



## REDESIGNING SUPPLY CHAIN NETWORK OF A LUBRICANT COMPANY: AN INNOVATIVE APPROACH

Sharfuddin Ahmed Khan<sup>1</sup>, Hanna Sawicka<sup>2</sup>

1) University of Sharjah, Sharjah, **United Arab Emirates**, 2) Poznan University of Technology, Poznan, **Poland**

**ABSTRACT. Background:** The purpose of this paper is to redesign the supply chain network of a lubricant company by implementing an innovative solution concentrated on the delivery of products and minimizing total loading, unloading and transportation costs.

**Methods:** In this paper the authors' approach to redesigning the supply chain network (SCN) is presented. It comprises 3 phases: analysis of the current state of the SCN, identification of disadvantages in the SCN and SCN improvement. This step-wise procedure is verified on a real-world supply chain network, which is analyzed, evaluated and redesigned. Based on this analysis, the most important strengths and weaknesses are identified. The main criteria for evaluation are loading, unloading and transportation costs. A redesign of the company is proposed, the stakeholders' opinions are gathered and the innovative solution is implemented.

**Results:** After successful implementation of the innovative solution, the result shows savings in loading, unloading and transportation costs and an improvement in the level of service.

**Research Limitations:** The proposed methodology can be implemented in other supply chain networks. However, the way of limiting the loading, unloading and transportation costs presented in this paper cannot be regarded as a general rule applicable to all companies.

**Conclusions:** This study presents innovative thinking in the logistics network of a company and the results obtained prove that companies which are innovative in terms of products can also become innovative in their services.

**Key words:** Innovation, Logistics, Transportation, Supply Chain, Lubricants.

### INTRODUCTION

Nowadays, innovation in supply chain management is an integral part of any organization. It does not matter which business is considered, innovation in supply chain might set the company apart from crowd. However, on the one hand, not all that new solutions are successful. In some cases excessive innovations in supply chain can be a disadvantage for organizations. Prof. Vaclav Smil [2015] from University of Manitoba in Canada claims that one of the most remarkable examples of a prolonged and costly innovation failure is the fast breeder reactor. Due to high

costs, technical problems, social and environmental issues, the shutdowns of experimental reactors were made in many countries. Therefore, companies should be very careful in changing or selecting new products or services.

On the other hand, in order to remain competitive, innovation can be a key difference between market leaders and their contenders [Kotler and Keller, 2014]. In any kind or nature of business, generation of new ideas is essential for organization's success. If organizations are un-innovative, they have a risk of losing their edge in the market.

With the help of innovation in supply chain process, organizations can also discover opportunities, which already exist or are likely to emerge in the future. Responses to current customers needs are not only the key for successful business, but predicting future needs and developing new ideas and incorporating innovative ways of operations allow organizations to meet future challenges in an effective and efficient way.

It is universally accepted that innovation is the key to ensure the future growth and survival of any firm. Innovation allows organizations to coordinate themselves with the changes of the environment, market and customer demand. It is found that there is a relationship between organizational culture innovations and the adoption of information system. The innovation is described as a critical factor in organization performance and survival of the firm in a competitive environment. The importance of product innovation for good long-term company results is now widely recognized and has been extensively reported in the literature [Tohidi and Jabbari, 2012].

There is a misperception about innovation and many professionals think that it is only about designing a new product or service to sell. Despite the fact that innovation has been studied in different disciplines, the term is often poorly understood and can be sometimes confused with related terms such as change, invention, design, and creativity.

J. Schumpeter [1983], well-recognized as an authority in the area of companies' organization, defines the innovation as follows:

- the introduction of a new product with which consumers have not yet had to deal with;
- the introduction of a new production method, which has not been utilized in the particular field of industry;
- the opening of a new market, i.e. an area in which the type of industry previously did not work, regardless of whether the market has existed before or not;
- getting new source of raw materials or semi-finished products, regardless of

whether the source already existed, or had to be created;

- the introduction of a new organization of industry.

According to The New Oxford Dictionary of English [1998], innovation is the application of practical tools and techniques that make changes, large and small, to products, processes, and services that result in the introduction of something new for the organization that adds value to customers and contributes to the knowledge store of the organization. This shows that even a small incremental change of any process is an innovation. Innovating and improving continuously operations is essential for the better performance of an organization.

Innovation can be also explained as the using of new ideas that lead to the making of any new products, services or processes. Not only the invention of something new is important, but getting it out into the marketplace is just as significant. Thus, implemented innovation includes technologically new products (goods and services) and processes or represents significant technological improvements in products and services [European Commission & Eurostat, 2005]. Based on this definition, innovation is considered as implemented if it is placed on the market or is used in the production process.

In a literature review on innovation, Edison, et al., [2013], found over 40 definitions. They also performed an industrial survey to capture how innovation is defined in industry. Based on the analysis of the existing definitions covering all the dimensions of innovation, they presented the following one to be the most complete:

*"Innovation is: production or adoption, assimilation, and exploitation of a value-added novelty in economic and social spheres; renewal and enlargement of products, services, and markets; development of new methods of production; and establishment of new management systems. It is both a process and an outcome."*

Undoubtedly, novelty is a common part of all the above-mentioned elements of innovation. The company is innovative when a new or technologically developed products or processes are introduced on the market.

Due to increasing rate of new product launched or new service introduced on the market, innovation management becomes important. The objective of innovation management is to enhance the effectiveness and efficiency of new product development or service.

The models, which explain the development and commercialization of new products, are key elements of innovation management. Researchers and academic professionals define many process models presenting companies' evolution or new products or services. It is essential for organizations to develop process models, because this will help them to standardize their innovative efforts.

