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Liberko I., Bednarová L., Hajduová Z., Chovancová J.

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POSSIBILITIES TO OPTIMIZE THE LOGISTICS CHAIN IN THE MANUFACTURING PLANT

Liberko I., Bednarová L., Hajduová Z., Chovancová J. *

Abstract: The market economy is, among other, characterized by the fact that businesses are able to respond promptly to market demands - customers. In practice, this means that the customer wants to have the goods at the location at a specific time and provided in adequate quality and price, which is determined by the market supply and demand. One of the options to increase business efficiency and competitiveness in general is to reduce production costs or the total cost. Logistics costs (in literature also referred to as "total costs") represent a very high proportion of these costs. They are part of the total cost, which greatly affect management of the company. The paper outlines the possibility of how these costs can be reduced, based on an analysis and using rationalization approach to the current state of the organization and its management, without requiring significant costs of implementing certain measures.

Key words: logistics, SWOT, transport, company, milk

Introduction

The paper is based on real business requirements. Special request of the surveyed company was the cost reduction mainly in the process of storage and transportation - distribution of products as a part of the logistics chain. However, beyond supply chain and logistics employees, not many in business or the public fully understand the role and importance that the supply chain plays in gaining and maintaining a competitive advantage in today's world. Our aim was to highlight not only the importance of the logistics chain as a whole, but also the importance of its individual components. In today's highly competitive economy it is difficult to reinvent the wheel and engage in costly innovations from scratch (Goncharuk et al., 2015). Most businesses especially small and medium enterprises do not have the opportunity to develop their own methods and provide high efficiency through internal capacity. To make transport fulfill its task properly, the process of transportation should be fast, flexible and precise. Because of the cost, it is necessary to keep an eye on the means of transport, make sure that are they best loaded and avoid any kind of empty trips, which generate entirely unnecessary costs (Grabara et al., 2015). Because supply chain and logistics costs can range from 50% to 70% of a company's sales (with trillions spent on it worldwide),

* **Prof. Igor Liberko, PhD Eng.**, Rzeszow University of Technology, **Prof. Lucia Bednárová, PhD Eng.**, University of Economics in Bratislava, Faculty of Business economy with seat in Košice, **Doc. RNDr. Zuzana Hajduova, PhD,** University of Economics in Bratislava, Faculty of Business Economy with seat in Košice, **Jana Chovancova, PhD Eng.**, Department of Management, Faculty of Management, University of Prešov in Prešov
✉ igor.liberko@unipo.sk
✉ lucia.bednarova@euke.sk; zuzana.hajduova@euke.sk; jana.chovancova@unipo.sk

organizations of all sizes both perform and are interested in this function. Therefore, understanding and implementing an efficient supply chain strategy can prove critical to both an employee's and a company's success. From the management point of view it is primarily an optimization of costs incurred in the distribution and follows on this to achieve minimum wastage staffing and material resources of the company. When optimizing these parts can then appropriately allocate management resources saved.

Methodology and Data

The basic principle of supply chain as part of logistics management is the orientation on processes, where logistics chain "indicates the sum of all business activities involved in moving a product or service from supplier to customer" (logistics chain, www.timocom.sk).The basic idea for the creation of synergy effects in logistics is suitable allocation of activities and resources as well as their use for the benefit of the overall functioning of the logistics chain.
As is mentioned in many literatures about SCM, many supply chain methods have been proposed. Most methods address logistical issues of the supply chain, e.g., quality rates, inventory, lead-time and production cost. The methods of pipeline mapping, see (Scott et al., 1991), supply chain modelling, for (Davis 1993) and logistics performance measurement, for (Lehtonen 1995) analyse stock levels across the supply chain. For La Londe et al., supply chain costing (La Londe et al., 1996) focuses on cost build-up along the supply chain. Integral methods like value stream mapping, see (Hines et al., 1997), (Jones et al., 1997) and process performance measurement (De Toni et al., 1996) offer a "toolbox" to analyse various issues. Material used for the elaboration represents primary and secondary sources. Primary data were collect from internal company sources and secondary data were collected form. In this study we use flow diagrams of products. It is commonly used method for describing the flow of materials and goods from source to customer. When diagram is made, we can analyse all the logistic parts of the process. The contribution was developed based on practical requirements, to reduce the transportation and storage costs and optimize logistics flow. When analysing the current state of the light is theoretically possible to use a number of methods. In our case, we used some of the recording methods, especially the study of time - frames of the working day, the time duration of the individual images of logistics operations and Snapshot observation.
These were confronted elements of the material flow. To show the movement of material –material flow was used simplified Sankey diagram form of a simplified flowchart. This data was processed in terms of the systems approach, i.e., solving the problem as a whole. By the aim realization, different standard scientific research methods were used, e.g. comparative method, analyse and a synthesis. By the evaluation process, standard mathematic-statistical relations and numerical calculations were used.

