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LOGISTIC COST OPTIMIZATION IN THE FOOD INDUSTRY OF SMALL COUNTRIES

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Abstract

This research is aimed to determined and conduct a logistic cost optimization algorithm in the small markets food industry. The authors conducted a survey and indicated that in a small market food industry the main influence to the transportation cost is partial cargo transportation. Regarding this finding the authors offers a cost optimization algorithm using clustering processes. It was concluded that the usage of clusters can dramatically reduce cost and the optimization level is even higher in a small market.

KEY WORDS: *competitive advantage, clusters, logistics, supply chain management, food industry.*

Introduction

The world's economics is growing and rapid technology change requires a new perspective to competitive advantage maximization possibilities. This paper is orientated to the small markets and particularly to the food industry. Today a new perspective to the small market competitiveness is needed, because there are countries that are developing rapidly and some a failing in the market. Regarding the competitive world index Netherlands remains in the 8th place, Lithuania has dropped from 41th place to 48th. Even united states lowered her ranked from the 3th place to the 5th. Nether less, Belgium increased from the 17th till 18th place (World economic forum, 2015). Regarding this information, it is important to determine the competitive advantage maximization strategies of the small markets. The food industry has been chosen, because new trends in the industry has required a more complex supply chain management and one of the most complex is the food supply chain. Because there is a new trend that consumer desire for safe, healthy and high quality food products (Canever, Van Trijp, Beers, 2008). There are researches done about competitive advantage increases for the food industry. Sam Saguy and Vera Sirotinskaya analysis the importance of innovations in the food industry with a focus on medium enterprises (Saguy, Sirotinsaya, 2014). The globalization has changes the world and it does not matter the resources or the land, what matters is the technologies that are used (Pilzer, 2006). The internet has created new possibilities and today industry's that learns how to distribute information and products faster will prevail. Bosana and Gebresenbet indicates the importance of food supply chain clustering in order to increase supply chain competitiveness (Bosana, Gebresenbet, 2011). There are scientists that analyzed the logistic cost singularities and their results indicated the need for caution in interpreting changes in logistics costs, and for simultaneously controlling the effects of numbers of employees, transport costs, warehousing costs and total logistics costs (Engblom, Solakivi, Toyli, Ojala, 2012).

Therefore, all irrational cost strongly raises the end product cost in a small markets, because of this the company competitive advantage may lower. In this paper, the authors are aiming to optimize the food supply chain by offering to use clustering processes that would increase the company's competitive advantage. In order to optimize the supply chain it is essential to analyze different transportation cost components in a small markets food industry.

Novelty of the study: Authors research indicates that in the food industry logistic cost has a large impact to the total cost. These cost even more increases in a small market, where the market's receptivity is small. Business cooperation, clustering and integration processes are popular and rapid, because using these processes the company can dramatically lower its cost. The authors done research indicates that using clustering processes in the logistic field, the companies can lower its supply chain cost. Additionally, in small markets clustering processes dramatically lowers cost. Regarding these findings, it can be concluded that clustering process usage in the logistic field, can be treated as a competitive advantage increases factor.

Object of the study: Small market's food industry's logistic cost.

Goal: analyze transportation cost components and model a cost optimization algorithm for small markets food industry.

Objectives:

1. Analyze the structure of food industry's supply chain cost
2. Module food industry's logistic cost optimization algorithm.
3. Conduct a statistical analysis to determine clustering process effectiveness to the total logistic cost.

Food industry‘s logistic cost

Before analyzing the supply chain cost it is essential to understand the complexity of the food supply chain and what kind of expenses may appear in logistics. After all one of the main priorities of competitive advantage is customer satisfaction and today the customers expect food products to be in good quality and on time.