In many companies the innovation management is considered to be a set of tools that help managers a general understanding of processes and goals. It also allows organizations to respond to external or internal opportunities, and use its creativity to introduce new ideas, processes or products [Kelly and Kranzburg, 1978].

The importance of innovation measurement is well emphasized in industry. According to The Boston Consulting Group's survey, 74% of the executives believed that their company should track innovation as rigorously as core business operations, but only 43% of the companies actually measured innovation. Although, some companies think that innovation cannot and should not be measured, the real issue is lack of metrics and measurements. This makes companies measure too little, measure the wrong things or not measure innovation at all [Andrew et al., 2008].

Literature and studies confirmed that all organizations are eager to be more innovative. Most of the companies believe that innovation is essential for them. This shows that the importance of innovation is increasing and increasing significantly. Due to globalization

and shorter technology life cycle, innovation has become an integral factor in strategic planning.

According to Chesbrough H., [2006], companies that don't innovate die. Few years ago, "business as usual" was enough for most of the companies but nowadays all stakeholders of any organization are agreeing that "business as usual is soon no business at all".

It is a fact that nowadays we need innovation more than any time before. Due to the impact of globalization, migration, technological and knowledge revolutions, innovation will bring added value to business and helps organizations to remain competitive.

If your company manufactured a product from a purchased raw material and sells it to customers, it means that your organization has supply chain and needs its management. Simchi-Levi et al. [2008] define the supply chain management (SCM) as follows:

*"It is a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses, and stores, so that merchandise is produced and distributed at the right quantities, to the right locations, and at the right time, in order to minimize system-wide costs while satisfying service level requirements".*

This definition leads to several observations. First, SCM takes into consideration every facility that has an impact on cost and plays a role in making the product conform to customer requirements; from supplier and manufacturing facilities through warehouses and distribution centers to retailers and stores. Indeed, in some supply chain analyses, it is necessary to account for the suppliers' suppliers and the customers' customers because they have an impact on supply chain performance [Simchi-Levi et al., 2008].

In order to improve competitiveness in the market, organizations should be aware of the importance of incremental innovation and its opportunities in logistics management.

Organizations are forced to maintain competitive in the market and deliver products to the customers according to 7R in logistics, i.e. right products, to right place, at right price, to right customer, in a right condition, at right time and right quantity. The example of highly competitive market is the oil sector. Part of the top importers of oil from all over the world is located in Pakistan. Therefore, their supply chain network should be of the highest quality and cost effective at the same time.

This study proposes an incremental innovation in Pakistan's biggest oil company's supply chain network and the improvement of customers' service, warehousing and transportation costs reduction based on the redesign procedure presented by the authors of this paper.

The paper is composed of 5 sections. The first one presents the introduction to innovation and the problem considered. In the second section the methodological background is described, including an overview of innovation that many companies have adopted in the field of supply chain management and logistics. The third section presents the authors' approach to redesign SCN, which is composed of 3 phases. In the fourth section the application of a proposed procedure is presented. There is described information about the company's background and current logistic management. There is also presented the innovation in company's supply chain network. The results of the innovation process introduced to the company are analyzed. The special attention is put into the costs' reduction and customers' satisfaction improvements, as well. Finally, in the fifth section, the conclusions are drawn and future recommendations are presented.

## **METHODOLOGICAL BACKGROUND**

Management focus and commitment is vital in supply chain innovation. Moreover, supply chain managers should benefit from technological advancement to better management of the supply chain. According to Gravier and Swartz [2009], the interaction of managerial policies and technological factors

presents an important focus of research for innovation management research.

Literature has proven that companies adopting innovative ways to enter the market, and then supporting those plans with successful supply chains, can gain competitive advantage quickly and increase market share in short period of time.

The relation between innovation and supply chain management is not a new trend in the market. Many leading organizations applied radical or incremental innovations over a period of time. In late 1800s, company named "Taylorism" applied innovation in manufacturing shop floor and invented the concept of standard time. Similarly "3M" company applied innovation in its transportation lead control center and adopted the concept of centralization in transportation planning to look for network synergies.

Abbott lab Canada developed and implemented a first computerized distribution requirement planning system. This system is more or less similar to material resource planning and based on its core concepts. It is considered as the start of today's supply chain planning software. Moreover, Fedex Tracking System, the Universal Product Code, Toyota production system and Ocean Shipping Container Technology are the examples of innovations in supply chain.

Some studies provided evidence that better integration of suppliers in managing overall supply chain cycle within the product innovation process can improve a firm's overall performance (e.g. Bonaccorsi and Lipparini [1994]; Ragatz et al. [2002]; Johnsen [2009]; Lau et al. [2010]).

Continuous innovation is a vital solution to overcome pressures from customers, competitors, and regulators, and this increases the entire supply chain performance [Porter and Van der Linde, 1995].

According to Rice [2014], most innovations in supply chain management are built on existing achievements and reconfiguration of known methods and technologies, rather than

on inventing new ones. This doesn't mean supply chain innovation is unexciting or largely irrelevant. On the contrary, incremental change represents one of the most powerful weapons companies have to stay ahead of the competition. Table 1 shows some examples of supply chain innovations in real-world companies.

Gattorna, et al. [2003] and Skjott-Larsen [2000] claim that, in order to maintain cooperation between supply chain partners, coordinated supply chain relationships are the best form. Thus, it is very important for key players in supply chain to improve coordination and communication. Moreover, information sharing is vital for effective SCM.