Production System

Production systems are often characterized on the basis of the Black Box model, where the materials, equipment, labour, money presents an input into the process, whereas goods, services and money are outputs. In our case, the goods and services represent the product. All functional areas of logistics - production, supplies, transportation and storage (material handling and packaging) are an integral part of the logistics solutions in Business Company. These functions in their mutual relations are the essence of system solutions for integrated logistics (Pampel, 2000). Some authors have the same opinion that storage is one of the most important parts of the logistics system, as it forms the connecting link between manufacturers and customers. It provides information on state, terms and deployment of stored products.
All activities demand significant financial resources, which present logistics costs as part of the total cost of the company. The literature states the following classification of logistics costs.

Table 1. Types of logistics costs *(SIXTA, 2005)*

Activity	**The share of total costs [%]**
Transportation	29
Packaging	12
Administration	11
Undertake and sending	8
Order processing	6
Storage, manipulation, management, maintenance	34

The Analytical Part

The object of the examination was certain businesses company located in eastern Slovakia producing and supplying dairy products. Business activity of the company can be characterized in two basic areas. The first area consists of everyday goods (milk, curd, cream, butter). The second area consists of fermented products (different types of flavored products such as yogurts, cream, etc.). SWOT analysis indicated that the main strengths of the company include: flexible reaction to the customers' demands, quality of production, the price of products, staff qualification, logistics, stable customers, good working environment and service, creating a good image of the company.
Logistics of the company is considered one of the biggest advantages. The notable threats include obsolete machinery, insufficient use of vehicles, strong competition, low motivation and poor working environment and insufficient air conditioning (noise, unpleasant odour). Currently, within the logistics enterprise uses external carriers, despite the fact that company owns 30 vehicles, most of which does not comply due to inability to meet hygienic requirements.

The main problem is currently in the import and processing of raw milk from individual suppliers. The average monthly volume of raw milk from all suppliers is approximately 350 000 litres. For information we are listing a brief overview of the technology of processing raw milk: centrifugation, homogenization, modification of homogenized milk to the desired fat value (1.5%, 1% or 3.5%), packaging, and distribution.

The logistics of treated milk and packaging means is shown in Figure 1.

1. Import of raw milk (350 000 liters).
2. Import of secondary raw materials (external suppliers).
3. Imports of packaging materials (external suppliers).
4. Raw materials entry to the manufacturing plant.
5. The processing of packaging (bottle making machine, control).
6. Milk processing and storage of secondary raw materials (pasteurization, homogenization, centrifugal separation, control).
7. The production process (filling link, packaging, control).
8. Transport of final products to the refrigerated warehouses.
9. Transport of final products to the distribution warehouse.
10. Transport of final products by an external company.

