed information which would describe not only need for special treatment and analysis, but also consequences of lack of including new products into plans as early as possible. Literature overview motivated author to show effects of "silo" approach based on beverages companies and to present practical tools for operational and tactical horizon, which can be used to monitor NPD from supply chain perspective. A main research method supported by a literature study is a case study of dozen or so production FMCG companies located in different countries of Europe. Within a case study author have been used several years of data, reports and materials to introduce and monitor particular processes. In particular author proceeded and published weekly reports together with comments about influence to production and service performance. These reports has been used in this article and comments used as examples.

1. Including new launched products in short-term planning processes

A product passes through several stages, known as the product life cycle, beginning with its introduction, through growth, maturity and ending with its disappearance from the marketplace (APICS Dictionary, 2015). Figure 1 gives a simplified view of the profit and volume relationships in each phase of the cycle. No time scale is implied. The life cycle may take months or years to complete, depending on the products and the market (Arnold, 2004). An introduction phase is proceeded by a product development process defined by Bozarth as overall process of strategy, organization, concept generation, product and marketing plan creation and evaluation and commercialization of a new product (Bozarth, 2005). The author insists that in a definition of a supply chain role in product, development process should be also stressed.

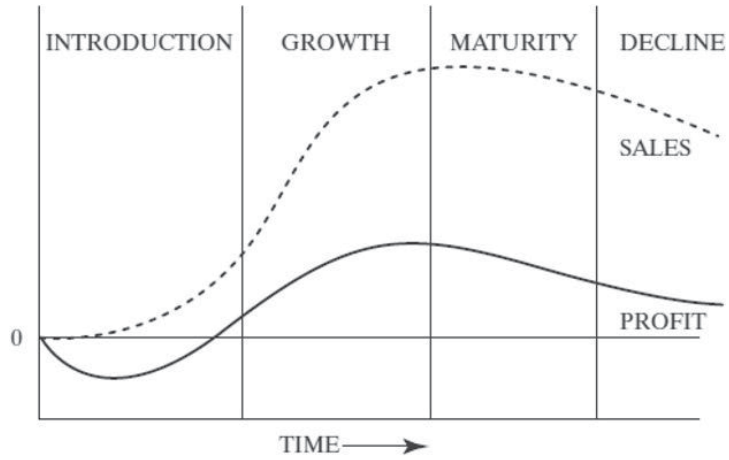

Figure 1. Life cycle of product
Source: (Arnold, 2004)

Below have been shown positive effects which involve including, monitoring and analyzing new products at an early stage of launching from balancing demand and supply point of view.

Due to lack of sales history new products are usually forecasted using qualitative techniques such as independent judgement of experts, historical analogy, judgements of executives and managers or market research (APICS MPR, 2015). It is a difficult exercise but crucial for production planning and availability on stock and on shelf in a store. Product underforecasting causes out of stock effect and customer orders cannot be fulfilled on time which is especially dangerous for "to be or not to be" in an introduction phase. There is a risk of launch failure and costs carrying. If sales underforecasting is extended to weeks and a production process takes week or more as time goes on, it is more and more troublesome to fulfill orders and go back on track. A situation with sales overforecasting looks different but

output is also negative. If a product is present on a shelf, customers are satisfied so the first goal has been reached. However, if sales are much lower than forecast which causes overproduction, costs of warehousing (raw and pack materials, finished goods) occur, costs of obsoletes by short expiration date in FMCG companies or by short product life time like in an IT sector. Due to constrained capacity there is also risk that through new product priority rule, defined as simple heuristics used to select the order in which jobs will be processed (APICS Dictionary, 2015), another ordered one can waits in a queue to produce which causes backlog.

To monitor sales forecast accuracy, analyze bias and enable taking action on time the author recommends, based on benchmark taken from FMCG company, to calculate such KPI for new products separately and show it in a chess board like in the example in the Figure 2. 12 weeks chessboard presents Bias figures understood as a forecast error calculated based on sales in comparison to forecasted sales. A given result shows whether forecast was overestimated (dark color) or underestimated (bright color). 6w Bias gives result for last six weeks as it is important to analyze a few following periods based on fixed target i.e. <–5%; 5%> which shows that forecasting process is under control. In addition, FA measures forecast accuracy in absolute values. Presented picture shows that in DK and FI exist continuous overforecasting and an action should be taken immediately. In turn NO in the beginning of the reported period underforecasting occurred and market tries to fix it. An example of a balanced market is SE which monitors and takes action on time.

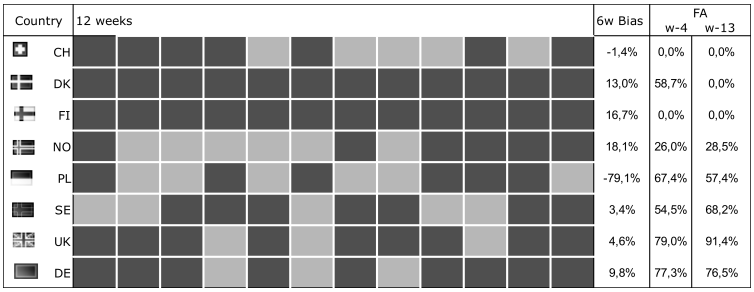

Figure 2. Forecast bias
Source: (KPI report of FMCG company, 2016)

Due to no timely information from commercial departments a new launched product is not taken into account early enough by production planners. For instance, information comes a week before a first customer orders should be fulfilled while manufacturing lead time takes 3 weeks. Manufacturing lead time defined by APICS is the total time required to manufacture an item, exclusive of lower level purchasing lead time (APICS DSP, 2015). Additionally, a procurement department has also received delayed information and contracted purchasing lead time to deliver raw and pack materials by suppliers is 2 weeks. They can deliver faster but this requires additional cost. To summarize, total lead time is 4–5 weeks while sales department has promised to deliver a product in a week. Such a situation, time and supervisors'

pressure cause stress for employees and if it is not a single incident, such a company is not an employee friendly environment. Besides, deprioritization of other initially scheduled batches cause higher production costs due to an unplanned changeover. The changeover also referred to as setup time is the time required for a specific machine, resource, work center, process or line to convert from the production of the last item to the next one (APICS DSP, 2015). Efficiency is also highly affected. Apart from that, initially scheduled items can be delayed and customer orders not fulfilled on time.

Figure 3 expresses KPI referred to order fulfillment. SSL (Stock Service Level) called also OTIF is an indicator which describes perfect delivery in percentage. The results split in the separate boxes allow focusing attention on low performing elements. In this example there are markets but it can be a brand, region, single SKU (Stock Keeping Unit).

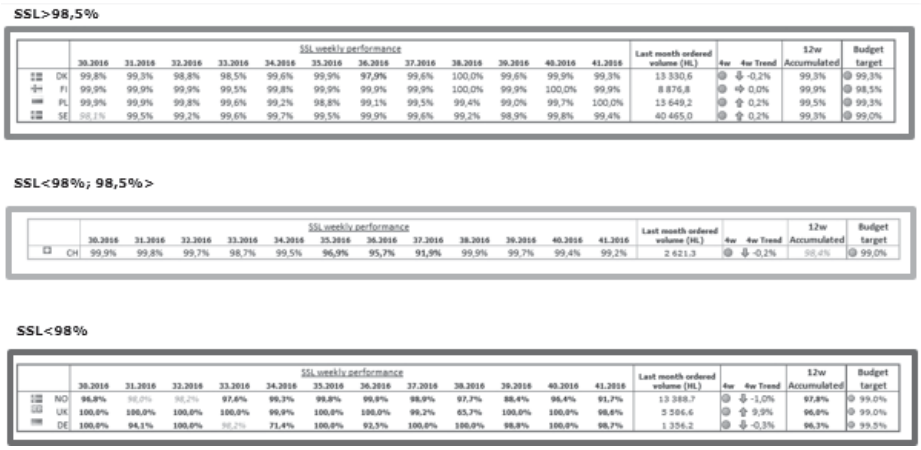

Figure 3. Order fulfillment analysis
Source: (KPI report of FMCG company, 2016)

Including new products in short-term planning in advance, setting KPIs and monitoring through visual dashboards enables better supply chain management and cost saving. In the next chapter the author will focus on the results of skipping new products in middle-term and long-term planning.

2. Results of not including products planned to be launched in the middle- and long term capacity planning.

So far reflections of this article have been focused on short term priority planning linked with demand. It is a marketplace which establishes priorities through determining what and when should be available. At each level manufacturing develops unconstrained priority plans to satisfy demand (Arnold, 2004). However, without resources to achieve the priority plan, the plan will be unworkable. It is function

of capacity management to supply necessary resources and make it possible to have product available when and where customer needs (Blackstone, 1989).

In this chapter the author focuses on middle-and long term effects of missing forecasts for products which will become soon the part of portfolio. Assuming that products already launched are properly taking into account in planning processes, company can develop a process which enables showing forecasted sales of a new item at a very early stage, even if a product is still in a phase of development, has no commercial name, but a planned date of launch has been initially set, even a year or two in advance. Thanks to such visibility planners can estimate needed capacity more accurately for a year or more.

Long term planning involves changes in staffing, capital equipment or other facilities that take a long time to acquire. Middle term capacity planning called Rough-cut capacity planning takes capacity to a next level of detail and checks the feasibility of master production schedule, provide warnings about any bottlenecks, ensure utilization of work centers and advice vendors of capacity requirements (Arnold, 2004). A product, brand, line of products planned to be launched which are not included in such plans can make them useless if a new product is going to be a big part of a portfolio.

