

UTILISATION OF TECHNOLOGIES AND INNOVATIONS IN LOGISTICS OF AUTOMOTIVE ENTERPRISES

*KLAUDIA GUBOVÁ

University of Economics in Bratislava, Faculty of Business Management, ^aDepartment of Production Management and Logistics, Dolnozemska cesta 1, 852 35 Bratislava, Slovak Republic
email: ^aklaudia.gubova@euba.sk

The article is a partial output of research project VEGA No. 1/0375/20 „New dimension in the development of production management and logistics under the influence of Industry 4.0 in enterprises in Slovakia“.

Abstract: In the thriving enterprise, logistics ensures continuous flow and speed of all processes, from the moment of obtaining materials, through their processing up till the product delivery for acceptable price to the customer. The fulfillment of these requirements is not easy and requires a sophisticated logistics system involving the use of innovations that help improve and streamline processes such as transport, transfer, handling, storage, management of packaging. The main objective of the paper is based on the study of theoretical knowledge and the implementation of a questionnaire survey, to determine and analyse the utilisation of selected technologies and innovations in logistics of automotive enterprises.

Keywords: logistics technologies, logistics innovations, Supply chain management, Cross-docking, logistics outsourcing

1 Introduction

In today's dynamically developing world there are many economic, social, technical and political changes. Their nature and extent is determined by factors influenced by economic development and economic growth. As a result of globalization, there is a sharp increase in competition. Globalization of markets and business brings the same prerequisites for access to information, resources and technology. We see that the "world" is getting smaller and distances are minimized by information and communication technologies (Richnák, 2015a).

In today's revolutionary conditions, logistics technologies are a prerequisite for efficient results in business management in the form of economy and efficiency. Their use and continuous improvement must be one of the necessary management activities in the enterprise. Nowadays we are witnessing a different theoretical understanding of logistics technologies and the use of a wide range of technologies by enterprises (Richnák, 2020b). Entrance of internet and dynamic technics expansion supported growth of space for service innovations. Nowadays, the biggest competitive strength is hidden in information. Information moves the world of innovations. Innovation is an enormous power, an important factor for survival, growth and business prosperity. Innovation is now recognized as the key to bridging the gap between technology and business strategy. Innovations are fundamental source of economic growth in society. Sources of innovation are considered to be human activities, thinking, changes in intellectual character, changes in human knowledge, those are new inventions, discoveries, knowledge in scientific-technological development. Term used to name all these processes is invention (Leščišin, 1979). Innovation is defined as „every change in the organism (product, service, technology, organisational structure, etc.) in the company which tends to its new stage (Molnár, 2015). Theory of innovation was established before World War I by J. A. Schumpeter, who clarified reasons why businesses innovate and what are the reasons for technological changes. His explanation was supported by studies and he reasoned as follows: „ The reason is an achievement of regular income, as new materials, technical means, technological advancements and processes represent certain advantage for businesses. Result of innovative processes, activities are lower expenses created by higher productivity resulting from process innovation, in cases of patents of innovated product, company might achieve monopoly position, which enables them to determine higher price (Heřman and Hezina and Zeman, 2002).

Recently, there have been significant changes and advances in logistics. Its competences within the company have gradually

expanded and have taken on more and more activities, thus beginning to fulfill an essential role in the management of the company. Globalization, economic changes, turbulent development of information and communication technologies, automation of production, development of industrial revolutions, especially the Fourth Industrial Revolution contributed to the new form of logistics (Richnák, 2019c).

2 Literature Review

Effective Supply Chain Management (SCM) has become a potentially valuable way of securing competitive advantage and improving organizational performance since competition is no longer between organizations, but among supply chains.

The main aim of Supply Chain Management is an integration and management of supply chain which represents all organisations and activities connected with the flow and transformation of goods from material to final customer. In supply chain we can find material and information flows. Within Supply Chain Management businesses cooperate via effective business systems with an objective to decrease logistics expenses, disbursements, investments while satisfying needs of final consumers (Handfield and Nichols, 2002).