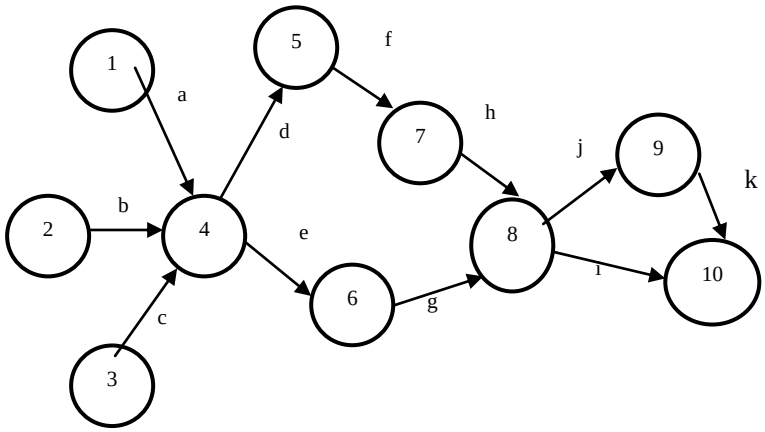

Figure 1. The logistics of treated milk

Next data shows the time duration of individual transport lines: a- 360 min., b-180 min., c- 330 min., d- 120 min., e-560 min., f- 240 min., g-420 min., h- 300 min., i-60 min., j- 40 min., k- 60 min.

Purchase and Transport of Materials and Raw Materials

Analysis has been performed on the size of orders, purchasers, and reliability of purchasers. In respect to contracted supplies we focused on: negotiated price, delivery time, the intensity of supply, estimated time of cooperation. Packaging

materials (pre-forms for bottles, caps, labels and packaging films) are supplied by external companies.

Transport Packaging Material

Packaging in the form of pre-forms, closures, labels, packaging films and other necessary materials are after picking up from the freight elevator subsequently transferred into two rooms in the basement (1) into storage containers and (2) the room for bottle making. The first part of the packaging material is unloaded in storage containers. Most represented part of the packaging material is PVC packaging which is supplied by an external contractor providing also design and packaging equipment. The warehouse has its own handling units – Pallet Truck with carrying capacity 2500 kg. The second part of the material brought from a freight elevator that material needed for the production of bottles and other packaging material needed for packaging other products. The route of delivery of the material in the basement begins in a freight elevator. There is consequently a short and two different routes.

Route M1

Material flow is performed in the following order: ↓ Freight elevator, ↓ Storage of packaging materials, ↓Bottle making machine

Table 3. Route M1

Room ↓	**Transport [minutes]**	**Handling during unloading [minutes]**
Freight elevator	2	———-
Storage of packaging materials	2	9
Bottle making machine	2	15
Transport time - total		6 min
Delay - down time in the room during unloading		24 min
The total average duration of the route		**30 min**

Repetitiveness per shift - 2 times

Route M2

Material flow is performed in the following order: ↓ Storage of packaging materials ↓ Production of yogurts, ↓ Yogurt filling

Table 4. Route M2

Room ↓	**Transport [minutes]**	**Handling during unloading [minutes]**
Storage of packaging materials	2	3
Production of yogurts	2	10
Yogurt filling	2	15

Transport time - total	6 min
Delay - down time in the room during unloading	28 min
The total average duration of the route	34 min

Repetitiveness per shift - 2 times

Route M3

Material flow is performed in the following order: ↓ Freight elevator, ↓ Butter production, ↓ Cream production, ↓ Production of curds and cheese, ↓ New production of yogurts, ↓ Liquid products packaging,↓ Curd production link

Table 5. Route M3

Room ↓	**Transport [minutes]**	**Handling during unloading [minutes]**
Freight elevator	1	5
Butter production	2	7
Cream production	2	5
Production of curds and cheese	2	10
New production of yogurts	2	10
Liquid products packaging	2	4
Curd production link	2	4
Transport time - total		13 min
Delay - down time in the room during unloading		45 min
The total average duration of the route		58 min

Route M4

Material flow is performed in the following order: ↓ Freight elevator, ↓ Curd production link, ↓ Liquid products packaging, ↓ Filling of liquid products, ↓ Cream production, ↓ New production of yogurts

Table 6. Route M4

Room ↓	**Transport [minutes]**	**Handling during unloading [minutes]**
Freight elevator	2	5
Curd production link	2	4
Liquid products packaging	2	5
Filling of liquid products	2	6
Cream production	2	7
New production of yogurts	2	4
Transport time - total		12 min
Delay - down time in the room during unloading		31 min
The total average duration of the route		43 min

Routes M1 - M4

Table 7. Routes M1 - M4

Rout	Transport	Manipulation	Repetitivenes s per shift	Total
M1	6 minutes	24 minutes	2	60 minutes
M2	6 minutes	28 minutes	2	68 minutes
M3	13 minutes	45 minutes	2	116 minutes
M4	12 minutes	31 minutes	2	86 minutes
Total duration			330 minutes	