Figure 4 presents an example of too short planning horizon. A company creates plans for 12 months. Working on a budget for the next year in autumn, such range is not enough to cover a whole budget year and to take responsible decisions. If this company planned to start selling new Christmas items in the next budget year it would be hard to judge if there were enough capacity in the shop floor. It is only possible to predict based on current available capacity (bright colour) that there should be enough resources.

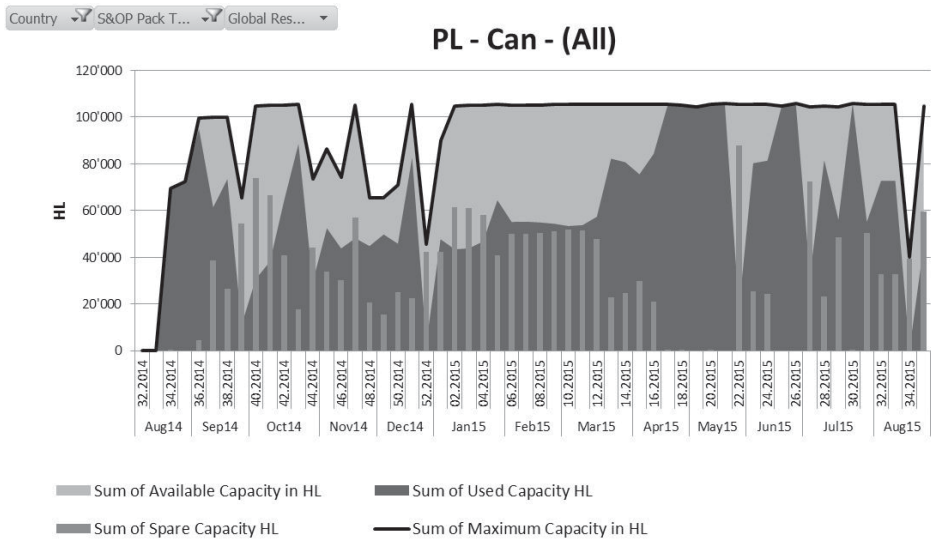

Figure 4. Capacity available in time period
Source: (KPI report of FMCG company, 2015)

Figure 5 shows an example of a company which fully utilizes resources. There is nearly no spare capacity to produce. The company has decided to introduce a new brand for the next summer which has been not included in middle term planning, as only active products has been taken into consideration. In this case a problem starts to be visible only by first scheduling which is too late for taking action which would not cost organization a lot. It is possible e.g. to add a new shift (if not already 24 hours), support by subcontracting or, in the long term, to add a new line.

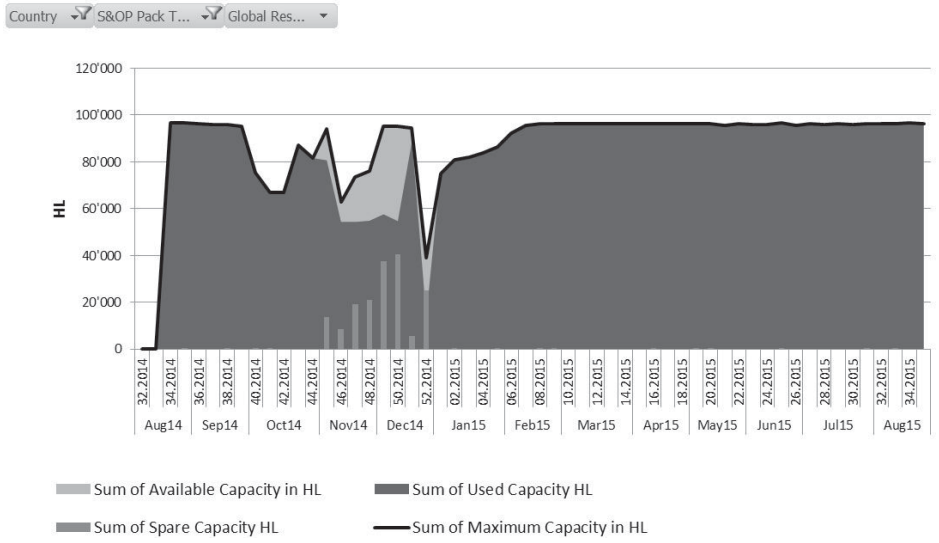

Figure 5. No spare capacity in time period
Source: (KPI report of FMCG company, 2015)

Having information about planned launching activities in advance, even at very low level of granularity, opportunity is given to consider strategic decisions which are often not possible within one budget year.

Middle-term and long-term planning can be supported by Sales & Operations Planning process. This term is traditionally referred to a decision-making process for balancing demand and supply in aggregate. One of its benefits is faster and more controlled launching of a new product. Owing to forward-looking orientation, potential problems for example with plant capacities can be seen early enough to remove these potential obstacles before they become real ones (Wallace, 2006).

Conclusions

In the article the author focused on the importance of including supply chain departments in new product development. In particular chapters of the article it has been shown how new items can be implemented in classic planning processes and how collaboration between departments gives added value to an organization.

In chapters presented examples which had been collected during work on NPD case study and showed tools which enable NPD analyze from supply chain perspective. Author stressed that if plans related with an introduction of new products will be not shared with supply chain departments, they will have a problem with balancing between demand and supply. What is more, they always have to focus on short-term planning instead of developing middle-term and long-term horizon.

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Corresponding author

Agata Krzemińska can be contacted at: agata.krzeminska@carlsberg.com.pl

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Agnieszka Szmelter

Department of Logistics, Faculty of Economics, University of Gdańsk

THE IMPORTANCE OF AUTOMOTIVE INDUSTRY IN SHAPING HABITANTS MOBILITY IN FUTURE CITIES

Abstract

The paper is a summary of different kinds of sources linked to the role of automotive industry in shaping mobility in future cities. This research fills existing research gap, identified in previous research, and also presented in the Introduction and Literature review sections. The research was conducted with the use of systematic literature review. Research results describe the role of cars in future urban mobility systems and the solutions helping to meet new mobility requirements of urban residents.

Keywords: mobility, logistics, automotive, car, future city, urban planning, city

Introduction

Today more people live in cities than in rural areas[1]. It is estimated that city and suburbs habitants will reach 70% of the global population in 2050 (Priester et al., 2014). What is more, never before so many goods and people have been transported globally. Additionally, consumers are more and more demanding, they are called "next generation consumers" or "next-gen consumers" (Firnkorn, Muller, 2015). This also applies to mobility. Mobility demand has been found by D. Metz as inelastic and increasing with improved infrastructure (Metz, 2008). It was always connected with human development history – migrations, wars, exploring new continents etc. (Kammerlander et al., 2015). Many elements of city life are adjusted to the individual, private transport, that is why the lack of sustainable, multimodal infrastructure can be seen in the city (Sha et al., 2013). The global society is addicted to the car. It results in environmental pollution, noise and many diseases (Kammerlander et al.,

[1] According to data from the UN, population living in cities in 2050 is expected to reach 6.3 billion. See in *The Connected Automobile Nears Critical Mass* (2015).

2015). But from a couple of years, the "peak car" phenomenon can be observed, car use has stopped and is decreasing in some regions (Thomopoulos, Givoni, 2015). That has been generating many problems in logistics in the city (Jezierski, 2002; Chaberek-Karwacka, 2015).

Future mobility in the city and rural areas will be characterized by growing complexity. Mastering this complexity will be made by strategies adjusted to megatrends and based on market innovations (d'Gama Rose, 2017). The growing demand for mobility and the differences between specific world regions in this respect (and between types of locality) were observed and predicted already by A. Schafer and D.G. Victor (Schafer, Victor, 2000). The future mobility will be sustainable mobility – societies are just now aware of costs of today's transport and, especially young generations in developed countries, declare resource-saving lifestyle (Winterhoff et al., 2009). Future mobility will be also created by older generations – Baby Boomers and X generation[2], but it is not clear, in what way (Siren, Haustein, 2013), because their mobility patterns are evolving over time (Thomopoulos, Givoni, 2015). It is caused by a number of changes, among others:

– multidimensional evolution of cities;
– sharing economy model;
– glocalization (globalization and localization), also in automotive industry[3];
– shortening product life cycles in the automotive industry, the development of autonomous vehicles, the appearance of electric mobility;
– shortening innovation cycles;
– technology convergence;
– Industry 4.0;
– emphasis on sustainable development, including the development of transport.

Because of these changes the automotive industry has to reshape strategies to meet new customer requirements. It has to find a new place in future mobility systems, especially in cities (Kellermann, 2011). There are only few research articles about automotive mobility future, mostly about electric mobility or low-carbon mobility, but still, this research field is unexplored. There are no research papers about the role of the automobile industry in shaping urban residents' mobility in the future, although city transportation systems agendas and strategies can be found. This research field is interdisciplinary because it connects urban planning, society studies, logistics and transportation in one research subject.

The aim of the article is to answer a research question: How will the automotive industry influence on shaping mobility patterns and urban space? The paper is organized as follows. Firstly, transportation systems and mobility patterns are described. Secondly, research methodology is presented. Then, research results are listed. In the end, conclusions, research contribution, limitations and future research directions are drawn.

[2] Baby Boomers – people born in 1946–1964; X generation – people born in 1965–1983; Y generation – people born in 1984–1995; Z generation – people born after 1995.

[3] Automotive industry in this research paper includes automotive supply chains for passenger cars in premium and mass segments: 1, 2, 3-tier suppliers, manufacturers, 3PL, 4PL (if exists), dealers.