The food supply chain is a complex process that needs to be taken in to consideration constant, because of this there are many database, management systems, like lean management, just in time production and other aspects not only of manufacturing processes, but also about distribution possibilities. Turkensteen and Klose analysed the demand dispersion on logistics costs and determines that the market segmentation is essential for warehouse management systems and offers a one-to-many distribution system in which a central facility serves all demand points (Turkensteen, Klose, 2012). In addition, there research indicates the importance of relationship with distance and logistics cost. Nether less, this particular research does not take in to consideration the short lead-time of food products. Other authors analyze the importance of lead-time in the food industry. Turi, Goncalves and Mocan takes in to consideration not only cost, but also quality and lead-time for the food industry to increase competitive advantage. They conclude that companies within the food industry must improve their overall logistic performance, be aware of any developments from the very beginning, to anticipate them as soon as possible and to adapt quickly, only then they can better distribute their products, meet the needs of their customers and ultimately remain competitive in a highly competitive market (Turi, Goncalves, Mocan, 2014). The supply chain is complex and there are many factors that need to be taken in to consideration, lead-time, cost and product quality is just some of the importance issues that has to be analyzed to determine the impact to the food industry’s supply chain. In addition, there are authors that offers tracking systems for the food supply chain. Chen offers a fuzzy tracking model with can not only determine the position of the product, but also indicates damage products and analysis the reasons why the damage occur (Rui-Yang Chen, 2015). This is another factor that should be taken in to consideration for the logistic cost analysis, nether less this is still a complex field and it differs from the product type and market. Because of this, the main strategy that can lower the damage product cost can be a well prepared packaging for the transportation of the products. “Packaging plays a key role in protecting the product from contamination by external sources, and reducing damage during its transportation and handling in the supply chain from the producer and manufacturer to the consumer. In the United States alone, estimated annual losses due to damaged products exceed $10 billion“(California Polytechnic State University, San Luis Obispo, CA, USA; Michigan State University, East Lansing, 2008). These are the main problems that may occur in every supply chain. However, the small market has another problem that they may have. Partial cargo transportation also makes a large impact to the supply chain cost. The price of transportation differs if you want to transport 32 pallets or 2 pallets. A survey about Lithuania’s market was conducted and in summarize it concluded that that many food companies exports and imports partial cargo, i.e. raw materials for manufacturing. In addition, part of cargo requires frozen temperature while the other part requires chilled. Considering these facts and analyzing the logistic costs, it is possible to conclude that one of the reasons of higher transportation cost is partial cargo transportation (Navickas, Baskutis, Gruzauskas, 2015).

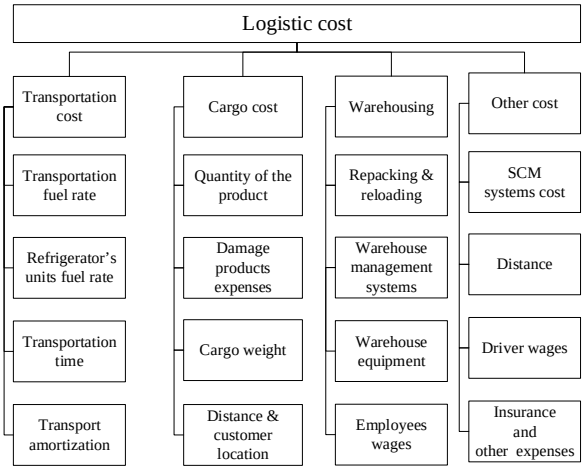

Fig. 1. Total logistic cost

Figure 1 shows the main logistic components. Some of them were already disguised above, like the damage product expenditure, quantity and distance relationship to the logistic cost. It is important to mention the tracking system’s employee wages and other expenses. These are areas that has influence in the supply chain cost, but a small market does not have a big flow of cargo and these kind of systems will not be taken in to consideration in this research. Transport in this scheme is regarded as all types of transportation - truck, sea, railway or air transportation. This is because all of them consumes energy, needs to control the temperature and has amortization expenditures. And lastly the last part is warehousing and it’s maintenance. The warehouse usually has to reload the cargo and repack it, also a lot of expenditures goes to the ordering and cargo tracking systems, because the products needs to be hold as inventory before moving to the customer. The transportation cost components is essential to analyze, because the optimization algorithm needs to be oriented to a particular field.

Logistic cost optimization algorithm

In order to determine and module a cost optimization algorithm, it is necessary to overview the food industry. This is important because the food industry is a wide topic and it is hard to describe the transportation singularities of the food industry, without understand the temperature control regulations. Many different products require different regulations or transportation ways. Food products can be categorized in to groups and there are many different aspects of them. One type of the products can be that requires chilled or frozen transportation.