The largest group in the material flow is the transport of milk (350 000 l per month). Number of necessary raw materials for such number of products is high. Therefore it is in the interest of the company to set up a warehouse inside the building, where the production is carried out. To shorten the logistic routes in the company is the storage facility located on the ground floor, near the production link. In the storage are places ingredients such as jams to yoghurt, milk powder, cream, probiotic cultures, curd and rennet. Storage capacity is 34000 kg. For the transport of units is used pallet handling equipment.
The following routes and times indicate the amount of yogurt, milk and cream desserts. Estimated production is on average 7000 pieces of yogurt per shift (8 minutes). The average amount of milk products is set at 3000 units. Desserts are made depending on requirements of customers in the 4000 or 8000 pieces. Pallet truck has a capacity of 1500 pieces of yoghurt, cream and dessert products. Milk capacity is 500 units due to its increased eight. In the storage of raw materials there are available 3 pallet trucks.
The third truck serves as a reserve. In the present state there occurs a situation that manipulation device with a load capacity of 500 kg at the last manipulation is not fully utilized (50 kg).

Proposals and Recommendations

Based on an analysis of the current state, we can conclude that it is possible to increase production by 30% without significant increase in costs. The company was recommended as follows:

- Increase production by 30%. (This change would require a change in organizational structure, flow of input material - milk, modification of storage in the ground floor),
- The flow of final products - yoghurts,
- Optimization of information system,
- Optimizing the duration of the logistics flow.

Table 8. Current state of selling – all products

Type of product	Sales excluding VAT in €	Quantity in pieces	Quantity in kg
Milk	491 000.78	1 690 897	1 095 791
Curd cheese	23 577.45	6 901	6 901
Butter	196 333.16	40 850	40 850
Yogurts	208 036.30	870 234	143 124
Flavoured milk	20 706.84	101 303	20 261
Creams	1 598 255.06	5 778 087	1 198 965
Curdled milk	246 954.35	499 141	360 566
Curd	190 073.58	78 723	78 723
Cream deserts	143 857.75	626 897	50 152
Total (average for 1 year)	3 118 795.27	9 693 033	2 995 334
Average for six months	1 559 397.63	4 846 516.334	1 497 666,763
Average for one month	259 899.6058	807 752.7223	249 611.1272

Increase production by 30% would have effects on organizational structure, what is not the subject of this paper. Though, we expect that this change would occur only in case of five workers from the existing current state (change of position).Increase production by 30% would demand to provide increased supply of milk from the current average monthly amount of 350 thousand litres to approximately 455 000 litres. Producibility of the current line is sufficient. The Table 9 shows the values of the 30% increase in production.

Table 9. Current state of production increased by 30%

Type of product	Sales excluding VAT in €	Quantity in pieces	Quantity in kg
Milk	638 301.014	2 198 166.1	1 424 528.3
Curd cheese	30 650.685	8 971.3	8 971.3
Butter	255 233.108	53 105	53 105
Yogurts	270 447.19	1 131 304.2	186 061.2
Flavoured milk	26 918.892	131 693.9	26 339.3
Creams	2 077 731.578	7 511 513.1	1 558 654.5
Curdled milk	321 040.655	648 883.3	468 735.8
Curd	247 095.654	102 339.90	102 339.90
Cream deserts	187 015.075	8 149 667.5	3 893 934.2
Total (average for 1 year)	4 054 433.851	12 600 942.9	2 995 334
Average for six months	2 027 216.919	6 300 471.2342	1 946 966.7919
Average for one month	337 869.48754	1 050 078.53899	324 494.46536

Because of limited extend of the paper we present only the final state of the time (duration) of particular stages of production process, which should be kept from the technological point of view.