Effective design and management of supply chain networks can cut costs and enhance customer value. The supply chain can be a sustainable source of advantage in today's turbulent global marketplace, where demand is difficult to predict and supply chains need to be more flexible as a result. The real competition today is not between companies, but between supply chains. The winning approach to supply chains is an integrated perspective that takes account of networks of relationships, sustainability and product design, as well as the logistics of procurement, distribution and fulfilment. Supply Chain Management is a network of facilities that produce raw materials, transform them into intermediate goods and then final products, and deliver the products to customers through a distribution system. The management of the supply chain and the roles of various actors involved differ from industry to industry and company to company. As a result Supply Chain Management (SCM) has become a vital issue for manufacturers, professionals and researchers. It is felt that to manage the supply chain effectively entire structure of supply chain must be understood properly (Shukla and Garg and Agarwal, 2011).

Cross docking is a distribution system where products are not stored, but they are translated and delivered as quickly as possible. It was first used by large business chains, later expanded into the food and automobile industries. It is currently being extended to other sectors. It has several different forms. It has several different forms. Different forms of Cross docking cause content and scope differences in the definition because they relate to the distribution chain or focus on the cross-docking center (Richnák, 2018d).

Implementing a cross-docking warehouse for perishable product distribution improves food distribution, reduces the cycle time of the delivery and improves customer service level. "Cross docking is a warehousing strategy that involves movement of material directly from the receiving dock to the shipping dock with a minimum dwell time in between. Cross docking can effectively bring substantial reductions in the transportation cost without increasing the inventories while simultaneously maintaining the level of customer service. Cross docking can also lead to the reduction of order cycle time, thereby improving the flexibility and responsiveness of the distribution network (Apte and Viswanathan, 2010).

Rajesh (2009) defines cross-docking as distribution process, where products are not stored, but they are reloaded and dispatched further as quickly as possible. At first it was employed by big business chains, later it spread into food and

automobile industry. Currently it is widely spread within other industries as well.

With the help of cross-docking, it is possible to transport goods that allow easy and fast handling, have the same shape and are sufficiently packaged. By means of a standardized handling technique, it is possible to flow as quickly as possible from receipt to the next dispatch, which is why boxes and pallets are used in handling. It is possible to transport with the help of cross docking mainly goods with constant demand, or its small change, it is, for example, drugstores, food, beverages and other consumer goods, which are intended primarily for retail (Richnák, 2014e).

In cross-docking, shipments typically spend less than 24 hours in a cross-dock. The purpose of cross-docking includes reducing inventory costs, increasing inventory turns, consolidating transportation, increasing throughput and reducing operation costs associated with eliminating unnecessary handling and storage. It also offers a way to increase inventory velocity (Li et al., 2012). Vendor-managed inventory (VMI) is a collaborative strategy between a buyer and supplier to optimize the availability of products at minimal cost. Overall, inventory management cost plays a significant role in reducing supply chain cost. Specifically in the fast-moving consumer goods (FMCG) sector, inventory–turnover ratio needs to be very high to compete in the global market. Throughout the supply chain, VMI is used to cut inventory-related costs and keep inventory levels low. VMI helps organizations to reduce the inventory-associated costs by shifting the responsibility of managing and replenishing inventory to vendors (Singh, 2013). J. Van Belle and P. Valckenaers and D. Cattrysse (2012) described “as the process of unloading freight from inbound vehicles and loading these goods into outbound vehicles, with minimal handling and with little or no storage in between one of the most popular logistical strategies.

Dupaľ and Richnák (2017) point out new trends in the sale of products, such as online shopping or adapting production according to customer requirements, increasing the share of logistics in the success or failure of the company. Logistics is the area in which a company can gain a competitive advantage.

In cross-docking, goods are first classified as per the demand at the respective destinations and then are reloaded into the corresponding outbound transport vehicles. This strategy has several advantages such as reduction in total inventory costs and lead time, enhanced customer service levels and improvement in the supplier relationships. Cross-docking centres are dynamic environments where products arrive, are regrouped, and leave the same day (Vis and Roodbergen, 2008).