1. Literature review

1.1. Mobility in future cities

The number of megacities will continue to grow. Rural population will decrease. Cities will be smart – sustainable, intelligent, digital, connected and innovative (Firnkorn, Muller, 2015). IT systems will support almost every part of city functioning – also transport. Today many cities use intelligent transportation systems to plan their capabilities in particular areas within the city. Effects of these are lower congestion, higher safety, and better control. Digital solutions will allow to the communication of infra- and suprastructure (see in: Wasielewska-Marszałkowska, 2016) – everything will be connected according to Internet of Things concept. The smart city will be a part of the smart economy, governed by the smart government, inhabited by smart society, living in a smart way, presenting smart mobility patterns (Ishida, Isbister, 2000). These cities will be network cities, characterized by social inclusion, efficient transit, innovative businesses. Their living cycle will be planned according to urban mobility plans. The differences and contrasts between private and public transport, individual and collective will be blurred because of new business models and forms of transportation. Mobility platforms, existing in a large number today, will be very popular among city residents (Röhrleef, Deutsch, Ackermann, 2015).

Today many long-term sustainable urban mobility plans (SUMP's) are made for cities having problems with environmental pollution and congestion (Nelson, 2016). Cooperation between local authorities, residents and private sector can result in efficient mobility system (Economides et al., 2012). Repositioning of urban transport systems will be possible only with the use of ICT systems, especially Intelligent Transportation Systems (Nelson, 2009). They have based also on multimodal mobility and blurred borders between private and public transport. Nevertheless, public transport system should be changed dramatically to respond to new demand characteristics in the area of mobility. A car will be owned by individuals, private and public companies. It will be a source of income. New mobility services will be offered in different sales channels, especially B2B and B2C, but also C2C. Many web platforms offering car-sharing, charging and parking will emerge, they are already present in today's transport systems and are developing very fast (Strasser et al., 2015).

Mobility is now one of the main elements of human activity. Mobility is secondary to some primary needs, like work, education, healthcare, leisure. The demand for mobility will be growing exponentially (Spickermann et al., 2014). Urban areas will generate more demand in this regard –both related to time and space (Wegener, 2013). They should be perceived as flexible, complex, living systems. Future mobility will be characterized by: "zero emission", "low carbon", "electric", "shared", "autonomous", "green" and "sustain" (Phillips et al., 2013). But, different generations, including Baby Boomers, generations X, Y, and Z will have other targets and needs in everyday life. But still, regional differences will be visible among world's cities (KPMG, 2014).

Growing technology addiction will result in realizing the Peter Sale's scenario of Technopolis, characterized by connected, fragmented, dispersed society. There is also another possible scenario is about eco-friendly urban future, based on sharing economy solutions (Shared mobility system). The last one is the most traditional, similar to today's dominated by private car ownership, even if there will be high charges in the city (Controlled mobility). Dennis and Urry supplement this scenario group by Local sustainability concept about self-sufficient, socially oriented urban society (Julsrud, Uteng, 2015).

Differentiation of transport modes will include micro mobility – use of small vehicles with and without engines, bicycles, new routes, infrastructure for pedestrians etc. The choice of means of transport will be less routine than today. Multi-optional users will choose different transport modes on the basis of special algorithms calculating prices in real time. There will be plenty low-cost offers, also low-priced cars and low-priced long-distance buses (Feige, 2010).

1.2. A car and mobility patterns

It is now known, that future city transport will be sustainable, energy-efficient and low-cost. Mobility infrastructure will be planned in long-term with taking into account future structure of urban society. Many pedestrian and bicycle areas will threaten car transport, but a car will be still a very important mean of transport. Many non-residents of the city will live in the suburbs or further – in rural areas relatively close to the city. They will need health, education and entertainment services, so they will use the car to go to the city. All mobility patterns, both represented by residents and non-residents should be analyzed before planning city transportation system. Nevertheless, to achieve objectives of sustainable urban transport, car traffic should be minimized. Therefore, a number of solutions will be implemented, including pay zones and entrance prohibition. But mobility of people from rural areas will be linked to the car, so park & ride zones will be crucial to meet their needs and reconcile them with the sustainable vision of the city (Szmelter, Woźniak, 2016). Available, attractive, fast, reliable and cheap public transport should provide an attractive alternative for people traveling within the city area (Jiang et al., 2015). Public transport should be more competitive to private car transport by providing available transport services, also between cities (a good solution can be high-speed train transport).

Future (even in some cases current) automotive industry will respond to new market needs. New mobility patterns will be supplemented by new business and services models, like car sharing and hitchhiking of the new generation, renting a public car or intelligent drive, which will be a part of a new market area called Mobility as a Service. It is estimated that 30% of cars in cities can be shared in 2050 (Szmelter, Woźniak, 2016). Autonomous, electric, low- or zero-emission vehicles will dominate the market. New kinds of vehicles will appear in cities – they will be smaller than today's city cars, but more environment-friendly. It can be seen on the small scale even today – in London, Berlin, Rotterdam or Singapore. The whole infrastructure will be transformed into multimodal one – everything

will be uniform, the predictability of traffic participants behavior – high. Thanks to sharing solutions poorer people will use new cars. Access to the Internet and digital solutions will be a part of every car. Route optimization, traffic analysis, car sharing, car renting, car connection and other services linked to car mobility will be used as a standard solution in every car. Public companies will offer car renting as a part of their product portfolio.

According to KPMG's Global Automotive Executives Survey 2015, new technologies are now a part of automotive companies, which, surprisingly, are mostly interested not in environmental issues but in standard solutions: combustion engines, product platforms, modularization, commonality. These priorities are linked to customer needs on emerging markets, which expect ultra-low-cost cars and other new car segments according to their dynamic growth (KPMG, 2015). In the future, a split into the Western and Eastern parts of the world will be visible in the context of mobility patterns (see Table 1), but every of these societies will reconsider car ownership. However, the Eastern part of the world will be less inclined to give up buying a car for its rent.

Table 1. Types of future mobility behaviour

Type of mobility	Description
Triad countries (Western Europe, USA, Japan)	
Greenovator (27%)	A dominant type of mobility in the future Combines care of the environment, work-life balance, high quality of life Restrained in pursuit of luxury and a consumerism goal: environmental aspects, running costs, product durability
Family Cruiser (11%)	Patchwork family members – mobility is necessary, because of frequent visits to family members Mobility means high quality of life Use of inter-family car sharing Goal: unlimited mobility for all family members
Silver Driver (24%)	Drivers aged 50 and over Focused on enjoying life, new experiences, adventure, fun, sports competition, participation in social life Goal: preserving the autonomy of mobility, comfort, safety
High-frequency Commuter (24%)	Job nomads, have to commute daily (far away) to work Usually, residents of suburban areas, looking for the possibility of effective, flexible movement in the metropolitan areas Mostly women Usually, rides funded by the employer The car is a dominant mode of transport Goal: low cost, speed, flexibility
Global Jet Setter (2%)	Constantly on the move, often change location (also in the field of housing and work) Multi-mobile workers, smart mobility services-oriented, can professionally manage the mobility Goal: quality of life, comfort, luxury, speed
Sensation Seeker (4%)	Like to drive a car for pleasure, it is a second home for them, combine it with individuality and freedom Their behaviour is related to the trend of the new ecology Goal: recreation, high quality of life, self-realization

Type of mobility	Description
Low-End User (8%)	Cost-oriented Looking for inexpensive mobility solutions, are able to give it up for the lower cost of living Goal: low costs
BRIC countries (Brazil, Russia, India, China), also other developing countries	
Basic (48%)	Having their own car gives them social advancement For them, mobility is a sign of modernity and participation in the global economy A very large group Goal: saving energy, low price of a car, functionality
Smart Basic (43%)	Looking for mobility solutions that highlight their social advancement More focused on comfort and individuality than basic consumers Not only want to imitate consumers from the West but also focus on issues related to environmental protection and CSR Goal: comfort, individuality, low cost, environmental aspects
Premium (4%)	Perceive luxury as an expression of self-esteem and social status Accept high prices Focused on originality Goal: luxury, individuality
Others (5%)	

Source: (Szmelter, Woźniak, 2016)

2. Methodology

In this study, to analyze the approaches to car role in shaping people mobility in future cities, a method of the systematic literature review was used. There is a lot of research procedures linked to literature analysis, but the most often cited are classical procedures described by Cochrane[4]. In this study, a newer approach to literature review was implemented, which is procedure presented by Tranfield et al. (2003) and Denyer and Tranfield (2009). This method allows for state-of-the-art analysis and identification of potential research gaps. It is used also for concluding about homogeneity or heterogeneity of research results in the current literature. This research is a qualitative study, and, according to mentioned literature, transparent, replicable, exclusive, aggregative and heuristic research. That is why the main result of this research is a descriptive report in Research results section. The research procedure is described chronologically in Table 2.

Table 2. Research procedure

Phase	Stage
I	Determining the study purpose
II	Determining basic literature
	Selection of publications
	Preparing publications database

[4] Cochrane Collaboration specializes its research in healthcare and medicine. See in: Cochrane (1972).

Phase	Stage
III	Bibliometric analysis
	Content (text) analysis
IV	Preparing a report/paper

Source: (own elaboration based on: Denyer, Tranfield, 2009)

Table 3 presents the process of literature selection and analysis. Firstly, the literature search engines were chosen according to their range and scope. It was decided to choose the biggest engines and, at the same time, often used by researchers to increase the replicability level for other researchers. There were 6 search engines chosen to this research: DOAJ, EBSCOhost, Google Scholar, Infona, ScienceDirect and Web of Science. After this step, the Boolean Logic was used to identify the literature to further analysis. The inclusion criteria were keywords in title and text of research paper. Also, the publication year was taken into account, because the Author decided, that forecasts about future mobility, made before 2009 are not reliable because of constantly changing the global business ecosystem. The other reason was the last global economic crisis in 2007–2009, which changed many areas in world's economy and started new research in areas linked to environmental issues, energy, automotive and many others. This crisis generated huge financial problems in the whole automotive industry (big sales decline, bankruptcies, government financial aid, mass layoffs) and a need to modify supply chain management. Because of these difficulties all previous forecasts were recognized as unreliable. The research process was modified in the case of Google Scholar search engine because of a big amount of results, impossible to analyze during the research process.