Table 10. Comparison of the duration of the particular stages of production process

Current state		State after increased production by 30%	State after applying optimization measures
a.	6 hours (360 minutes)	6 hours (360 minutes)	6 hours (360 minutes)
b.	3 hours (180 minutes)	3 hours (180 minutes)	3 hours (180 minutes)
c.	5,5 hours (330 minutes)	7 hours (560 minutes)	6 hours (360 minutes)
d.	2 hours (120 minutes)	3 hours (180 minutes)	3 hours (180 minutes)
e	7 hours (560 minutes)	7 hours (560 minutes)	7 hours (560 minutes)
f.	4 hours (240 minutes)	5 hours (300 minutes)	4 hours (240 minutes)
g.	7 hours (420 minutes)	7 hours (420 minutes)	7 hours (420 minutes)
h.	1 hour (60minutes)	2 hours (120minutes)	1 hour (60 minutes)
i.	1 hour (60 minutes)	1,5 hours (90 minutes)	1,5 hours (90 minutes)
j.	40 minutes	1 hour (60 minutes)	40 minutes
k.	1 hour (60 minutes)	1,5 hours (90 minutes)	1,5 hours (90 minutes)

Conclusion

Production companies are now trying to fully utilize the logistics system tailored to specific needs of the company. They are aware that an appropriate use of logistic principles to arrange transport and handling across the enterprise can become evident at least in two areas. The first is inside the company, and that can be achieved by reducing their own cost of production, which also includes logistics costs, which means that while maintaining market prices, the company achieve higher profits. On the other hand, properly selected logistics chain improves business flexibility to market demands enabling better provision of services to customers. Although in this paper an example of a solution is not directly in the field of mechanical engineering, solving the logistical issue to some specific features (hygiene standards) is similar. We found some limitations. It is difficult to get data from companies. If we can, then we could make more complex research. There is still gap in effectivity. New technologies, that could be not invented yet, will surely help to shorten the logistic path. In the future company can focus on other areas of its activities, for example, are collaborating with more manufacturers, the introduction of new brands to offer or attract new customers. Based on the literature, but also on the experience such a procedure can be used to solve similar problems in different sectors. In examining logistics route it is and increasingly will be applied to GPS, which has and may indicate the possible optimization routes for distributors. In the future it will have a closer also address this issue and therefore implementation GPS with distributors. This principle could be helpful in different countries and for a wide range of raw materials.

References

Bradbury K., Hill J., Newton M., Malins M., *Introduction to Logistics & Operations Management Strategy,* Available at: *http://www.rcmse.eng.chula.ac.th/?q=node/55*, Access on: 11.10.2012.

Coyle J. John et al., 2008, *Supply Chain Management: A Logistics Perspective,* US, Cengage Learning.

Davis T., 1998, *Effective Supply Chain Management*, "Sloan Management Review", ITcon, 12/2007, Delphigroup, www.delphigroup.com.

de Toni A. and Tonchia S., (1996) *Lean Organisation, Management by Processes and Performance Management*, "International Journal of Operations and Production Management", 16 (2).

Dupaľ A., BREUINA I., 2006, *Logistika v manažmente podniku,* Bratislava, SPRINT.

Grabara J., Bajdor P., Okwiet B, 2010, *Center as a tool for logistics activities in support of the company on the example of SME*'s *enterprise X* , "Polish Journal of Management Studies", 2.

Gincharuk A.G., Lazarev N.O, Alsharf I.A.M., 2015, *Benchmarking as a performance management method*, "Polish Journal of Management Studies, 11(2).

Gajdošová E., 2006, *Logistická stratégia podniku,* Bratislava, Ústav priemyselného inžinierstva, manažmentu a kvality.

Goldsby J.T. et al., 2005, *Lean Six Sigma Logistics: Strategic Development to Operational Success,* US, J. Ross Publishing.

Gubbins E.J., 2003, *Managing Transport Operations,* London, Kogan Page.

Hines P., Rich N., 1997, *The Seven Value Stream Mapping Tools*, "International Journal of Operations and Production Management", 17(1).

International logistics management. Logistics Book. Available at: http://www.filestube.com /mLb8Ks7vf3kH0lAAGH5BH/Logistics-Book.html, Access on: 12.12.2012.

Jünemann R., 1989, *Logistik in Europa: Innovationsstrategien für Wirtschaft und Dienstleistungen*, Köln, TÜV Rheinland.

Jones D.T., Hines P., Rich N., 1997, *Lean Logistics*, "International Journal of Physical Distribution and Logistics Management", 27(3/4).

