

THE ASSESMENT OF RISKS OF LOGISTIC CHAIN BASED ON MEDICINE RETAIL CASE

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The article analyzes the problem of assesment of business risks of the Logistics chain from the point of storage to the end-user based on medicine retail case. The problem of the article – how to evaluate and manage the business risks of the logistics chain? The purpose of a research – after conducting a thorough scientific literature analysis, to define the business risks affecting the Logistics chain and to evaluate them according the impact on the Logistics chain, thus creating a basis for a more efficient management of these risks. The research was conducted using Analytical hierarchical process method in a medicine retail sector in Lithuania. It has been determined that the most important risk factor, affecting the Logistics chain from the point of storage to the end user, is the demand. Three of the following risk factors: operational risk, information dissemination risk and financial risk are almost equally important, with supply and environmental factors being of the least importance.

Keywords: Analytical hierarchical process, business risk, logistics chain, risk management, supply chain.

JEL Codes: D81, G32.

1. Introduction

Logistics management processes are well-known in both global and in Lithuanian companies. Organizations of Western Europe, USA, Southeast Asia countries apply logistics systems and its' processes in the field of management to support efficient activities and to satisfy customers' needs. This fact was revealed in S. Wagner and Ch. Bode (2008), D. Ojha and R. A. Gokhale (2009), R. Muthuveloo, R. Pulenthiran and A. Teoh Ping (2013), J. Varzandeh, K. Farhbood and J. Z. Jake (2016) researches. Meanwhile, this area is relatively new and not very widespread in Lithuania (Beniušienė, 2007; Rutkauskas, 2011). Many business entities consider logistics as a separate business area, so only few of them integrate logistics into business processes as an integral part of unitary system, although this aspect allows companies to operate effectively and remain competitive on the market. One of the components of the logistics system is the logistics chain. It is an integral part of the supply chain, which includes, planning, delivering goods from the storage point to the end consumer in order to meet all customer needs.

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Specifically in this process companies are faced with a number of risks affecting the competitiveness of a whole business entity. It was researched by M. Manzouri, M. A. Ab Rahman, B. Selangor (2015), M. M. Marchesini and R. L. C. Alcântara (2016), R. Messer (2017). Such a situation suggests a research problem – how to evaluate and manage the risk factors in the logistics chain? The research object – risk factors affecting the company's logistics chain from storage point to the end-user in Lithuania. This suggest an aim of a research, which has been formulated as follows: to evaluate the risks of the company's logistics chain from storage point to the end user. The empirical basis of a research was provided by Lithuanian retailers of medicines. The methods of analysis and synthesis of a scientific literature, expert interview, Analytical hierarchical process and statistical analysis were employed in order to solve a scientific problem.

2. The concept of the Logistics chain

According to J. M. Yean, K-H. Chien, C-H and Wu, T-L. Lee (2017) logistics is the process by which the company is trying to move resources from the starting point to the final destination as efficiently as possible. As logistics management becomes more and more complex, companies need to gain more experience and use advanced technology in order to improve processes. Improving customer service can ameliorate company's reputation, improve process optimization and reduce costs in ongoing operations. Logistics is increasingly seen as an essential element of modern supply chain management. According to R. Dekker, J. Bloemhof and I. Mallidis (2012), global trade growth requires advanced solutions for manufacturers, suppliers, wholesalers, retailers and importers, and the ever-increasing movement of material objects and information flows on a global scale requires precise process execution and improvement. Logistics management and optimization processes are improving due to information technology innovations that allow the supply chain to operate more efficiently. For successful logistics management, according to M. M. Porporato (2016), it is necessary to select and coordinate actions that optimize the whole process of the company's operations as a single system. R. Matwiejczuk (2013) states that many of the business success factors are related to logistics. Among them, logistics resources, logistics capabilities and logistics competencies. Logistics capabilities, or otherwise, potential, should be integrated into strategic management concepts that allow the process to be analyzed and used in practice. It is a strategic management that creates the basis for defining the so-called profile of a strategic business success potential, including logistics competences that depend on logistics resources and logistics capabilities.