Table 1. Supply chain innovations  
 Tabela 1. Innowacje w łańcuchu dostaw

Company		Examples of Supply Chain Innovation
Name	Short description	
Caterpillar	manufacturer of construction and mining equipment	Service parts availability via integrated network
Cisco	designer, seller and service provider of information technology	Proactive and upstream supply chain risk management, monitoring, and measurement
Dell	developer, seller of computers, related products and services	Make-to-order, sell direct, product and supply chain tailored to market segments
Fedex	global courier service company	Hub-and-spoke systems and network
Ford	manufacturer and seller of automobiles and vehicles	Vertically Integrated assembly line at River Rouge plant
Intel	semiconductor chip maker, inventor of the processors	Copy Exactly: standard fab design
Li & Fung	consumer goods designer, developer, sourcing and logistics company for retailers and brands	Complete upstream contract manufacturing management
Lucent (currently Alcatel-Lucent)	telecommunications equipment company	Platform/component standardization, supplier contract margin management
Procter & Gamble	producer of consumer goods, including cleaning agents and personal care products	Diamond relationship customer reams, Streamlined Logistics, Efficient Customer Response, Continuous Replenishment
Reebok	producer and distributor of fitness and sports items	Responsive supply chain via product redesign postponement and near shoring
Toyota	manufacturer and seller of automobiles and vehicles	Toyota Product System, SMED
UPS	global courier service company	IT integration across system, standardized engineering processes
Walmart	retailer operating a chain of discount department stores and warehouse stores	Everyday Low Prices, upstream supply chain management, store location impact on supply chains
Zara	clothing and accessories retailer	Hi-automation and near-market production aligned for supply chain of fast fashion

Similarly Miles and Snow [2007] mentioned that it is important for organizations to adopt strategic approach for better supply chain relationships. They also stated that this approach is critical for many organizations to survive and maintain adequate market share. Moreover, Lambert and Knemeyer [2007], indicated that different types and nature of supply chain relationships such as

coordination, cooperation and collaboration affect these connections. Therefore, a strong effective relationship is the key success factor for efficient entire supply chain management.

The other factors, such as utilization and ability to get information are vital for overall supply chain innovations activities and its performance. Nowadays, organizations depend

on their customers and suppliers. Managing the information between them can help organizations to fulfill customers' expectations and suppliers' requirements effectively and efficiently.

From customers' perspective, new or improved service or product is innovation. According to Benner and Tushman [2002], there can be distinguished two types of innovations, i.e. exploratory and exploitative. The first one is connected with radical changes, which are designed for new markets' needs. It requires new knowledge or a departure from existing knowledge in the organization. In the second type, it is assumed that the innovations are incremental and designed for existing customers' or market's needs. The aim of all these activities is to add the value of products and services. In particular, according to Sakchutchawan et. al, [2011], the channel of the supply chain which adds the value of time and place utility is logistics. It is defined as the management of the flow of goods, information, service and other resources between the point of origin and the point of consumption in order to meet the requirements of consumers. Lin [2006] states that logistics involves the integration of information, transportation, inventory, warehouse, material handling, security, and packaging. It also means the supply of service or product to the demander or demanding unit at the right time, with the right quantity, in the right quality, with the right cost and at right place. Innovation can occur within services, processes, or any business system.

Logistics has evolved with the overall responsibility for the movement, storage and handling of both inbound materials and outbound products. Logistics innovativeness and logistics service differentiation positively influences logistics performance [Ralston et al., 2013]. It means that innovation in logistics is essential for overall supply chain performance.

## **PROPOSED APPROACH TO REDESIGN SUPPLY CHAIN NETWORK**

In order to reduce inventory and to keep total supply chain costs at the minimum level, constant incremental innovations are required in logistics. These innovations include new routes and trade options. Therefore, it is essential for organizations to monitor their logistics activities, reduce disadvantages and introduce innovative solutions in order to maintain competitive edge and fulfill customer needs.

This approach of redesigning the supply chain network can be presented as a procedure, composed of the following phases:

- Phase 1. Analysis of the current state of the supply chain network. The aim of this phase is to precisely define how the SCN operates. Thus, its major components should be identified and the relations between them, as well. The analysis should also lead to the identification of the most important challenges and the level of their fulfillment.
- Phase 2. Identification of disadvantages in SCN. The aim of this phase is to rank drawbacks from the most to the least important. Their identification should be concentrated on overall characteristics of the SCN. The strategic thinking should also be incorporated. Not only disadvantages are important, but their reasons should be recognized, too.
- Phase 3. SCN improvement. The aim of this phase is to improve the supply chain network by adding the value of time and place utility. Thus, the innovative solution is required. This phase should be concentrated on the coordination of product and information flow in the SCN. The holistic approach of the redesign procedure makes that stakeholders' participation is required. Their opinions and preferences should influence the process of changes. Based on them different SCN variants of redesign should be constructed. They should reflect various aspects of SCN, such as technical, organizational, economical,

social, environmental etc., and stakeholders' preferences, as well.

Finally, the variant that has the most important influence on the overall system and at the same time is innovative should be selected. Its implementation in the system should reduce the most important disadvantages and provide competitive advantage.

To verify this procedure a real-world SCN has been considered and presented in the next section.

## APPLICATION OF INNOVATION IN XYZ LUBRICANTS

### *Analysis of the current state of the supply chain network*

For over a century XYZ Lubricants has been an innovator in lubrication technology

and has manufactured breakthrough lubricants for automotive, commercial and industrial sectors. From energy to manufacturing, from cement plant to metal processing, from textiles to plastics, every industry can utilize and benefit from the extensive range of XYZ Lubricants products.

The XYZ Lubricants brand is known for performance and innovation. It is highly recognized for its advanced technology in lubricants and services, and it is synonymous with Motorsport where performance counts.

To meet such challenges as: competitive prices, constantly improved quality of products, customers' requirements with shorter lead times, on time deliveries and a wide range of variety of available oil grades near the customers, the company has to be redesigned and new ways of operating their businesses should be specified.