Table 3. Process of literature database creation

Literature search criteria	Publication search engine					
	DOAJ	EBSCOhost	Infona	ScienceDirect	Web of Science	Google Scholar*
"mobility" and "future" in title, "city" or "urban" and "automotive" in text; publication year: 2009 and later	5	159	112	30	2	10
Full texts available	1	81	39	26	1	10
After abstracts verification	5	11	17	17	1	9
After removing duplicates	42					
After text analysis	22					

* Due to plenty of results (529), the researcher decided to modify the search and the word "city" included in the title and set the target file type as pdf
Source: (own elaboration)

Only studies that meet the inclusion and exclusion criteria are included in the review. Literature used in this article is based mainly on scenario-related methods. Selected research papers were analyzed taking into account abstracts (in the early phase of selection) and the content (in the later phase). The analysis rules in the last step of literature selection were (in addition to keywords):

– Language of paper – only English language;
– Research method – no restrictions in this area;
– Key findings related to future mobility and, at the same time, automotive industry or car as a mean of transport in the city of the future.

The efforts were made to prepare a report to represent high-quality evidence for the possible roles for the automotive industry in shaping urban areas in the future. Because of a low amount of selected papers a statistical analysis was not a good method to be included in the research procedure. In order to conduct the study, coding and observation sheets were used to unify all issues related to the topic of research, and fragmented in the individual items of literature considered for analysis.

Because of specific nature of systematic literature review in economics, the output of the analysis is heuristic, so contains many suggestions, guides, possible scenarios, trends, possible solutions, useful to solve managerial problems (Denyer, Tranfield, 2009). The results can be used both by practitioners from the private and public sector, as well as by other researchers to prepare their own studies. The aim of this study is stated to meet possible needs of different stakeholders interested in transport development, car development, city residents' mobility and other related areas.

3. Research findings

The chosen research papers were analyzed in order to identify, what are characteristics of future mobility, especially in regard to car usage. Research findings were divided into two parts. The first one is connected with life areas linked to mobility. The second is the main part of research results and describes urban mobility system elements related to the car, and, inevitably, to the automotive industry.

3.1. Life areas linked to urban mobility

As can be observed (see Table 4), according to selected authors' research, future society will be different than today's. Aging population will have an impact on mobility in cities, a lot of elderly people (described today as X generation, born in the 60s and 70s in the twentieth century) will use means of transport to travel within the city. Firstly, they have a driving license in large extent. This is the opposite situation to this of Baby Boomers, born after the Second World War, who couldn't afford a car, presented lower driving license ratio, especially among women. Also, gender gap will be visible – women will be more willing to use public transportation solutions than men. Differences between genders in this area will

be clear and transparent when they will be 50 and more years old. Nevertheless, elderly people will work longer than today, also because longer life expectancy, and if they retire, they will use a wide range of services in the city. That will generate mobility needs and will impact on urban mobility system.

Decreasing number of children (visible now), and in the future – increasing (according to some forecasts) will not change the trend of work emancipation of women. Most of the households will be double-income. Women will need means of transport to commute. Today the development of suburbs is strong, but in the future, more people will be willing to change their place of living into one in the city center to minimize commuting.

Table 4. Habitants' life characteristics in the future city (related to mobility)

Area	Characteristic	Sum	% of analyzed research papers
work	living close to the workplace	4	18.18
	more home-based offices, flexible work time	3	13.64
	teleworking (incl. teleconferencing)	16	72.73
	dual-income households	2	9.09
gender & age	the gender gap in work and using a car	5	22.73
	active elderly people	8	36.36

Source: (own elaboration based on: Howley et al., 2009; Feige, 2010; Dubois et al., 2011; Economides et al., 2012; Desai, 2013; Siren, Haustein, 2013; Wegener, 2013; Cascetta, 2014; Kollosche, 2014; Lennert, 2014; PR Newswire US, 2014; Spickermann et al., 2014; Urban Foresight Limited, 2014; Julsrud, Uteng, 2015; Kammerlander et al., 2015; Lennert, 2015; Shergold et al., 2015; Singh, 2015; Strasser at al., 2015; Thomopoulos, Givoni, 2015; GRID 3.0, 2016; d'Gama Rose, 2017)

When talking about work, people will change their working modes. They will live closer to the workplace if they have to be in the office every day. But, home-office work and teleworking will be spreading both in the developed and developing countries. Flexible work conditions will cause less congestion and adjusting work hours to family life and spouses daily cycle (for example education in the case of children). This will be also one of the causes of women work emancipation.

3.2. Urban mobility issues related to the car and the automotive industry

The role of the car in urban mobility system will change, like the whole mobility system. Urban planning will prioritize more creating space for pedestrians and bicyclists, creating green areas and multimodal transportation model. Special urban mobility systems planning programs will be implemented. This trend is observable also today, for example in Sacramento (USA) (Creating a Sustainable City, 2017), Lisbon (Portugal) (Urban Mobility System Upgrade, 2017), Berlin (Germany) (The Future of Urban Mobility, 2017), Stockholm (Sweden) (Urban Mobility Strategy, 2017) and many other cities.

Future public transport system will be characterized by good access to multimodal infrastructure and by customers – pedestrians and bicyclists, preferring an active lifestyle, sports activities traveling within the city. The new face of transport

infrastructure and accessibility to services are mentioned in the literature as the most crucial factors of the urban transport system (see Table 5). Public transport service providers will have to change their product portfolio to meet the changed needs of customers. They should create a wide range of mobility services, including car renting, bicycle renting, rail transport solutions, but also new pricing procedures (individual pricing, services on demand with flexible, multi-variable price calculation made by smartphone IT applications). In some cases, local authorities can consider free city transport system for all users, for example, to reduce congestion caused by car traffic. Both public and private service providers can offer new mobility services, starting from IT applications or services of planning individual and collective mobility (for example in the case of couriers), extension of today available e-commerce services, IT platforms for carsharing, bicycle-sharing, online payment methods, repair services and insurance packages for fleets, IT services for transport service providers, new applications for mobile devices etc.

A new trend in the city transport system is pursuing to the low carbon, circular mobility. This has two dimensions: low greenhouse gases emission and circulation of assets to use their maximal potential. The role of automotive industry is to ensure right products (cars) to enter into mentioned goals. That is why a new dimension of using a car is necessary. Firstly, the process of using a car will change. There will be high fares for driving and parking, so cars will need to circulate within the city, what will cause rising demand for car sharing and car renting. Also, park & ride systems will be used to avoid these fees by individual drivers, not willing to rent their car while not using it. Secondly, the car itself will need to be more environment-friendly. This aim will be achieved by offering zero-emission vehicles using renewable fuels like electric, solar or hydrogen cells. That is why e-mobility will develop mostly in cities. This will be simultaneous and independent from autonomous mobility increase, which will bring a new comfort standard in traveling, not only to the city but will change drastically demand for taxis in the city. Thirdly, the new segment of cars will emerge – linked to micro mobility, so building the network of small vehicles, shared, rent, connected with each other. This new segment will be a chance and a challenge for the automotive industry, tackling with today's needs for small, ultra-low-cost cars for Asian cities.

Table 5. Urban mobility systems elements (including car-related issues)

Area	Characteristic	Sum	% of analyzed research
urban planning	more green space	6	27.27
	implementing special urban mobility system planning programs	11	50.00
	locating amenities close to residents	5	22.73
public transport system	good access to the public transport (also for suburbs)	16	72.73
	renting of cars and bikes by public transport service providers	6	27.27
	intermodal/multimodal infrastructure	13	59.09
	the free public transport system	2	9.09
	individual pricing for residents	7	31.82
	more rail transport	5	22.73

Area	Characteristic	Sum	% of analyzed research
new mobility services inside and outside the city	maas	7	31.82
	more repair services	1	4.55
	work-, travel- and mobility planning	6	27.27
	IT services	19	86.36
	e-shopping, e-commerce	6	27.27
using a car	low car ownership ratio	7	31.82
	high fees for driving and parking	5	22.73
	high car sharing or car renting	13	59.09
	park & ride systems	7	31.82
vehicles in the city (related to low carbon mobility)	Zero-emission vehicles	14	63.64
	e-mobility, electric vehicles	6	27.27
	autonomous vehicles	9	40.91
	cargo bikes, cycle-sharing, and micro-mobility	10	45.45
	using renewable fuels (electric and hydrogen fuel cells)	11	50.00

Source: (own elaboration based on literature mentioned in the source of Table 4)

The development processes in the product dimension in the automotive industry will be fueled by specific residents' needs and interests while using a car. A car will be not the best mean of transport in the future because of lack of parking places, high fees within the city etc. So the needs of city habitants in order to use a car will change and that will initiate some new solutions, not only in products but also in additional services (see Table 6). Customers will declare such needs as low prices, environmental protection, comfort, luxury and individuality, independence, high quality of life etc.