Today, the logistic outsourcing is developing in an industrial environment marked by a strong commercial uncertainty (Wang and Yeung and Zhang, 2011). Business Process Outsourcing (BPO) is a program that has become popular in the past decade. It involves contracting with external suppliers to perform work previously done in-house. Much of the motivation has been to reduce the cost of performing the activity and reducing the investment in resources to perform the activity internally. Outsourcing, especially offshore outsourcing, has become one of the most discussed business activities during the first decade of the twenty-first century (Crandall and Crandall, 2015).

Stankovský and Cibulka (2011) say that logistics outsourcing is enhanced especially in fields of acquisition, distribution and reverse logistics. Acquisition and distribution covers mainly utilisation of transportation services. The reason is mainly growth of transportation complexity, only number of businesses is capable to operate their own fleet and appertaining personnel. Outsourcing of reverse logistics regards management of waste management, utilisation of leftover stock, recycling materials from returned non-functional products and repairs of repairable non-functional products. Within reverse logistics processes, to a certain degree, it is also possible to secure entering production materials, while they take part in roles of acquisition logistics. By outsourcing logistics activities, companies can achieve

economies of scale and thereby reduce financial risks. The investment in logistics assets, the example of the platforms, necessarily requires a considerable amount of agent, which implies a high financial risk. The reduction in the costs of logistics outsourcing comes mainly from the best use of capacity and the best allocation of capital (Kalinzi, 2016).

3 Methodology and data

The main objective of the paper is based on the study of theoretical knowledge and the implementation of a questionnaire survey, to determine and analyse the utilisation of selected technologies and innovations in logistics of automotive enterprises in Slovakia.

The questionnaire survey was attended by 80 automotive enterprises operating in Slovakia. Large enterprises in the automotive industry obtained the largest share of 39.8%. Medium-sized enterprises dominated in the automotive industry with a share of 37.2%. Small enterprises were represented with a share of 23%.

Table 1: Structure enterprises by business size

Business size	Percentage
Small	23%
Medium-sized	37.2%
Large	39.8%

Source: *own processing*

The objective of the paper was achieved using several research methods. In the processing and comparison in the theoretical part of the paper, we used literature search, analysis and synthesis, induction and deduction, comparison and scientific abstraction. In the Results and discussion chapter, we used the query, sorting method and elimination method.

On the basis of the main objective of paper was determined and tested following hypothesis:

H₀: There is no statistically significant dependence on the level of significance $\alpha = 0.05$ between the use of cross-docking and the improvement of distribution logistics.

H₁: There is a statistically significant dependence on the level of significance $\alpha = 0.05$ between the use of cross-docking and the improvement of distribution logistics.

Calculated testing characteristics (Chi-square = 11.98) was compared with 95 percentile χ^2 – division with $(r - 1) \cdot (s - 1) = (3 - 1) \cdot (3 - 1) = 4$ degree of freedom $\chi^2_{0.95}(4) = 9.487729$.

Based on the hypothesis testing, we conclude that there is a statistically significant dependence on the level of significance $\alpha = 0.05$ between the use of cross-docking and the improvement of distribution logistics, thus accepting the H₁ hypothesis and rejecting the H₀ hypothesis.

4 Results and discussion

From the results of the survey, we would like to point out that enterprises operating in the automotive industry use new technologies and innovations in logistics with a share of 82%. Only 18% of automotive enterprises do not use new technologies and innovations in logistics. The reasons given were a lack of funds and a lack of qualified staff. Based on Table 2, we can see the percentages of the use of new technologies and innovations in logistics according to the size of automotive enterprises. Large enterprises use new technologies and innovations in logistics with a share of 77.8%. Medium-sized enterprises use technologies and innovations in logistics with a share of 16.6%. Small enterprises in the automotive industry use technologies and innovations with a share of 5.6%. New technologies and innovations in logistics are not used by small enterprises with a share of 72.6%. Large enterprises do not use technologies and innovations with only a share of 7.6%.