Fig. 1. Map of Pakistan with an exemplary supply chain of XYZ Lubricants - current state  
Rys. 1. Mapa Pakistanu z przykładowym łańcuchem dostaw firmy XYZ Lubricants - stan obecny

XYZ Lubricants has its customers spread all over the country in various cities of Pakistan. In order to satisfy customer's demand on time, XYZ Lubricants currently has three warehouses, as presented in figure 1. There is a warehouse with imported products in Karachi, and two warehouses with local and imported products in Hub (Lube Oil Blending

Plant - LOBP), and in Lahore. Karachi and Hub (LOBP) Warehouses are located in south of Pakistan. They satisfy the demand of the following provinces: upper and lower Sindh (placed in southeast of the country) and selected regions of Balochistan (placed in southwest of the country). Some products delivered to Karachi Port are transported to

Karachi Warehouse, and then to Lahore Warehouse, located in the eastern part of Pakistan. The distance between Karachi Warehouse and Lahore Warehouse is around 1300 km. The products from the Lahore Warehouse, are delivered to upper and lower Punjab (the province placed in east of the country) and selected northern areas.

Current supply chain process of major customers in northern Pakistan is presented in figure 2.

It is composed of the following steps:

- Step 1. Orders placed by customers. Marketing and Sales (M&S) department of XYZ Lubricants receives information about the volume of customers' demand for the next 3 months. The company is the only one distributor of lubricant products to major customers in northern Pakistan. Therefore, it is mandatory for XYZ Lubricants to provide deliveries of products in right quantity and at right time.
- Step 2. Consolidation of products. Once the order quantity has been confirmed, Supply and Distribution (S&D) department consolidate different products to make it one full container load (FCL). If the order quantity is FCL, then S&D department places an order next day. This department also communicates Expected and Actual Arrival Times (ETA) at Karachi Port with M&S department to ensure information flow in the analyzed supply chain network.
- Step 3. Arrivals of products to Karachi Port and customs clearance. All shipping documents, including the list of consolidated products, are received from the supplier one week before the arrival of products to Karachi Port. After detailed screening of all documents, S&D department sends these documents to customs clearance service provider. The products are imported from different countries. However, 60% of them are delivered from Singapore and Thailand. They are transported to the Karachi Port by sea. Once the products arrive to Karachi Port, customs clearance service provider starts clearance process immediately.

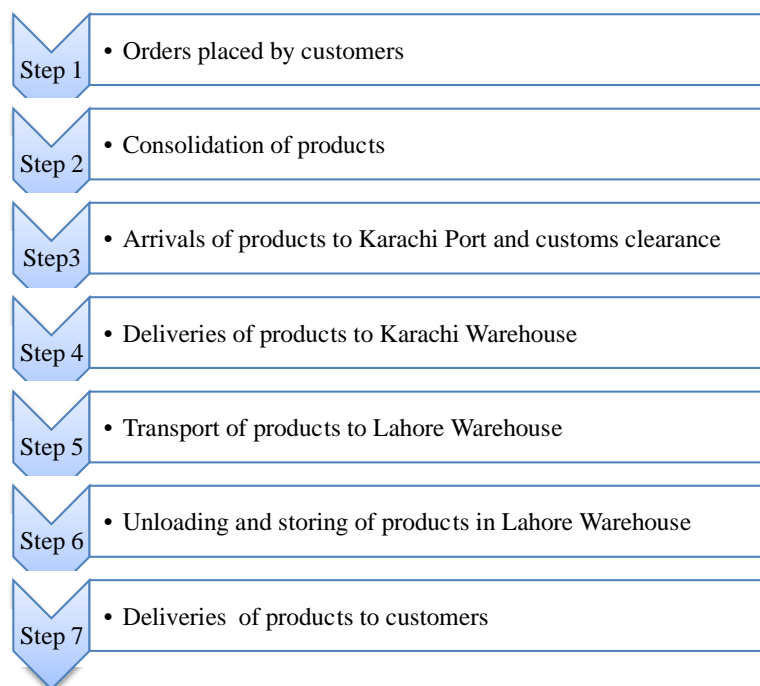


Fig. 2. Current supply chain process  
Rys. 2. Stan obecny procesu dostaw



- Step 4. Deliveries of products to Karachi Warehouse. After customs clearance process, the products are transported to Karachi Warehouse for temporary storage. All mandatory procedures such as inventory unloading and stock updating in SAP system take place.
- Step 5. Transport of products to Lahore Warehouse. Once the warehouse supervisor in Karachi Warehouse receives information from M&S department to transfer products to Lahore Warehouse, the internal transfer in SAP system is made. At the same time, FCL is transported to Lahore Warehouse by truck.
- Step 6. Unloading and storing of products in Lahore Warehouse. The products delivered to Lahore Warehouse are unloaded and stored. M&S department informs customers located in northern Pakistan about the availability of products in Lahore Warehouse.
- Step 7. Deliveries of products to customers. Based on the demand, the deliveries from Lahore Warehouse to customers are organized. The products are picked and delivered to customers.

#### *Identification of Disadvantages in SCN*

Based on the analysis of current supply chain process, there can be observed the unnecessary delays between step 4 and 7 (see figure 2), i.e. after customs clearance until the products are delivered to customers. The way of importing lubricants to the northern part of Pakistan starts in Karachi Port, because it is the only one port in the country. Moreover, there is XYZ Lubricants strategic decision and policy to deliver only FCL from Karachi Warehouse to Lahore Warehouse, which in some cases takes time to raise the load.

After overall analysis one can state that some operations are doubled, such as unloading, storing and loading of the same products in Karachi Warehouse and Lahore Warehouse. They cause the delays, they are labor consumers and they generate additional costs.

One of the measurable criteria evaluating the analyzed supply chain is cost of loading, unloading, storing and transporting of goods. Current inbound and outbound cargo costs are presented in table 2.