Table 6. Automotive industry activities in order to meet new mobility demands

Priorities of city residents related to mobility*	Examples of automotive industry activities influencing shaping of mobility patterns
low cost of ownership	Introduction of low-cost car rental services by fleet operators and car owners (peer-to-peer car rental) Reduction of engine capacity, increase in engine economy
environmental protection	Reduction of exhaust emissions in subsequent models Introduction of new types of engines (electric, hydrogen-fueled, fuel cells, etc.) Introduction of solar cars
comfort	Introduction of semi-autonomous and fully autonomous cars (without drivers) Development of IT applications to make driving easier Introduction of automatic parking systems Introducing the Automated Highway Driving Assistant
luxury	Increase in the number of electronic components, including those related to audio and video, and Internet connectivity Increase in the number of product variants (the more expensive segment, the more variants to choose from)
originality, individuality	Increase in the number of product variants (in all segments) Possibility of designing the car by customer himself (prosumer concept)

Priorities of city residents related to mobility*	Examples of automotive industry activities influencing shaping of mobility patterns
speed	Product development towards maximizing vehicle speed Development of communication between the vehicles (Internet of Cars) to avoid obstacles on the route (e.g. traffic jam)
high quality of life	Offering high availability of vehicles within the city Offering high-quality car rental at an affordable price
flexibility	Mobility-as-a-Service (MaaS) solutions Development of carpooling 2.0 (e.g. applications provided by fleet owners) Introduction of on-demand ordering services through e-hailing
product durability	Introduction of multi-variant offer in the field of service and after-sales service
independence	Offering opportunity to use a more or less expensive car without having to purchase it
security	Increase in the number of safety-related components, such as laser obstacle detectors Introducing Adaptive Cruise Control Technology, which allows quickly detecting and avoiding objects while driving or braking the vehicle Introduction of Autonomous Driving Highway, which allows completing transfer of driving to this vehicle
low price	Introduction of ULCC (ultra-low cost car) segment
functionality	Increase in the number of electronic car control systems
entertainment, recreation, self-realization	Extending car's audio and video system functionalities (both hardware and software) Creating an entertainment system for the user of a standalone car

* according to an occurrence in the identified literature
Source: (own elaboration)

There will be few concepts of solutions to meet these requirements, namely introduction of:

– new services based on MaaS concept,
– environment-friendly engines,
– autonomous cars,
– new safety systems,
– new IT solutions based on the Internet,
– more product variants,
– new repair services.

Conclusions

The development of new technologies has an impact on global society. Successive generations are generating new consumer needs, also in the field of mobility. Some similarities and differences can be observed in different world's regions, especially between developed and developing countries, but also between continents. In emerging markets, some trends can be not yet visible because they are still non-saturated markets (Zhao, 2014; d'Gama Rose, 2017). Nevertheless,

regardless of the region, some technologies will inevitably become part of the global automotive market.

Future mobility has a big chance to be connected with electronic vehicles or these fueled by hydrogen, solar energy or fuel cells. On the other hand, opposite forecasts are also available for the automotive industry (Lenz, 2013).

Research presented in this paper showed some similarities in forecasts on future urban mobility systems. Firstly, transport as a part of logistics system in the city (Chaberek, 2002) will be aimed at meeting users' needs related to new dimensions of mobility (primarily the low cost of ownership and environmental protection). Secondly, car usage model will change in the future. Sharing will replace traditional ownership in the city. In rural areas, the traditional model of ownership will still dominate. Thirdly, in the future city, the car will be included in public means of transport, but new mobility service providers will become individuals, new market players, car manufacturers and public transport companies. Fourthly, new mobility patterns in cities will deepen the differences between car usage models in Triad countries, BRICs[5] and others, so despite the similarities in these markets, car manufacturers and mobility service providers will differentiate their offers. Fifthly, because of previously mentioned changes, new business models will emerge on mobility service providers markets, also in the case of the automotive industry. It will be linked to the car itself and also to a wide range of services: mobility services, repairs, insurance etc.

This paper extends current literature by summarizing available research results from different research methods, research procedures, research samples and geographical areas (mostly Triad and BRIC countries). It is valuable to state some research hypotheses linked to trends in urban transport systems in different countries taking into account global trends. They can be a basis for further comparative analysis, statistical analyses, heuristic research, scenario building and others. There are few limitations of this article. Research methodology concerns only papers with particular search criteria, but there are also many other works dealing with mobility management in urban areas. This is only literature review made without any quantitative data and without empirical research. Also, the geographical area covered by the analyzed literature is not complete (no research is available on the African, South American, Central Asian countries, Australia and Oceania countries).

This research paper can be used by both researchers and practitioners. The researchers can address identified research results in their future works. The practitioners can revise mobility management approaches and logistics strategies. Future research should focus on mobility management in megacities, big and middle cities, SUMPs – their creating, implementing and controlling, mobility development according to Industry 4.0, Logistics 4.0 and Mobility 4.0. These and many other issues in mobility area should be addressed in future research.

[5] Triad countries: USA, Western Europe countries, Japan. BRIC countries: Brazil, Russia, India, China.

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Corresponding author

Agnieszka Szmelter can be contacted at: a.szmelter@ug.edu.pl

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Dariusz Weiland

Department of Logistics, Faculty of Economics, University of Gdańsk

BIG DATA AS AN INFORMATION SOURCE IN THE DECISION MAKING-PROCESSES OF THE E-COMMERCE COMPANIES

Abstract

This article discusses the opportunities offered by the use of Big Data in e-commerce and presents this tool as a source of information affecting the decision-making process. Some sections are devoted to introducing and presenting the perspective on information as a resource, while others attempt to define Big Data and outline the way in which Big Data may be utilised as a source of information supply in e-commerce; further parts elaborate on the challenges that information logistics has to face in order to make Big Data more adaptable in e-commerce.

Keywords: Big Data, information logistics, e-commerce

Introduction

The rapid development of information technology is contributing to the ever-increasing growth of e-commerce. Since it is comparatively easy to enter this market and set up one's own business in the virtual space, there is great competition. It is difficult for any corporation to function in such an environment since what has so far been its primary assets now cease to create a competitive advantage. While the e-commerce market was still in its inception, effective marketing strategies were enough to give a company an upper-hand over its competitors, but over time, this stopped producing the desired results. The next stage in the development of e-commerce was attaining the competitive advantage not just by virtue of marketing, but also well-operating logistics; however, as we can now clearly observe, these factors are only enough to keep a company afloat and do not guarantee a permanent competitive advantage. At present, what imparts

a competitive advantage in the e-commerce market is subject to change, hence, being competitive requires the ability to make decisions instantaneously, to deviate from one's habitual strategies and what often amounts to a foundational shift in the basic assumptions lying at the core of a given business (McGrath, 2013). What also makes building a competitive advantage so difficult – except for the rapid growth in the IT sector – are the changes that are happening within the social structure, leading to what is now called an information society and which has its roots in the 90's. This type of society is equipped with modern, highly-developed means of communicating and processing information. Both within and beyond the sphere of e-commerce, there has been a steady trend for the last few years wherein it is the customers who dictate the way companies are evolving, putting forward expectations that said companies find it hard to fulfil. Being able to adjust to these changes depends to a great extent on the ability to make correct decisions, and all the decision-making processes – be it those made by the business owners or the ones made by the customers – are strictly connected to information (Chaberek, 2010). It should thus be noted how crucial information logistics is when it comes to building a competitive advantage. The decision-making process cannot be effective unless it is adequately supplied with certain resources, specifically, information. Hence, information logistics allows one to make adjustments to change more rapidly and expedites the decision-making processes. The primary purpose of this article is to discuss Big Data as a source of information in the decision-making processes of corporations dealing in e-trade. Also in the article presents a collection of tools, which can support the decision-making process for e-commerce businesses.

The article consists of six sections. The first section is an introduction. The second section presents the necessity of considering the information as a resource. The third section contains definitions of "Big Data". This section is based on a review of the "Big Data" literature. Section Four presents "Big Data" as a source of information in the e-commerce sector. In this section, the author presents possible sources of information acquisition and use in e-commerce. This section is based on the author's experience and analysis carried out by the author. Section five presents an analysis of the challenges faced by information logistics. The last section is a summary of the article.

1. Treating information as a resource

Information has to be viewed as a fully-fledged resource as it is actively produced, stored and sold by companies. However, we should bear in mind that it is a very specific type of resource, because information itself has certain unique properties, the most crucial of which are:

- inexhaustible renewability of information (including the possibility to process it without causing its depletion),
- substitutability,
- complementarity,
- objectivity of information,

– its virtual nature,
– synergy of information,
– diversity,
– the possibility to endlessly replicate and move it across time and space,
– subjectivity of assessments.

One of the most important features distinguishing information from other resources is the fact that it does not get depleted whilst processing. This means that it can be accessed by multiple subjects simultaneously without any need to renew it. Another unique characteristic is its virtual nature, which means that it is not permanently bound to any one storage device – it may be stored in multiple places without losing its value to the user. What enables endless replication in time and space is precisely the virtual nature of information – it can be transferred between users and storage devices even across large distances.

Treating information as a resource also requires adequate logistics, which term refers to any intentional human activity, business-related or otherwise. The core idea of logistics is controlling the information flow both within and between cooperating business organisations along the logistics chains and channels (Chaberek, 2002). Currently, every action taken by a company involves a wave of information. The utilization of this information should be done in the most beneficial, efficient and effective way possible. Since contemporary, turbulent economy makes this particularly challenging, the role of logistics is of crucial importance as the factor that rationalizes the rudimentary processes (Szmelter, 2013). What handling information within the logistics framework primarily does is create systems enabling circulation, mining, storage and processing of information; it also ensures that both the primary and auxiliary processes are performed correctly. As a result, a company obtains the tools required to run the processes, as well as adequate technical and organisational solutions. The primary goal of these activities is to accomplish the objectives of logistics in reference to information handling, which includes supplying the appropriate information (that is also of sufficient quality), in the appropriate place and time, as well as at a reasonable cost. In order for the information resource to utilised in a profitable, efficient and effective way, it is paramount to design a system of information delivery within a company. Said system will aid the decision-making processes by supplying the appropriate information (i.e. resource), which is vital for the realisation of this process. It is impossible to acquire the appropriate information resources without establishing their source. By analysing the information that companies dealing in e-commerce are handling, one might observe that only a fraction of it is correctly understood and processed. The information handled by a company may be likened to an ice-berg, of which only a small portion is known, while the rest remains invisible and thus unutilized (Wit, 2008). From the point of view of logistics, it is pivotal to make companies realise the extent of the potential that information holds, as well as to demonstrate the means of its acquisition and processing that aim at building competitive advantage. Big Data is one of the sources of such knowledge, which may be viewed as an information handling tool (once the information supplying system is in place).