Table 2: Utilisation/non-utilisation of technologies and innovations

	Small enterprises	Medium-sized enterprises	Large enterprises	Total
Utilisation of technologies and innovations	5.6%	16.6%	77.8%	100 %
Non-utilisation of technologies and innovations	72.6%	19.8%	7.6%	100 %

Source: *own processing*

Based on the results of the questionnaire survey, automotive enterprises with the largest percentage of 65.8% use supply chain management. Respondents with share of 19.2% use cross-docking. The small enterprises use logistics outsourcing with share of 15%. In terms of the size of automotive enterprises, the use of selected technologies and innovations is different. Large enterprises use supply chain management with a share of 60.9%, cross-docking with a share of 53.2% and logistics outsourcing with a share of 41.8%. Medium-sized enterprises from the automotive industry use supply chain management with a share of 35.9%, cross-docking use with a share of 39.5% and logistics outsourcing with a share of 48.4%. Small enterprises from the automotive industry use supply chain management with a share of 3.2%, they use cross-docking with a share of 7.3% and logistics outsourcing with a share of 9.8%. The individual percentages are shown in Table 3.

Table 3: Technologies and innovations in logistics according to the business size

	Small enterprises	Medium-sized enterprises	Large enterprises	Total
Supply chain management	3.2%	35.9%	60.9%	100 %
Cross-docking	7.3%	39.5%	53.2%	100 %
Logistics outsourcing	9.8%	48.4%	41.8%	100 %

Source: *own processing*

Enterprises from the Slovak automotive industry that operate in production use supply chain management with a share of 78.6%. Enterprises providing services in automotive use supply chain management with a share of 13.2%. Trade enterprises use supply chain management with a share of 8.2%. Cross-docking achieved the largest percentage in trade (49.7%). In production, cross-docking has a share of 42.9% and in services it has a share of 7.4%. Logistics outsourcing is mainly used by production enterprises with a share of 68.8%. Enterprises providing services in automotive use logistics outsourcing with a share of 16.8%. Trade enterprises use logistics outsourcing with a share of 14.4%.

Table 4: Technologies and innovations in logistics according to business activities

	Production	Trade	Service	Total
Supply chain management	78.6%	8.2%	13.2%	100 %
Cross-docking	42.9%	49.7%	7.4%	100 %
Logistics outsourcing	68.8%	14.4%	16.8%	100 %

Source: *own processing*

Selected technologies and innovations in logistics of enterprises from the automotive industry were related according to business logistics fields. We can see from Table 5 that supply chain management is used in production logistics with a share of 62.3%. The use of logistics outsourcing also obtained a high percentage (60.8%) in this logistics. Cross-docking is used in production logistics with a share of 23.3%. The use of supply chain management dominates in procurement logistics with a share of 17.8%. Logistics outsourcing is used with a share of 11.2%. Automotive enterprises use cross-docking in procurement logistics with a share of 4.1%. In distribution logistics, the use of cross-docking with a share of 72.6% predominates. Logistics outsourcing is used by automotive enterprises with a share of 28% in distribution logistics. Supply chain management is the least used in distribution logistics with a share of 19.9%.

Table 5: Technologies and innovations in logistics according to business logistics fields

	Production logistics	Procurement logistics	Distribution logistics	Total
Supply chain management	62.3%	17.8%	19.9%	100 %
Cross-docking	23.3%	4.1%	72.6%	100 %
Logistics outsourcing	60.8%	11.2%	28%	100 %

Source: *own processing*

For respondents, we noted that the most common value (5) recorded supply chain management. Cross-docking reached a mode value 0. Logistics outsourcing achieved a value of mode 0. The highest value of the average (2.57) achieved supply chain management. Cross-docking achieved the smallest average value of 1.45. Supply chain management achieved a median value of 4. Logistics outsourcing obtained a median value of 1. Values are the most concentrated by supply chain management, the standard deviation reached value of 2.19. Values are the least concentrated by cross-docking, the standard deviation of this technology achieved value of 1.53.