Table 2. Costs of inbound and outbound cargo  
 Tabela 2. Koszty ładunków przychodzących i wychodzących

Cargo unit	Inbound costs		Outbound costs	
	Monetary units		Monetary units	
	PKR	USD	PKR	USD
Carton/ pallet	80.00	0.76	80.00	0.76
Drum/ pallet	85.00	0.81	85.00	0.81

The above presented charges are for destuffing of the incoming cargo and include the utilization costs of labor and equipment, necessary for removal of cargo from the container or vehicle and transporting it to the gate of the warehouse. In addition, the cost involves preparation of the documents of incoming cargo, operations with the cargo from the warehouse gate to the storage area, striping and segregating the cargo (in case of mixed pallet), quality assurance (QA) activities, labeling the cargo and stacking it

into respective pallet positions. Moreover, the inbound and outbound cargo cost also includes the following operations:

- preparation of goods in documentation for all the consignment received and prepared for delivery,
- updating the volume in the system to maintain the inventory level,
- communication expenses connected with the coordination and liaison within XYZ Lubricants,

– utilization of human and technical resources (e.g. printers, photocopiers, fax) to do all the above-mentioned activities.

Transportation cost from Karachi Port to Karachi Warehouse is given below (table 3).

Total logistics cost, which includes loading/unloading operations and transportation from Karachi Port to Lahore Warehouse is summarized in the following table 4.

Information presented in table 4 shows that the highest are total transportation costs from Karachi Port to final customers. Their value is 3.288 PKR/ liter, which is 0.030 USD/ liter. The total costs of operations in Karachi and Lahore Warehouses equal 1.219 PKR/ liter, which is 0.012 USD/ liter. It means that transportation costs are more than 2.5 times higher than warehouse operation costs. Thus, it is important to redesign the analyzed supply chain network, concentrating on the deliveries of products.

Table 3. Transportation costs between points of origin and points of destination  
 Tabela 3. Koszty transportu pomiędzy punktami nadania i punktami odbioru

Point of origin	Point of destination	Transportation cost / FCL	
		Monetary units	
		PKR	USD
Karachi Port	Karachi Warehouse	5400.00	51.22
Karachi Warehouse	Lahore Warehouse	43000.00	407.87

Table 4. Logistics cost of the current supply chain  
 Tabela 4. Koszty logistyczne w obecnym łańcuchu dostaw

Activity	PKR/load unit		USD/load unit		PKR/ liter	USD/ liter
	FCL	PALLET	FCL	PALLET		
1. Transportation from Karachi Port to Karachi Warehouse	5 400	-	51.19	-	0.324	0.003
2. Unloading at Karachi Warehouse	-	85	-	0.81	0.102	0.001
3. Loading at Karachi Warehouse	-	85	-	0.81	0.102	0.001
4. Transportation from Karachi Warehouse to Lahore Warehouse	43 000	-	40.76	-	2.580	0.024
5. Unloading at Lahore Warehouse	-	85	-	0.81	0.102	0.001
6. Loading at Lahore Warehouse	-	85	-	0.81	0.102	0.001
7. Transportation from Lahore Warehouse to Customers in northern Pakistan	6 400	-	60.67	-	0.384	0.003
8. Average inventory holding cost	-	675	-	6.40	0.811	0.008
<b>Total Cost</b>					<b>4.507</b>	<b>4.50</b>

### Supply Chain Network Improvement

Based on the above-mentioned supply chain analysis the directions of changes have been presented. S&D department of XYZ Lubricants is aware of this situation and the improvements of the current state of the company and innovations are required, as well. After several meetings of the stakeholders such as M&S department, Information Technology

department, customs clearance service provider, transportation company, customers in northern Pakistan, they agreed for changes within the transportation. One of the solution is a transformation of fast moving products to Full Container Load (FCL). Thus, the improved supply chain can be presented as follows (figure 3).

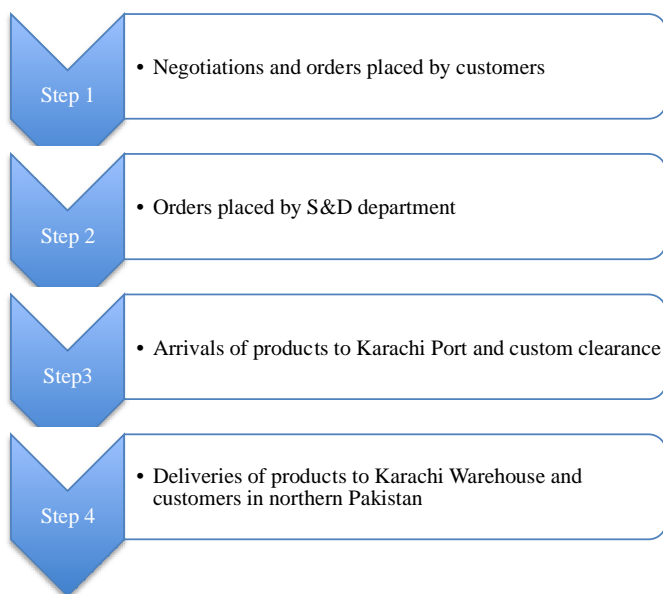


Fig. 3. Innovative supply chain  
Rys. 3. Innowacyjny łańcuch dostaw

This innovation is composed of 4 steps, which are as follows:

- Step 1. Negotiations and orders placed by customers. In order to reduce unnecessary costs of loading and unloading operations, S&D department analysis historical data of demand. Then it informs M&S department about selected groups of products that have a potential to be ordered as FCL by particular customers. Once M&S department has information about potential products, which can be ordered by customers in northern Pakistan, the negotiations with these customers start. At the end, there are expected orders placed by the customers.
- Step 2. Orders placed by S&D department. After receiving FCL order, S&D department places order with supplier in Singapore or Thailand. S&D department also communicates ETA in Karachi Port with M&S department to ensure information flow. Moreover, S&D department gives instructions to an export coordinator about the specification of packing list. This helps customs clearance service provider to identify the container's load. This operation is important because the customer will not

accept the container if seal is broken and if there is no possibility to identify the container's load. Therefore, in proposed innovative logistics solution, it is mandatory to include container's number on packing list. Next, S&D department receives the original documents from supplier.