Chilled transportation usually is from +2 C^o till +15 C^o, while frozen transportation usually is from -18 C^o and below. The temperature control of the product is important for several reasons for the food industry. First of all the transportation cost depends on the temperature, additionally this means that some programs can be transported together and other cannot. For example you can't transport ice-cream with vegetables and fruits. Unless you are using different temperature control transportation technology's.

1. Refrigerator truck.

Semi-trailer's part of the body is made from thermos material, that helps held the heat from diminishing. Then there may be several refrigerator units inside, that helps maintain the required temperature. The ventilation system for the refrigerator is a technology that uses air tracks from the top to bottom of the truck that creates an air cycle inside, what helps to maintain the required temperature (Laudet, 2013).

2. Flexible partitions for temperature zones.

These partitions are used to divide the transportation area in several parts. It may come in handy transporting partial cargo and maintain two or three temperature zones at the same time. Additionally, this may help companies increase their competitive advantage and decrease cost (Nelson, 2012).

3. Double decker

This technology is used for transportation cargo with several floors. Crossbars are fixed between the trailer walls and on top of them the cargo is loaded. It is important to know the possibilities of these crossbars, because overweight could damage the cargo.

4. Load securing system

Some food products may be transported in small packages and during braking they may fall. These bars are fixed lower than the double-decker and they manly help to maintain a fix position for the cargo.

5. Meat transportation equipment.

This equipment is used when transporting raw meat with hooks and not on pallets.

6. Folding wall

This is a new technology that helps a closed box trailer to load cargo even faster. This is specially developed to load from the side.

7. Thermogram

This technology is used to track the temperature for the whole trip. If necessary, they can print out a thermograph for detail visualization for the transportation process.

Understanding the temperature technology is important for cost optimization in a small market, because the small market has problems while transporting cargo and regulating the quantity of the transportation. This technology usage can help optimize the transportation cost.

Moreover, the temperature effects the food products quality. A research was conducted about the temperature controlled impact to the salmon quality. The results indicated that the DNA damage in salmon cells was visible for frozen salmon after 3 h of thawing at 10 C^o and for chilled salmon after 9 days of storage (Grandois, Ruas, Kalisa, Jolissaint, Marchioni, Aoudé-Werner, Le Fur, Ennahar, 2013). These findings indicate the importance of temperature technologies usage in the logistic area. Many products are frozen to maintain their freshness, nether less the quality of products lowers overtime. Regarding this fact, the lead-time of transportation is also very important for the food product. It is necessary to distribute the food products as fast as possible, otherwise the customer will not receive quality and healthy food and in these days, it would be a bad situation. Actually, it is already a bad situation in many regions. "Each year, Dutch consumers throw away approximately € 2.5 billion worth of food. This is equivalent to more than € 155 per person, or around 50 kilos. Food producers, wholesalers, the hospitality industry and supermarkets discard a further € 2 billion in food (Ministry of Economic Affairs, 2013) ". This is why lead time is essential for the company, to reduce their cost of wasted food, because it lowers the competitive advantage of the company's.

However these facts validates not for all products. There are products that has a low expiration day, other has a higher. For example cheese, sauces may be transported in longer lead time. This is another topic that is essential in order to professionally determine the temperature technologies impact to the food supply chain. Food can be transported with different types of vehicles. The most common one in Europe is land transportation. Trucks has been used for some times and their usage has increased when the fuel consumption allowed it, but this is not the only transportation possibility. Sea transportation is also commonly used in the food industry. There are large ports in the Europe union that is exporting and important food products often. It is also a way to reduce cost and to offer logistics compatibility. For example, some companies uses transportation from Lithuania, to United Kingdom by land, sea or combined transportation. There are also railway distribution that are used in the food industry, but it is used in larger distances and larger quantities. Usually the cargo in the railway transportations takes up from 2 till 4 wagons. In order to optimize the logistics cost and increase competitive advantage it is important to understand the logistic transportation comp ability. In order to be internationally competitive, businesses are organizing strategic worldwide networks that can deliver an efficient and high-quality response to demand from any segment of the world market. The efficient and integrated organization of such activities is often referred to as global logistics or supply chain management (SCM), and it has become the core of global competitive power.