Table 6: Descriptive statistics

	Mean	Median	Mode	Variance	Standard deviation
Supply chain management	2.57	4	5	4.80	2.19
Cross-docking	1.45	0	0	2.35	1.53
Logistics outsourcing	1.79	1	0	4.08	2.02

Source: *own processing*

The use of technologies and innovations in logistics also affects logistics processes. Table 7 shows the percentages for selected logistics processes. We can see from Table 7 that the use of technologies and innovations in automotive enterprises affects transport with the largest percentage (29%). Logistics processes also achieved high percentage values in inventory management (27%) and in customer service (23%). Material handling affects enterprises with a share of 14%. Enterprises operating in Slovakia in the automotive industry are influenced by packing with a share of 7%.

Table 7: Logistics processes

	Percentage
Customer service	23%
Inventory management	27%
Transport	29%
Material handling	14%
Packing	7%

Source: *own processing*

Table 8 summarizes the mean, median, mode, variance and standard deviation. Enterprises most often marked the value 5 in inventory management. Customer service achieved a mode value of 4. Material handling obtained a value of mode 3. Value of median 4 was reached in customer service. The median value (3) was reached in inventory management and material handling. Table 8 shows that values are the most concentrated by customer service. The standard deviation obtained value 1.96. Values are the least concentrated by packing, where the standard deviation obtained 0.95. Customer service achieved the maximum value of the average 3.06. Packing obtained the minimum value of average 1.93.

Table 8: Descriptive statistics

	Mean	Median	Mode	Variance	Standard deviation
Customer service	3.06	4	4	3.84	1.96
Inventory management	2.95	3	5	3.57	1.89
Transport	2.58	1	0	3.39	1.84
Material handling	2.36	3	3	2.76	1.66
Packing	1.93	0	2	1.10	0.95

Source: *own processing*

5 Conclusion

In Slovakia, automotive industry has the biggest representation on a market, representing „an engine“ of the Slovak economy for several years. Strength of automotive industry is reflected in the decreasing unemployment rate in Slovakia. The current news

regarding construction of new enterprises in Slovakia state that demand for qualified workforce in logistics keeps growing, as new businesses have not only their own logistics, but many of them utilise the growing network of logistics centres.

Technologies and innovations in logistics activities are situated in the middle of dynamic changes and enterprises must managed and followed them continuously during common daily routines. It has a significant impact on performance and effectiveness of production. World has changed dramatically in a relatively short time, and businesses focus on management of supplier chains. In approximately last three decades, since the phrase „management of supplier chain“ appeared for the first time, we have witnessed an important trend of globalised supplier chains, while activities which used to be performed internally are now ordered externally, being accompanied by a dramatic growth of changes in business environment, which creates higher level of uncertainty in demand and offer.

The results of the survey show that automotive enterprises in Slovakia use 82% of technologies and innovations in logistics. With large enterprises dominating with the share of 77.8%. Automotive enterprises with the largest percentage of 65.8% use supply chain management. The small enterprises use logistics outsourcing with the share of 15%. Enterprises from the automotive industry that operate in production use supply chain management with the share of 78.6%. Automotive enterprises operating in services use at least cross-docking with the share of 7.4%. The use of cross-docking predominates in the distribution logistics of automotive enterprises with the share of 72.6%. The small enterprises use cross-docking in procurement logistics with the share of 4.1%. The importance and position of distribution logistics and the use of cross-docking were also confirmed by the tested hypothesis. At the level of significance $\alpha = 0.05$ is a statistically significant dependence between the use of cross-docking and the improvement of distribution logistics. The use of technologies and innovations in automotive enterprises is influenced by transport by the largest percentage (29%). The small enterprises operating in Slovakia in the automotive industry are affected by packing with the share of 7%.

The proper functioning of small and medium-sized enterprises, which represent great potential, is important for the proper development of the economy, but their operation faces many pitfalls, which include, in particular, inadequate financial conditions for their development (Richnák, 2016f). Today's dynamic business environment brings with it a range of logistics technologies. Every enterprise has to realise that its competitive advantage in the market is not only lowering production costs and improving product quality, but also focusing on the employees themselves, so it is important to choose a logistics technology that not only increases productivity but also helps development of motivation and creativity of employees (Richnák, 2019g).

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