- Step 3. Arrivals of products to Karachi Port and customs clearance. The products are delivered to Karachi Port from suppliers located in Singapore and Thailand, S&D department instructs customs clearance service provider about the allocation of selected containers to be transported to Karachi Warehouse. The other products are left for a few hours in Karachi Port and when they are going to be delivered directly to customers in northern Pakistan. After customs clearance, the packing list and the other shipping documents are sent to S&D department for internal documentation. Warehouse supervisor enters products virtually in SAP system and generates delivery challan and invoice per each container. Unique container number in packing list helps warehouse supervisor to identify the load for specific customer in northern Pakistan. Once the product is entered in SAP system and delivery challan

is generated, the documents such as invoice, delivery challan and packing list are transferred to clearing agent for onward transportation to customer in northern Pakistan.

- Step 4. Deliveries of products to Karachi Warehouse and customers in northern Pakistan. Once the documents are

generated, the specific containers identified by the S&D department, are transported directly from Karachi Port to customers (see figure 4). The other products are transported from Karachi Port to Karachi Warehouse. Then, they are delivered to customers in Sindh and Balochistan provinces.

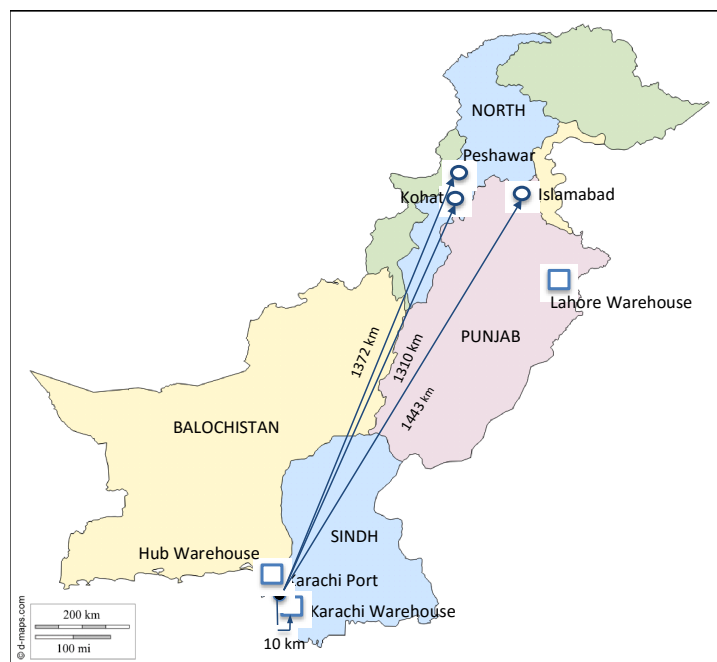


Fig. 4. Map of Pakistan with an exemplary supply chain of XYZ Lubricants - proposed changes  
 Rys. 4. Mapa Pakistanu z przykładowym łańcuchem dostaw firmy XYZ Lubricants - proponowane zmiany

Table 5. Logistics cost of innovative supply chain  
 Tabela 5. Koszty logistyczne w innowacyjnym łańcuchu dostaw

Activity	PKR/ FCL	USD/ FCL	PKR/ liter	USD/ liter
1. Special Handling Charges in Karachi Port	2 000	18.96	0.120	0.001
2. Additional Cost incurred in Karachi Warehouse	2 800	26.54	0.168	0.001
3. Transportation from Karachi Port to customer in northern Pakistan	48 000	455.02	2.880	0.027
		<b>Total Cost</b>	<b>3.168</b>	<b>0.029</b>

In this procedure, there is no temporary storage, unnecessary loading and unloading operations. Thus, total cost which includes loading/unloading and transportation from Karachi Port to customers in northern Pakistan is summarized in the following table.

The data presented in table 5 shows that the proposed innovation can benefit in logistics

cost savings. The reduction of total transportation cost from Karachi Port to final customers in northern Pakistan equals almost 12.5 %, i.e. the transportation costs in current supply chain equal 3.288 PKR per liter (0.031 USD per liter), while in the innovative solution they are 2.880 PKR per liter (0.027 USD per liter). Moreover, for the analyzed group of customers XYZ Lubricants can reduce the

number of loading and unloading operations in warehouses from 4 to 0, which means savings of 0.408 PKR per liter (0.004 USD per liter).

Concluding, total logistics savings in analyzed supply chain equal 30%, i.e. they are reduced from 4.50 PKR per liter (0.043 USD per liter) to 3.16 PKR per liter (0.030 USD per liter). The proposed innovation has been successfully implemented. The company negotiates with other customers in northern Pakistan convincing them for this new solution.

## **CONCLUSIONS AND FUTURE DIRECTIONS**

This paper presents the methodology to redesign supply chain network. This approach combines different components of supply chain management and is concentrated on relationships between chains, including communication and coordination aspects. The final result of the redesign process should add the value of time and place utility.

This innovative idea of changes is presented on a real-world supply chain. There is described the current state of the XYZ Lubricant company and its analysis. Based on the analysis of the company's supply chain network, the most important disadvantages, which are delays in deliveries, has been recognized. The main reason of this situation are unnecessary loading and unloading operations in Karachi Port and Karachi Warehouse. They generate additional loading and unloading costs and transportation costs, as well. It is worth to mention, that they have an influence on further operations, including loading and unloading of materials in Lahore Warehouse and customers' service, as well. Thus, to improve the supply chain performance changes in deliveries of products to customers have been proposed. This complex solution of the problem combines organizational and technical changes within ordering operations, transportation and storage process. It also takes into account stakeholders' opinions and preferences.