The food industry has a complex supply chain because of the singularities described above. To increase the companies competitive advantage it is essential to optimize different aspects of the cost.

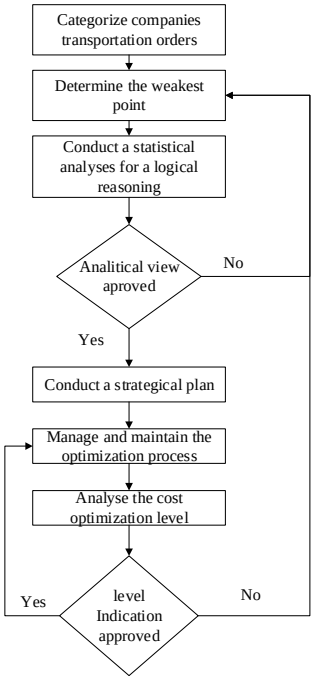

Fig. 2. Logistic cost optimization algorithm

A universal optimization algorithm is described in figure 2. This particular method is modeled for small and large markets, but it also helps indicated the necessary optimization strategy in the small markets. First of all it is important to categorize all the logistic cost, an example what made in the previous chapter about the different cost components. This is essential, because different companies may use different management systems, transportation possibilities, warehouses etc. Then it is important to conduct a survey inside the company and determine the theoretical weakest points. For example some companies may have a problem with the lead-time, because of this many products may be damaged. Nether less this particular problem usually happens in a large market and not in a small market. A small markets main problem would be transporting partial cargo. Usually the companies outsources logistic services, but this method can increase cost, because the transportation price per pallet can vary from 120 euro to 40 euro. When the theoretical weakest points are determined by a survey it is important to conduct a logical reasoning and determine if the experience really indicates the best points to optimize cost. If the statistical analysis is approved it is important to conduct a strategically plan for the cost optimization. This plan can vary for every companies, because some of them should start using fleet management systems, clusters, ordering data bases etc. This particular method needs to be determined inside the company. Then another plan needs to be conducted that would maintain the cost level and if this isn't enough for a cost optimization the algorithm can be continued from the second weakest point, until the company reaches satisfaction.

Clustering process effectivness

Logistic cost structure and the temperature controlled technology overview shows ways how to use clustering process for competitive advantage maximization. Transporting combined cargo and organizing clusters could dramatically increase competitive advantage. Pu-yan Nie and Peng Sun analysed the formation of industrial clusters based on spatial competition and search costs in a game theoretic model. By establishing a spatial competition model, this paper compared firm profits under clustering to those without clustering. They found that search costs are an extremely important factor in the formation of industrial clusters that can give rise to industrial clusters in certain industries (OECD, 2002). This chapter will indicate the impact of different logistic costs to the total logistic cost. This is important to understand and to help determine better strategies in order to use clustering processes for competitive advantage maximization.

A specialist interview was conducted in a small market. Lithuania has been chosen as a proper market - it is in a good geographical position and the food industry is strong in the region. Lithuania holds 64th place in the world's international trade with an export of 30.4 billion $ in 2013. In 2013 part of the export was food that generated 1.9 billion $ revenue and this is an increase by 8.3% if compared to the previous year. In addition, there are 816 food manufactures working in Lithuania (Navickas, Baskutis, Gruzauskas, 2015). Regarding these facts, this is an excellent region to conduct a specialist interview and to determine the main cost of logistics in a small market. During the interview, information was gathered about the loading, unloading addresses, cargo quantity, temperature requirements and fuel consumption rate. During the analysis, it was determined that the largest impact to the total logistic cost does the quantity of the cargo. While transporting a full truck (32 pallets) the pallet price is about 40-48 euros per piece. While transportation partial cargo price per pallet may be from 120 till 80. This is a large influence to the total logistic cost. While transportation full cargo the cost is quite standard, but when transportation partial cargo the cost rises dramatically, this factor is influencing negative the total logistic cost and it lowers the company's competitive advantage. Manufactures who imports raw material usage transport them in partial cargo and they use outsourcing logistics for cost minimization. This is a wise strategy, because it sure lowers cost, because you do not need to send large distances only part of the truck. Nether less it is still expenditures and logistic service providers have their own margin. Because of this the authors offers to use clustering processes for competitive advantage maximization. Cluster can help combine industry's and increase their information flow, R&D and optimize transportation and ordering cost (Pu-yan Nie, Peng Sun, 2015). Why should a company give away their orders to an outsourcing logistic company, if they can create clusters and share cargo together? This way the margin of the cargo can be shared between the cluster for developing centers and development possibilities. This is a strategy that small markets are already using, but not all understand this kind of competitive strategy. To understand the importance of clustering to optimize cost it is essential to overview different types of clusters.