2. Big Data

Big Data, just like many other IT terms, may be defined in a number of ways. The available literature offers at least several dozen different definitions, which leads to the conclusion that the development of modern technologies made it compulsory to alter the definitions in consonance with the current situation and the technical and technological possibilities of qualitative and quantitative processing of large cashes of data of various kinds (McKinsey, 2011). One of the most common definitions of Big Data was introduced in 2001 by an analyst working for Gartner. It centres around three primary properties that characterise Big Data: volume, variety and velocity, or '3V' in short (Doug, 2001; Russom, 2011; Kwon, Sim, 2012; McAfee, Brynjolfsson, 2012; Gartner, 2017). It is precisely this definition that has been updated most frequently through the addition of new components, such as veracity (IBM, 2012), variability, complexity (SAS, 2014). The assumption made within the framework of this article is that Big Data equals immense amounts of data displaying such characteristics as volume, variety, velocity, veracity, variability and complexity (Doug, 2001; IBM, 2012; SAS, 2014), and thus requiring modern architectures and technologies to be obtained and processed (Katal et al., 2013) in order to acquire new information relevant for the decision-making processes, which could not have been utilised had they not been aggregated by means of Big Data. Examples definitions of the term "Big Data" are shown in Table 1.

Table 1. Examples definitions of the term "Big Data"

Author(s), date	Attributes
Doug, 2001 Russom, 2011 Kwon, Sim, 2012 McAfee, Brynjolfsson, 2012 Gartner, 2017	3V: Volume, Variety, Velocity
IBM, 2012 IDC, 2012 Oracle, 2013 Forrester, 2012	4V: 3V + Veracity
SAS, 2014	5V + C: 4V + Variability + complexity
Other definitions	
Author(s), date	Definition
Johnson, 2012	Big Data: extremely large sets of data related to consumer behaviour, social network posts, geotagging, sensor outputs
Davenport et al., 2012	Big Data: data from everything including click stream data from the Web to genomic and proteomic data from biological research and medicine
Manyika et al., 2011	Big Data: datasets with a size that is beyond the ability of typical database software tools to capture, store, manage, and analyse
Rouse, 2011	Big Data: description of the voluminous amount of unstructured and semi-structured data a company creates or data that would take too much time and cost too much money to load into a relational database for analysis

Source: (own elaboration based on: Wamba Fosso et al., 2015)

For Big Data to be properly understood, it is crucial to clearly define each of its constitutive features.

'Volume' is characterized by very high dynamics of data acquisition. In 2013, IDC[1] predicted that the amount of global data would rise from 4.4. zettabytes to 44 zettabytes by the year 2020. The current prediction made by IDC estimates that by 2025, the combined data from across the globe will amount to 180 zettabytes. This substantial increase is primarily due to the rapidly growing number of devices that have Internet access. At present, there are approximately 11 billion such devices, which number is estimated to rise to 30 by 2020 and 80 by 2025 (Kanellos, 2016).

'Variety' pertains mainly to the diverse types of data storage devices and such file formats as audio, video, documents, geolocational data, online logins, links to texts, browser queries, etc., all of which derive from a number of different sources (Chang et al., 2006).

The term 'velocity' is to be understood as data that rapidly arises into existence and is characterized by a stream-like flow. The pace at which data is created makes it necessary to constantly update it in such a way as to preserve its value-edgendering properties and its capacity to contribute to the decision-making processes. The pace of data flow has to be divided into two sub-categories, each selectively applied to a different type of streams:

– those data that are newly-created in various places and originate from diverse sources, evolving into an accretion over the already-existing data and data sets;
– and those data that are created as a result of queries made by widely-dispersed users and streams of updates to the already-stored data (Palańska, Wassilew, 2015).

'Veracity' pertains to the matters of trust and uncertainty when it comes to mass data. This hold for both data themselves as well as the results of their analyses (Ward, Barker, 2013). This property is also connected with the value of information. What is meant by 'value' here is the unique information value implicit in large, complex sets of data, which value could not be extracted through a singular analysis of specific items of data (Jinchuan et al., 2013).

The term 'variability' denotes the multiplicity of hidden, potential meanings within the same data sets, which meanings may be extracted depending on the perspective from which said data is analyzed. In other words, certain items of data may yield different information within different contexts of analysis (Vorhies, 2014).

The next property, 'complexity', points to the diversity of data, it covers data organization, data structure, mutual relations and hierarchies of information. By viewing data through the prism of its complexity, it is possible to reveal new, hitherto unrecognized inter-relations between individual items of data.

Proper understanding of Big Data and implementation of mass data sets management within e-commerce may aid companies in coming up to the expectations set before them. Consequently, these companies start building a competitive advantage in both the domestic and international market. If the data sources are

[1] IDC (International Data Corporation) – the premier global provider of market intelligence, advisory services, and events for the information technology, telecommunications and consumer technology markets.

correctly localized, understood and processed, both the customer and the company will find it easier to make decisions (Brown, Chul, Manyika, 2011). The big challenge for the information logistics within Big Data is creating the underlying architecture of information systems that acquire and process these data, and identifying sources from which data may be obtained. Since the number of devices with Internet access is growing and new sources of information are being created, the above definition of Big Data as well its implementations are constantly evolving. Hence, it will be necessary to create systems that will enable adjustments to the ever-changing conditions.

3. Big Data as a source of information in the e-commerce sector

Supplying decision-making processes with information is, to a large extent, dependent on access to said information. In order for the information to arise, it is first necessary to acquire adequate data, which will be turned into information in the course of processing. In literature, very often the word "information" is replaced with related terms such as knowledge or data. The relationship between them is shown in Figure 1.

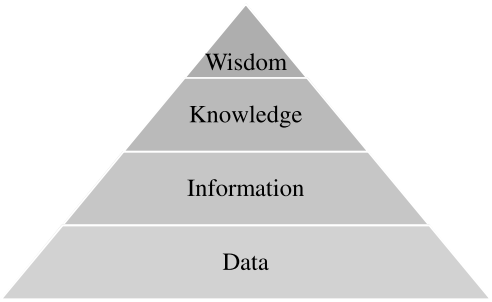

Figure 1. Hierarchy of data, information, knowledge, and wisdom
Source: (own elaboration based on: Heracleous, 1998, p. 155)

The term 'data' encompasses all forms of unstructured, individual facts about a certain object or event. Data may manifest as individual items, which makes their further processing significantly easier, or in data sets (large streams of data), whose processing and rapid changeability require special tools. These might be results of observations or research, raw statistical data or even records of commercial transactions, as well as information pertaining to Internet users – their preferences, interests, etc. Results such as these might constitute raw material used in the process of creating information, which – by contrast with data – has both purpose and meaning. One of the means of transforming data into information is processing it in terms of its intended goal, classifying it, subjecting it to mathematical, statistical and econometrical analysis, and, finally, presenting it visually in form of graphs and charts. While data is being transformed into information,

it is imbued with acquired value, which gives it greater priority and emphasizes its superiority over data.

The e-commerce market in Poland is primarily composed of small and medium-sized businesses, which do not possess adequate financial resources and which often lack the knowledge that is necessary to conduct detailed analyses of information or to implement the usually costly information management systems. However, a properly organized and planned information logistics may allow such companies to build a competitive advantage at a relatively low expense. As previously observed, the information that every e-commerce company has to handle may be compared to an ice-berg. This problem also results from the fact that companies are often incapable of specifying which information is important for them and which is not, they also do not know where information may be obtained from and how to process it. The significance and usefulness of a given piece of information is determined by the following properties: being up to date, relevance, completeness, assimilability and trustworthiness (Bukowski, 2004). The simplest, and yet most commonly underused, sources of information include:

– Google Analytics – this statistics system allows the user to acquire the basic information about the customer, such as: their browsing history, the means through which they found out about a given website, how much time they spent visiting it, what they looked at and how much they spent doing so, what region they accessed it from, what operating system they were using, what are their gender, interests, what were they looking at and clicking. This is one of the first implementations of the Big Data e-commerce technology, and it consists in building algorithms, which recommend goods and services on the basis of prior customer experience, such as the scores they gave to certain products and whether they bought them at all (Cho, Kim, 2004). The next step is to expand on these algorithms by inputting data from Google AdWords and AdSense;
– Advertising systems Google AdWords, AdSense – these make it possible to determine what it is that the customers look for the most, which form of an ad is most effective (graphics, text, video), what the best time to air an ad is and whom the ad attracts – their interests, etc.;
– CRM system – this system allows companies to get to know their customers, build relations with them and strengthen the customer-company bonds. It may also supply information regarding our current customers: who they are, the number of times they contacted us, the time and place of the purchases they made, their birthday, etc. (Kozłowski, Sikorski, 2013);
– Mailing systems – the efficacy of individual topics, which mailings were opened by the customers and when, whether they proved to be effective, what was it exactly that the recipient clicked, what device/software did he use to do this;
– Social Media (Faceboook, Tweeter, etc.) – who is our customer, what did they like, what are their interests, what activities do they engage in;
– Other systems, such as Google Trends, etc.