La Londe B.J., Pohlen T.L., 1996, *Issues in Supply Chain Costing*, "International Journal of Logistics Management", 7(1).

Lambert M., 2005, *Logistika,* Brno, CP Books.

Lehtonen J-M., 1995, *Logistics Performance Measuremen*t: *an Application to Pulp and Paper Industry,* Proc. Intl. Federation for Information Processing Working Conf. on Reengineering the Enterprise, University College Galway, Ireland.

Liberko I., 2010, *Základy logistiky. Teória a prax*, Prešov, Fakulta Manažmentu Prešovskej Univerzity.

Logistický reťazec, Available at: http://www.chirasys.sk/home.nsf/pages/ibisdblog? opendocument&start=1&count=1000000&collapseview&jazyk=sk, Access on: 3.2. 2012.

Logistický reťazec, Available at: *http://www.euroekonom.sk/obchod/logistika/logisticky-retazec*, Access on: 12.12.2012.

Lumnitzer E. et al., 2013, *Metodológia komplexného hodnotenia zdravotných rizík v priemysle 2,* Zrecin: MUSKA.

McKinnon C.A. et al., 2002, *Transport logistics*, Cheltenham, E. Elgar.

Pampel C.F., 2000, *Logistic Regression A Primer*, SAGE Publications.

Pernica P., 1998, *Logistický management: teorie a podniková praxe*, Praha, Radix.
Pfohl Ch., 2001, *Systemi logistyczne, Podstawy organizacji i zarządzania*, Instytut Logistyki i Magazynowania.
Poliačiková E., 2012, *Manažment kľúčových zákazníkov*, Bratislava, Iura Edition.
Preberanie a oceňovanie mlieka, Available at: *http://www.mlieko.sk/ocenovanie_m.php*, Access on: 3.2.2012.
Sixta J. et al., 2005, *Logistika teorie a praxe*, Brno, Computer press.
Vom Brocke J. et al., 2010, *Handbook on Business Process Management*, Berlin, Springer.
Zákon o hygiene, Available at: http://www.svssr.sk/legislativa/zakon_152.asp, Access on: 3.2.2012.

MOŻLIWOŚCI OPTYMALIZACJI ŁAŃCUCHA LOGISTYCZNEGO W ZAKŁADZIE PRODUKCYJNYM

Streszczenie: Gospodarkę rynkową charakteryzuje między innymi fakt, że przedsiębiorstwa są w stanie natychmiast reagować na wymagania rynku - klientów. W praktyce oznacza to, że klient chce mieć towar w lokalizacji, w określonym czasie i dostarczony w odpowiedniej jakości i cenie, która jest określana przez podaż i popyt rynku. Jedną z możliwości zwiększenia wydajności biznesu i konkurencyjności jest zredukowanie kosztów produkcji lub kosztu całkowitego. Koszty logistyczne (w literaturze również określane jako „koszty całkowite") stanowią bardzo wysoki odsetek tych kosztów. Są one częścią kosztu całkowitego, który w znacznym stopniu wpływa na zarządzanie firmą. W artykule nakreślono sposób, w jaki koszty te mogą zostać zredukowane, na podstawie analizy i wykorzystania podejścia racjonalizacyjnego do obecnego stanu organizacji i zarządzania nią, bez konieczności stosowania znaczących kosztów wdrożenia pewnych środków.
Słowa kluczowe: logistyka, SWOT, transport, firma, mleko

可能性優化物流鏈中的生產廠房

摘要：市場經濟是，除其他的事實，企業能夠迅速響應市場需求特點客戶。在實踐中，這意味著該客戶希望有貨的位置在特定的時間和足夠的質量和價格，這是由市場供求關係決定的規定。一到提高業務效率和競爭力在一般的選項是，降低生產成本，或總成本。物流成本（在文獻中也被稱為“總成本“），表示這些費用的比例非常高。他們是總成本的一部分，大大從而影響公司的經營。本文概述了這些費用如何降低的基礎上，分析和使用合理化的方法來組織和管理的當前狀態的可能性，而不需要實施某些措施的大量成本。
關鍵詞：物流，SWOT，交通，企業，奶