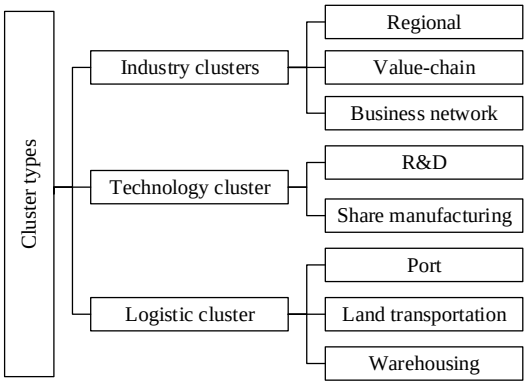

Fig. 3. Cluster types (United Nations ESCAP, 2008)

The first groups of the clusters can be categorizes in to industrial, technological and logistic clusters. The process of clustering is similar in a simplistic way to say companies that has similarities their can combine their information, technology, money and increase their competitive advantage. This particular method is popular around the world, because only working together it is possible to stay competitive and ahead of the growing technology.

Industrial clusters are clusters that work together and share their information. These kind of clusters usually are located regionally and has similar suppliers and working area. After all to get a better price it is wise to buy raw material together and by doing this the cost for raw material would lower. Additionally there are companies that works as groups and are trying to monopolize a specific market. There are many examples like this, particularly in Lithuania there a companies like "Arvi kalatukai", "Viči group", „Kauno grūdai" and etc. These companies have their own and primary working area, but as time goes by they start working with different companies and buys their stocks. This is just one example of a possible industrial cluster.

There other type of cluster is called technological. To put it simple, these companies combines their knowledge and technology to increase capacity, R&D centers and etc. One of the best example is Food Valley, which is a region in the Netherlands. The Food Valley area is the home of a large number of food multinationals and within the Food Valley about 15,000 professionals are active in food related sciences and technological development. Within this region, the Food Valley Organization is intended to create conditions so that food manufacturers and knowledge institutes can work together in developing new and innovating food concepts.

And the last type of clusters are logistic clusters. These clusters are orientated totally to logistic services. This clustering process is the best method for small markets, because of the food industry's singularities the partial cargos can be combined and it will help to optimize cost. One of the best food logistical clusters in the world is "World food programme". This cluster helps to solve the hunger problem in the world and they combine thousands of companies together and organize distribution through the whole world. The logistic systems used in this cluster is incredible, because they have achieved high level of logistic compatibility. Hey control over 100 planes, 3000 railways, trucks, 30 ships and they distribute the food from amazon jungles to Iraq etc.

In general it is hard to determine just one type of clusters, usually they are combined clusters and are working in several areas. For example industrial and logistic clusters often can be used together.

Conclusions

This research indicated that the food supply chain is a complex process in a small market and it is different from large markets. The main singularity of a small market is the flow of cargo, it is much lower than in a large market. Because of this it is necessary to conduct a different approach to the competitive advantage increases. Regarding this finding and analyzing the transportation cost of small markets the results showed that partial cargo transportation can dramatically increase transportation cost in a small market and lower the company's competitive advantage. An optimization algorithm was offered to maximize competitive advantage. This particular algorithm is adapted to all logistic sector and it also can be used in a small markets food industry. While applying the optimization algorithm in a small market a clustering processes strategy was offered for cost optimization. The clustering process indicated that in a small market logistic cost can be dramatically lowered by combining orders and transporting them in a group of companies. Regarding these findings it can be concluded that clustering process can be treated as a competitive advantage maximization factor for a small market's food industry's logistic sector.

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