An e-commerce company will find a variety of applications for the data acquired from the sources listed above. Better adjustments to the pricing across time. Thanks to Big Data and the analysis of data acquired in real-time, it is possible to dynamically

adjust the prices of products to the current situation on the market. Companies have full knowledge of the costs of purchasing the product, as well as of the additional expenses relating to product handling they will have to cover (such as the cost of storage, packaging, transportation, etc.); and thanks to the information acquired through such means as price-comparison websites and applications, a company is able to monitor its prices and those of their competitors, thus becoming better equipped to adjust appropriately.

More efficient utilisation of the advertising budget. Google AdWords and AdSense, to name just a few, made it possible to manage advertising more satisfactorily, as the Google algorithms enable making such adjustments to a given advert so as to make it displayable only to those who are interested in the type of products or services that it is representative of. By obtaining the information about the customer's interests, the websites they frequently visit, their age and combining it with the information acquired through, for instance, remarketing, the advertisement that is displayed on their screen may be perfectly fitted to their needs. Thus, these systems inform the decisions regarding what should be advertised and what form said advertisement ought to assume (text adverts, graphics, video). Additionally, the Cost Per Click system facilitates detailed advertising budget planning, which results in a company paying only for that advertising which proves to be effective, which means the one that attracts potential customers to the shop.

Learning about the clients and their preferences. The analysis of data acquired through such systems as CRM, Google Analytics, AdWords and AdSense, it is possible to get a holistic perspective on the client's sphere of interests. As a result, the decisions regarding, for instance, the release of new products, will be made on the basis of whether the customers are likely to find it appealing and whether it comes up to their expectations.

Creating a personalised offer. Google algorithm-based remarketing allows for the displayed products to be tailored specifically to the customer's requirements. It also furnishes the opportunity to generate networks of related products; for instance, a customer who bought a pair of shoes may be interested in purchasing shoe protection and maintenance products. With the aid of customer information, a personalized sales offer may be designed, one that is informed by both the client's preferences as well as the company's potential to respond to the client's needs.

Optimisation of the sales route. The information acquired through the use of Big Data may facilitate the decision-making processes regarding the sales route. In simple terms, this refers to the path that the customer has to follow in order to finalise their purchase. It is, of course, best if the sales path is optimized in such a way as to meet the customer's expectations. By following customer online behaviour one may acquire the information detailing the specific point at which a given customer refrained from purchase, thus laying the groundwork for the optimization of this precise step so as to encourage them not to quit in the process of completing a purchase.

Improving the management of the supply chain. By utilizing the data from the transportation companies, it is possible to monitor the flow of resources out

of and into a corporation, which enables optimization of said resource flow and close scrutiny of the so-called last mile of the supply chain.

Companies are able to build a competitive advantage through the acquisition and utilisation of information from Big Data. Having the information acquired through Big Data at their disposal, companies are capable of building their advantage. This, coupled with comprehensive understanding of the fundamental nature of today's e-commerce sector and of the expectations that customers have of the corporations, will allow the companies to get ahead of their competition in an ever-changing environment. The primary function of information logistics is to support the decision-making processes on part of the customer and the company. Applying the main objectives of logistics (5R) to information handling facilitates smooth functioning of said processes as well as the accomplishment of the company's goals.

4. The challenges for the application of information logistics in e-commerce

Big Data is undoubtedly of great benefit to the companies that use it, and not just those from the e-commerce sector. Virtually any business organisation can identify the most suitable sources of mass data and process said data into information. Yet despite multiple benefits offered by the utilization of mass data in e-commerce, this tools is burdened with many limitations, which are primarily due to the imperfections of the information technology systems within information supply frameworks. Because the amounts of accessible data are so immense and data themselves constantly undergo rapid change, these systems are often stifled and cannot work to their fullest potential. It is necessary to remodel anew the processes of acquiring, processing and utilizing data for the informational purposes and to transform these models into efficiently working information systems. While a great deal of the data obtained from the Internet are described as open-access[2], there are there also a great number of data that are inaccessible and invisible online[3], generating such data is often very costly due to their large size and the necessity to first establish a suitable data infrastructure (servers, networks, etc.), as well as the need to ensure maximum safety and privacy for the sensitive data (Greenberg et al., 2008). The large size of the sensitive data results in high storage, processing and analysis costs, which makes it necessary to seek new (cheaper) means of storing data, taking into account their nature and properties (such as variability, in-flow pace, etc.). The first step towards solving this problem is to implement appropriate technology, such as Apache Hadoop (hadoop.apache.org). It is an open-source technology – which means it is being created by an open community – it is free of charge, though it is frequently plagued by a number of faults, the primary of which is the fact that

[2] Data that is generally available. It is necessary to have the appropriate skills to "see" and to acquire them.

[3] Deep web data, these data are not indexed by standard search engine algorithms, and therefore are not available in standard search results (Wei et al., 2010).

it may only be used by programmers with a lot of experience. Another downside is that its functionality is limited in terms of the queries that may inputted. Perhaps the coming years and the development of Big Data platform will make it more accessible to regular Internet users, but this cannot happen unless there is strict cooperation between programmers and logisticians.

Another important challenge is data cleansing (also known as data cleaning), which is absolutely crucial whenever multi-source data are utilised. When a business organization is analysing date acquired through the Internet, it cannot differentiate between a product that it itself has on offer and a similar one, but belonging to its competition. This results from a lack of appropriate procedures that would enable identification of commodities sold online. Thus, the data cleansing process very time- and labour-consuming, and constitutes one of the greatest obstacles for the practical implementation of Big Data (Rahm, Do, 2000).

It is not only data storage and acquisition that cause the costs of mass data utilization to be so high, it is the need to process them in order to obtain information. Both basic, descriptive, statistical analysis and more elaborate econometric models may be hindered by the vastness of the amounts of data available and their high degree of changeability.

What also proves to be a problem in many of these cases is current technology and the omission of many significant components of information logistics. However, it is highly likely that once these processes are explored and understood on a deeper level, as well as re-modelled by logisticians cooperating with programmer, the functionality and adaptability of Big Data will vastly expand.

Conclusions

Professional utilisation of the Big Data tool in e-commerce is still plagued by a number of limitations resulting from the fact that this technology is in early stages of development. The tools that are currently used are still insufficiently explored and complicated. Nonetheless, the following report attempted to demonstrate the possibility of implementing Big Data in e-commerce without necessarily incurring great costs. Big Data already is an ideal source of information supply in the decision-making processes. The benefits that Big Data offers for a company include better-informed decisions regarding the selection of products on offer, their prices, advertising costs, client service, etc. It is also of great value to a customer, since a company that can handle information efficiently is able to aid its customers while they are deciding which product to choose, where to buy it, etc.

Further research into the means of acquiring and also processing and analyzing large sets of data may make Big Data more successful in future, thus creating something that not only bolsters e-commerce and constitutes a source of information, but also shapes new strategies in the e-commerce sector.

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Corresponding author

Dariusz Weiland can be contacted at: d.weiland@ug.edu.pl

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Grzegorz Lewandowski

Faculty of Economics and Marketing in Bydgoszcz, WSB University in Toruń

A BICYCLE AS A COMPLEMENTARY ELEMENT OF URBAN LOGISTICS

Abstract

The fact that public transport, with particular regard to the urban logistics, experiences difficulties in numerous Polish cities indicate there is a need to refine a transport network using an alternative mean of transport which is a bicycle. It is necessary to limit usage of traditional means of transport in favour of solutions generating zero emission of exhaust fumes. One such solution is bike & ride + bicycle & bike system. It was introduced in Bydgoszcz and now the bicycle is a complementary element of urban logistics.

Keywords: a bicycle, public transport, ecology, logistics

Introduction

One of the major problems, which modern towns need to face, is heavy traffic and hundreds of cars blocking the streets. Traffic capacity of the available road infrastructure hinders the number of vehicles which leads to congestion on the roads. In consequence, the smog, caused by large numbers of cars stuck in traffic jams, appears to be another problem. Therefore, the construction of modern transfer points where bicycles rental is possible seems to be a reasonable solution. There is a good chance that an increase in the awareness of people who use such mean of transport could contribute to the limit of exhaust fumes and positively affect the air people breathe in Poland. The presented study aims to present both issues concerning using bicycles as the alternative mean of city transport, as well as implementing necessary innovations at the level of Polish provincial cities. The following informations have been collected by the author as a single-case study, which should prompt the reader to reflect on his or her everyday surroundings.

1. Changes in public transport functioning in a city

The heavy traffic cannot be handled by the city roads anymore. It is one of the greatest challenges which people managing urban infrastructure have to deal with. The strongest congestion[1] is observed in highly urbanised areas and, especially, during the, so called, peak traffic – between 7 a.m. and 9 a.m. which is the time when people commute to work. The consecutive rush hours take place between 4 p.m. and 6 p.m. when people return to their homes. The most frequent reason why congestion happens is an enormous increase in the number of cars used by individuals. Moreover, people tend to move to the outskirts, what, in consequence, leads to the high extension of the city areas. The society is becoming lazy and, because of long hours usually spent at work, people do not always have time to do some shopping (Stangel, 2013). In order to deal with that problem, they use all the available services offered them by the supermarket chains, such as a home-delivery service. The number of operations carried by delivery vehicles is so great that, regularly, it is impossible to find a free parking space in residential areas. The same can be claimed as far as public transportation is concerned. Finally, the number of single-track vehicles (scooters, motor bicycles, or motorcycles) is growing all the time.