Based on the authors' experience, innovation process requires a lot of time for successful implementation. Sometimes this process is much more difficult than the product innovation. This situation happened in XYZ Lubricants. It took a long time to negotiate and convince all the departments in the company and all cooperating institutions that the innovative idea is the step of company's evolution. Finally, the proposed changes were successfully implemented and now the organization's savings are approximately 263700 PKR per month, which is 2500 USD per month.

Further studies should be based on more complex evaluation of the current supply chain. The set of criteria should be constructed satisfying all stakeholders' points of view, which are usually contradictory, such as: logistics costs, time of deliveries, environmental issues. The company should also find more customers in northern Pakistan and other parts of the country, interested in FCL deliveries. This solution should reduce the logistics costs, including transportation costs, loading and unloading operations' costs and inventory costs in Karachi and Lahore Warehouses. It should also improve the level of customers' satisfaction.

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## **REFERENCES**

- Andrew J.P., Haanaes K., Michael D.C., Sirkin H.L., Taylor A., 2008. *Measuring Innovation: Squandered Opportunities*. A BCG Senior Management Survey, available at: <https://www.bcg.com/documents/file15302.pdf> (accessed 22 December 2015).

- Benner M.J., Tushman M., 2002. Process Management and Technological Innovation: A Longitudinal Study of the Photography and Paint Industries, *Administrative Science Quarterly*, 47, 4, 676-707.
- Bonaccorsi A., Lipparini A., 1994. Strategic partnerships in new product development: an Italian case study, *Journal of Product Innovation Management*, 11, 2, 134-145.
- Chesbrough H., 2006. *Open Business Models: How to Thrive in the New Innovation Landscape*, Harvard Business School Press, Boston.
- Edison H., Ali N., Torkar R., 2013. Towards innovation measurement in the software industry, *Journal of Systems and Software*, 86, 5, 1390-1407.
- European Commission & Eurostat, 2005. *Oslo Manual. The measurement of scientific and technological activities. Proposed guidelines for collecting and interpreting technological innovation data*, available at: <http://www.oecd.org/sti/inno/2367580.pdf> (accessed 22 December 2015).
- Gattorna J., Ogulin R., Reynolds M., 2003. *Gower Handbook of Supply Chain Management*, Gower Publishing, Farnham.
- Gravier M., Swartz S., 2009. The dark side of innovation: Exploring obsolescence and supply chain evolution for sustainment-dominated systems, *Journal of High Technology Management Research*, 20, 2, 87-102.
- Johnsen T., 2009, Supplier involvement in new product development and innovation: taking stock and looking to the future, *Journal of Purchasing and Supply Management*, 15, 3, 187-197.
- Kelly P., Kranzburg M., 1978. *Technological Innovation: A Critical Review of Current Knowledge* San Francisco, San Francisco Press, San Francisco.
- Kotler P., Keller K., 2014. *Marketing Management*, Prentice Hall, Cloth.
- Lambert D., Knemeyer A., 2007. We're in This Together, *Harvard Business Review*, 82, 12, 114-122.
- Lau A., Tang E., Yam R., 2010. Effects of supplier and customer integration on product innovation and performance: empirical evidence in Hong Kong manufacturers, *Journal of Product Innovation Management*, 27, 5, 761-777.
- Lin C., 2006. Influencing Factors on the Innovation in Logistics Technologies for Logistics Service Providers in Taiwan, *Journal of American Academy of Business*, 9, 2, 257-264.
- Miles R., Snow C., 2007. Organization theory and supply chain management, *Journal of Operations Management*, 25, 2, 459-463.
- Porter M.E., van der Linde C., 1995. Green and Competitive: Ending the Stalemate, *Harvard Business Review*, 73, 5, 120-134.
- Ragatz G., Handfield R., Petersen K., 2002. Benefits associated with supplier integration in new product development under conditions of technology uncertainty, *Journal of Business Research*, 55, 5, 389-400.
- Ralston P.M., Grawe S.J., Daugherty P.J., 2013. Logistics salience impact on logistics capabilities and performance, *International Journal of Logistics Management*, 24, 2, 136-152.
- Rice J., 2014. How Many Supply Chain Innovations Are Truly Revolutionary?, available at: [http://www.supplychain247.com/article/how\\_many\\_supply\\_chain\\_innovations\\_are\\_truly\\_revolutionary](http://www.supplychain247.com/article/how_many_supply_chain_innovations_are_truly_revolutionary) (accessed 22 December 2015).
- Sakchutchawan S., Hong P., Callaway S., Kunnathur A., 2011. Innovation and Competitive Advantage: Model and Implementation for Global Logistics, *International Business Research*, 4, 3, 10-21.
- Schumpeter J.A., 1983. *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle*, Transaction Publishers, New Brunswick.
- Simchi-Levi D., Kaminsky P., Simchi-Levi E., 2008. *Designing and managing the supply chain: concepts, strategies, and case studies*, McGraw-Hill, New York.

Skjott-Larsen T., 2000. Third party logistics - from an inter-organizational point of view, *International Journal of Physical Distribution & Logistics Management*, 30, 12, 127-141.

Smil V., 2015. When Innovation Fails, *IEEE Spectrum*, available at: <http://spectrum.ieee.org/energy/policy/when-innovation-fails> (accessed 22 December 2015).

Tohidi H., Jabbari M.M., 2012. The Effective Factors on Formation of Innovation Processes, *Procedia Technology*, 1, 524-527.