However, often in the scientific literature, the concept of the supply chain and the logistics chain are identified or expressed as two separate activities, and it is therefore necessary, in the context of this topic, to find out their interconnectedness and determine what exactly we will consider as a logistics chain. I. Beniušienė and J. Stankevičienė (2007) distinguish the supply chain and logistics processes in the supply chain rather than the logistics chain as a separate factor. According to these au-

thors, the supply chain includes logistics processes, order management, information flow, production processes, and control activities for activities in the supply chain. Logistics activities in the supply chain include processes such as planning, efficient delivery of services, and supply of goods from the starting point to the destination and from destination to final customer in order to meet all its needs. C. Rafele (2004) emphasized that the logistics strategy affects all business processes in the supply chain. According to A. Gargasas and V. Kavaliauskienė (2000), the logistics chain is the arrangement of logistic operations, in a corresponding linear way, which helps to predict the costs of each part of the chain. R. R. Lummus et al. (2001) study emphasizes that logistics involves the flow of material through efficient logistics operations, planning, implementation and control from start to finish within the company and from the company to the end user in order to meet its needs as good, as possible. Logistics is often viewed as a single entity integrated into the company's business, but it quite autonomously manages flows between suppliers, businesses and customers. Supply chain management includes logistics flows, customer order management, production process, and flow of information needed to monitor all activities.

A. Gargasas and V. Kavaliauskienė distinguish the following logistics operations: processing of information, receipt of order, operations related to the warehouse, i.e. ordered quantity, delivery, transportation, loading, reception, etc. All these operations also referred to as elements related to each other, often form a unified system. M. Bielecki and M. Hanczak (2016) distinguish these logistical operations, including integrated order management, supply, storage, packaging and transport. D. M. Gligor and M. C. Holcomb (2012) argue that logistics operations that affect supply chain's flexibility and adaptability to the environment have a significant impact on management. Stock management, which includes processes such as receiving customer orders, supply of production and its distribution, to satisfy client's needs also requires logistics operations to maintain these processes. They help quickly adapt to changing environmental conditions, as well as to customer needs also. Based on a literature analysis, the authors formulated the following definition of the logistics chain. The logistics chain is the arrangement of logistical operations in a most effective way, what helps to achieve the goals of the company. The logistics chain is an integral part of the supply chain, which includes the planning of supply chain activities, efficient delivery of services or goods from storage point to the end user in order to meet the customer's needs.

3. Risk factors in a Logistics chain

M. F. Rebelo and R. Silva (2016) state that both internal and external business environments encourage risk, and the whole organization's activities are related to risk and its manifestation. These authors highlight the consequences of a weak enterprise risk management. The poor risk management has the greatest impact on business, which leads to a loss of competitiveness in the market, and thus a weakening of business. Risk management strengthens confidence within the company personnel, business partners as well as other stakeholders or third parties. Therefore, in order to

remain on the market and to be competitive, business enterprises must reduce their risk to a level that would ensure such a position. According to E. J. Sieber and B. Tolich (2012), in order to avoid or minimize risk, first it is necessary to analyze and identify risk factors. By doing this, we can begin the analysis and evaluation of risk factors of a company, which is to find out the possible consequences of each risk and their impact on the overall business activities. According to I. Manuj and J. T. Mentzer (2008), both global supply chain and logistics chain risks comprise four main areas: supply, demand, operational and security risk categories. The *supply risk* is associated with unforeseen incidents in arrival or distribution of goods, these events affect the company's ability to deliver the goods to the client in a timely manner and meet all his needs, as these events may be detrimental to the quality of the product or to the satisfaction of the required demand. *Operational risk* is an unforeseen event that affects the ability to produce goods and services, and can also include quality and timeliness and profitability of production. *Demand risk* – affects the ability of customers to get the product, and the company to provide what product. *Security risk* is a threat to human resources, operational integrity and information systems. These risks can have consequences such as cargo breaches, data leaks, property disappearance, vandalism, crime.

Summarizing the main risk factors affecting the supply chain from storage point to the end user proposed by the various authors, we grouped into the following risk groups: demand, supply, operations, information, finance, and environment. More detailed these factors will be described in the methodological part.