The bicycle rental network is enjoying a huge recognition and it is used by millions of recipients every year. In such a situation, it seems to be logical to include the bicycle as an alternative mean of transport into the urban logistics network. The bicycle rental points, which are created all over Poland, have numerous supporters. The registration does not take long and the possibility to use them on the area of the entire city gives the users many benefits, like: no need to own a bicycle, no money necessary to buy or service one, as well as no risk of theft. In Bydgoszcz, there are 37 bicycle rental points where one can rent one of 15 available bicycles. At rational using the time given, it is achievable to travel across the city without any extra fees. The rental points are located in such a way that 20 minutes is just enough time to cover the distance from one station to the other (Guzman, 2010)[2] . When cyclists are tired, they can always use public transport network which includes modern buses and trams connected in a way that it is possible to change the vehicle without any problems. Additionally, on the Brda River, there are also water trams available.

Among the most common systems of commuting involving bicycles, the following ones can be distinguished:

– bike & ride – a combination of a bicycle travel with public transport; commuting to work, school, for shopping, and the like;
– ride & bike – a travel starts with getting to a bicycle rental point by public transport and then continues by bicycle;

[1] Congestion is an increase in the number of vehicles on roads and the traffic intensity. It is the, so called, "road paralysis", caused by blocking certain parts of roads. In transportation, it is connected with the increase in the number of cars at certain periods of time. In the transport of cargo, the congestion is the most frequently observed in the case of seasonal freights. Source: (www 1).

[2] See also how the bike-renting systems looks like in other countries.

– bike & ride + bicycle & bike – a travel from home to the public transport station by bicycle, transporting the bicycle and continuation of the travel by bicycle.

Following the clients' expectations, bicycles adjusted to any situation appeared on the market. Their construction allows the user to quickly travel across the city but, if the need be, it is possible to quickly convert them into a handy suitcase and travel by public transport (Midgley, 2011)[3]. It has been calculated that the average distance traveled by bike by bike renting places in Bydgoszcz does not exceed 3 km (Pucher, 2008)[4]. In the context of City Logistics, Smart City (Midgley, 2011), Green Logistics taking advantage of the possibilities offered by bicycles seems to be an important issue as far as public transport logistics is concerned (Tundys, 2011).

The data published by Warsaw Public Bike Veturilo shows the changes in the demand for using rented bicycles over a span of several years. As presented in the Table 1, at the beginning of 2013 there were about 1 million rentals, whereas in 2016 their number reached 6 million – it shows the scale of the phenomenon.

Table 1. The level of bicycle rentals in Warsaw 2013–2016

1 million rentals noted by the Veturilo system on 23rd June 2013
2 million rentals noted by the Veturilo system on 8th October 2013
2.5 million rentals noted by the Veturilo system on 17th April 2014
4 million rentals noted by the Veturilo system on 28th October 2014
5 million rentals noted by the Veturilo system on 23rd June 2015
6 million rentals noted by the Veturilo system on 29th April 2016

Source: (www 2)

Bicycle is also a great challenge for the producers of cycling equipment, clothes or additional car equipment. Various roof-racks or carriers installed on towing hooks ensure safe car travelling with bicycles during holiday travels. It also needs to be added that because of the lack of precise data regarding the amount of cycle paths and traveled kilometers in relation to different types of vehicles it is not easily possible to make a comparative analysis.

2. Cyclists safetyin regard to the cost of accidents

But for the right road infrastructure, the systems presented above would not be able to provide efficient services to the bicycle users. There are more and more cycling lanes in Polish cities and that allows much safer travelling on the roads. The awareness of the single-track vehicles users is increasing as well and, as a result, there are fewer accidents in which they are involved. However, according to the data published in the cyclists' safety in Poland report of 2016, the cyclists were involved in 4737 accidents. There were 271 casualties (cyclists only) and 4298 injured (4276 were cyclists and 22 car passengers). Compared to the previous year, the number

[3] See also what the amount of cycle paths is in other countries.
[4] See also the average length of the rides in other countries.

of accidents involving cyclists increased by 103 (2.2%) (www 3). The most common reasons of accidents are:
– ignoring the right of way – 615 accidents,
– inappropriate turning – 215 accidents,
– inappropriate speed to the driving conditions – 136 accidents.

According to the report the highest number of people involved in bike accidents are those belonging to the 60+ group who are not always able to properly asses the road conditions. In 2016, they were involved in 479 road accidents. Another group of casualties are children between 7 and 14 years old – there were involved in 286 accidents. The most common reason of accidents with children is the complete lack of knowledge concerning traffic regulations.

Table 2 presents road accidents perpetrators. 6% of them were riding bicycles. They are also responsible for 6% of casualties. However, in accidents with bicycles involved, it is not always the cyclist who is to be blamed. Hence, it is important to constantly inform about possible risks which can be encountered on the road. It is probably best understood by people who travel using both bicycles as well as cars.

Table 2. Road accidents according to the vehicle of the perpetrator

A vehicle of an offender		Accidents	%	Killed	%	Injured	%
A motor car		22 134	76.1	1657	72.5	28 342	78.4
A bicycle		1778	6.1	139	6.1	1703	4.7
A motor bicycle		731	2.5	54	2.4	762	2.1
A motorcycle		823	2.8	132	5.8	801	2.2
A motorcycle with the capacity to 125 cm^3		172	0.6	16	0.7	176	0.5
A bus	public transport	318	1.1	11	0.5	452	1.3
	other	101	0.3	4	0.2	156	0.4
A heavy-loaded truck	gross vehicle weight rating to 3.5 t	1297	4.5	122	5.3	1643	4.5
	gross vehicle weight rating above 3.5 t	904	3.1	108	4.7	1165	3.2
An agricultural tractor		118	0.4	16	0.7	133	0.4
A quad bike		32	0.1	6	0.3	33	0.1
A light quad bike		19	0.1	3	0.1	17	0.0
An emergency vehicle		3	0.0	–	–	8	0.0
A tram, trolleybus		51	0.2	1	0.0	104	0.3
Other vehicle		68	0.2	4	0.2	79	0.2
An unspecified vehicle		532	1.8	11	0.5	576	1.6

Source: (www 3)

Taking into consideration data from the chart above, it can be concluded that it is the result of the huge scale of bicycles popularity. The reasons of accidents mentioned above are just a few of many. In many situations the people involved in the accident failed to think and foresee possible consequences. According to the report the main reason for the majority of accidents and collisions is the lack of the knowledge concerning traffic regulations. When it comes to children at the school age, they have to do various tasks and finish a courses in order to get

a "bicyclist's licence". Unfortunately, in case of adults, who want to travel using a bike, only an ID is necessary and having one is in no way a guarantee of skills and knowledge when it comes to travelling on public roadsEvery traffic incident involving cyclists is associated with significant costs, often arising to more than a few thousands of zlotys, and emergency services participation. According to the author, the relevant solution to this problem would be introducing obligatory civil liability insurance (OC) for cyclists. The insurance would cover a part of rescue actions and rehabilitation costs.

3. Cyclists and ecology

Travelling by bicycle has become an important element of urban logistics. Persuaded by others to actively participate in the social life, people try to follow the so-called "fashion". According to the author, it is a very positive fashion as it offers numerous benefits provided that one follows it in a sensible way. It is not enough to buy a good bicycle, fashionable accessories and an app for counting the kilometres ridden on the bike. First and for most it, it is important to realize what the benefits of using a bicycle are. It neither uses fuel nor does it produce exhaust fumes, it takes less space than a car, allows one to burn some calories and makes one feel better. In Picture 1 one can see the author of the article who in 2016 rode 4000 km on his bike, whatever the weather. If one assumed that the average fuel consumption of a average class car is 7 litres per 100 km, it would turn out that the author saved about 1400 PLN.

Figure 1. A bicycle in practice
Source: (Grzegorz Lewandowski's private records)

All the presented issues make one wonder what the future of bicycles and cyclists might be. Local authorities are aware of the fact that cycling is not only beneficial

for citizens' health but it also contributes to making the roads more passable. This is why in so many places the authorities try to increase the bicycles participation in transport as it may be the solution for the problem of congested roads. Using a bicycle as a daily mean of transport is definitely a healthier and better choice for both the cyclist as well as for the environment. However, the question is whether or not the bicycle has not become a threat for the cities' income connected with the parking fees and public transport tickets. Taking into consideration the data concerning the number of bicycle rentals, not only in Warsaw but also in many other Polish cities, one can agree with such a claim. The author's personal experience can be used as an example. Because of health problems the author was forced to use his car in the period from December till the end of March. The cost of using the car was, on average, 450 PLN a month. Based on this example, it is clear what impact on economy travelling by bicycle has.

Conclusions

A greater access to cycling lanes creates a need for adjusting modern technologies to the existing infrastructure. A connection with the existing public transport, providing rest places with amenities, parking spaces for bicycles or toilets and places where cyclist could have a snack while travelling is of vital importance. Another thing is making other users aware of interdependence on the roads. The streets are not a place where one fights for survival as cyclists are on a lost position in a confrontation with cars. To achieve success, a coordinated system of cycling lanes safe for cyclists, pedestrians and car drivers should be created. The current regulations concerning using cycling lanes by rollerblades and skateboarders should also be analysed. What can also influence the road safety is supporting alternative means of transport and developing an educational program for schools. Bicycle is becoming more and more popular due to its mobility in the urban logistics (Stangel, 2013). The influence of modern technology, business development and an increase of the demand for bicycles usage is one of the elements stimulating the economy. Due to high level of pollution in cities, especially during summer months, it is reasonable to promote using bikes as a main mode of transportation. To make this happen cities should make an effort to expand already existing and create new safe cycle paths.

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Corresponding author

Grzegorz Lewandowski can be contacted at: grzegorzl@wsb.torun.pl

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