The New Oxford Dictionary of English, 1998, 1st ed., Oxford University Press, Oxford, 942.

## REORGANIZACJA ŁAŃCUCHA DOSTAW W PRZEDSIĘBIORSTWIE BRANŻY OLEJOWEJ: PODEJŚCIE INNOWACYJNE

**STRESZCZENIE. Wstęp:** Celem niniejszego artykułu jest reorganizacja łańcucha dostaw firmy funkcjonującej w branży olejowej, poprzez wdrożenie innowacyjnego rozwiązania skoncentrowanego na dostawach produktów i poprzez minimalizację całkowitego załadunku, wyładunku towarów i kosztów transportu.

**Metody:** W niniejszym artykule jest przedstawione podejście do reorganizacji łańcucha dostaw (ŁD). Składa się ono z 3 faz, tj. analizy stanu aktualnego ŁD, identyfikacji słabych stron ŁD oraz poprawy funkcjonowania ŁD. Przedstawiona wielofazowa procedura jest zweryfikowana na przykładzie rzeczywistego łańcucha dostaw, który jest poddany analizie, ocenie i reorganizacji. Na podstawie przeprowadzonej analizy, są definiowane jego najważniejsze mocne i słabe strony. Głównymi kryteriami oceny są koszty załadunku, wyładunku i transportu. Rekomendowana jest reorganizacja przedsiębiorstwa, zbierane są opinie osób zainteresowanych funkcjonowaniem łańcucha i zaimplementowane jest innowacyjne rozwiązanie.

**Wyniki:** Po udanym wdrożeniu innowacyjnego rozwiązania, uzyskany rezultat pokazuje oszczędności w kosztach załadunku, wyładunku i transportu oraz poprawę poziomu świadczonych usług. Ograniczenia badawcze: Proponowana metodyka może być zastosowana w innych łańcuchach dostaw. Jednak przedstawiony sposób ograniczenia kosztów załadunku, wyładunku i transportu nie może być uznany, jako ogólna zasada dla wszystkich przedsiębiorstw. Ponadto badania nie uwzględniają sytuacji ewentualnych niedoborów magazynowych.

**Wnioski:** Przedstawione wyniki badań koncentrują się na innowacyjnym podejściu do sieci logistycznej w wybranej firmie, a uzyskane wyniki dowodzą, że przedsiębiorstwo świadczące innowacyjne produkty, może stać się innowacyjne w sferze usług.

**Słowa kluczowe:** Innowacja, logistyka, transport, łańcuch dostaw, branża olejowa

## NEUGESTALTUNG DER LIEFERKETTE IM UNTERNEHMEN DER ERDÖLBRANCHE: EIN INNOVATIVER ANSATZ

**ZUSAMMENFASSUNG. Einleitung:** Das Ziel dieser Arbeit ist es, das Lieferkettennetzwerk eines Erdölprodukte und Schmierstoffe umsetzenden Unternehmens durch die Einführung von innovativen Lösungen, die sich auf die Lieferungen von Produkten und auf die Minimierung von Gesamt-Be- und Entladungen sowie der betreffenden Transportkosten konzentrieren, neu zu gestalten.

**Methoden:** In der vorliegenden Arbeit wird der Ansatz der Autoren zur Neugestaltung des Supply-Chain-Netzwerkes (SCN) dargestellt. Er besteht aus drei Phasen, d.h. aus der Analyse eines aktuellen Status des SCN, aus der Identifizierung von Nachteilen im SCN und einer SCN-Verbesserung. Dieses schrittweise Verfahren beruht auf der Verifizierung einer realen Lieferkette, die zu analysieren, zu bewerten und neu zu gestalten ist. Basierend auf der Analyse werden die wichtigsten Stärken und Schwächen identifiziert. Die wichtigsten Bewertungskriterien sind Be-, Entladungs- und Transportkosten. Die Neugestaltung des Unternehmens wird vorgeschlagen, es werden ferner Meinungen der an der richtigen Funktionsausübung der Lieferkette Interessierten gesammelt und dementsprechend die innovativen Lösungen eingeführt.

**Ergebnisse:** Nach der erfolgreichen Implementierung der innovativen Lösung stellte man weitgehende Einsparungen innerhalb der Be-, Entladungs- und Transportkosten und die Verbesserung des Service-Levels fest. Die forschungsmäßige Einschränkung: die vorgeschlagene Methode kann innerhalb von anderen Liefernetzwerken implementiert werden, allerdings kann die Art und Weise für die Minimierung der Be-, Entladungs- und Transportkosten jedoch nicht als ein für alle Unternehmen geltendes Prinzip angesehen werden. Darüber hinaus werden in dieser Erforschung die Out-of-Stock-Situationen auch nicht berücksichtigt.

**Fazit:** Diese Studie stellt ein innovatives Denken im Logistiknetzwerk eines Unternehmens dar, und die erzielten Ergebnisse beweisen, dass die Unternehmen, die innovative Produkte anbieten, zu innovativen Dienstleistungsanbietern werden können.

**Codewörter:** Innovation, Logistik, Transport, Lieferkette, Schmierstoffe, Erdölprodukte

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Sharfuddin Ahmed Khan  
Industrial Engineering and Engineering Management Department  
University of Sharjah  
P. O. Box 27272  
Sharjah, **United Arab Emirates**  
e-mail: [skhan@sharjah.ac.ae](mailto:skhan@sharjah.ac.ae)

Hanna Sawicka  
Division of Transport Systems  
Faculty of Machines and Transportation  
Poznan University of Technology  
3 Piotrowo street  
60-965 Poznan, **Poland**  
e-mail: [hanna.sawicka@put.poznan.pl](mailto:hanna.sawicka@put.poznan.pl)