4. Methodology

As a research model we have chosen an expert survey, which is based on an Analytical Hierarchy Process model. According to the requirements of this model we constructed a questionnaire, where risk factors such as demand, supply, internal operations, flow of information, finances and the environment are analyzed through a pair-wise comparison. With the help of a questionnaire we aim to rank these factors according the importance and their influence on the company's logistics chain part from storage to the end user.

Demand. In particular, the customer demand for a company's products is analyzed. In this case, there is the risk associated with the company's product compliance with customer demand. Organization, in order to carry out its activities efficiently, must to sell its products and there must be a sufficient demand from consumers. It can be influenced by factors such as greater competitor's attractiveness to the customer, quality mismatch with expectations and etc.

Supply. In this case, this factor can also be called supply risk or product supply disruption. This risk is related to unforeseen events when supplying or distributing goods. These threats affect the company's ability to deliver the product to the client in a timely manner and meet all its needs, as the events can be detrimental to the quality of the product or to ensure that there is a sufficient demand for the product.

Operations. In the present case, this risk relates to unforeseen events that affect the ability to deliver goods. This area includes the day-to-day business operations of the company, which require the relevant logistics chain between the product and the end user.

Information. Risks related to information dissemination within the company and unforeseen events affecting processes, electronic systems, data movement factors in an organization, access to key information, data collection and use, market intelligence, etc.

Finance. Risks associated with unforeseen events that affect cash flows within and between organizations also include costs and investment management for the part of the chain in question, settlements with finance institutions, processes and the entire trading system of the company.

Environment. In the present case, it is the risk of unforeseen events that cannot be controlled, i.e. natural disasters. There is also a risk that can only be affected in part, such as the impact of weather changes on transportation, storage or provision of services.

These above mentioned risk factors, affecting the logistics chain from the storage point to the end-user are our research object, what will be examined further.

An expert survey based on expert judgment evaluation was chosen to perform the research and solve the problem. This is a method that summarizes expert judgment based on their knowledge, intuition and experience. A questionnaire was prepared for it, based on the Analytical Hierarchical Process method. Experts' survey was selected, because the specific problem is needed to solve the problem. For the survey we selected two expert groups, experts from academic field and practitioners. These groups differ in their experience, at the level of the livelihood and in relation to the research problem. Experts academicians are individuals who hold a doctorate and a professor's position and are interested in logistics processes in companies and have been investigating it for a long time, i.e. more than 10 years. Experts' practitioners are individuals, who are directly involved in logistics processes of a company, hold high positions in the enterprise and have a long experience in logistics field – no less than five years. According to V. Rudzkienė (2005), the number of experts required for achieving a high 95% confidence threshold is 7 persons. In order to ensure a high degree of reliability, 7 experts from the previously mentioned two groups were selected and interviewed. Three experts from academic field and four experts from a group of practitioners comprised the expert board.

As required by AHP method experts compare alternatives with each other by filling pair-wise comparison matrices:

$$A = (a_{ij})_{n \times n} \quad (1)$$

where

$$a_{ij} = \frac{\omega_i}{\omega_j}, (\forall i, j = 1, 2, \dots, n,) \quad (2)$$

$\omega_n (n = 1, 2, \dots, n)$ – priority vector

$$a_{ij} = \frac{1}{a_{ji}}, (\forall i, j = 1, 2, \dots, n,) \quad (3)$$

For completing individual comparison matrices experts were suggested to use nine point scale, where “1” means that factors are equally important and “9” means that one factor is extremely important over another. Every expert had to evaluate $(n(n-1)/2)$ pairs (n – number of alternatives) (Skvarciany, 2017).

Following the experts pair-wise comparison of the factors, all the assessments have to be constructed into so called standardised matrix and the standard arithmetic mean for each matrix line has to be calculated. Only after such procedure the main risk factor is being identified.

In case, if the level of response inconsistency is higher than the set limit (0,2), the matrix has to be modified into a consistent one, or should be eliminated from the further calculations. This procedure was not necessary as consistency of the matrices shows what experts’ evaluations were logical and reliable. A pairwise comparison matrix is considered as consistent if $p_{ik} = p_{ij}p_{jk}, \forall i, j, k$. It can be said, what exists such a priority vector $w = (w_1, \dots, w_n)$ that $p_{ij} = w_i/w_j, \forall i, j$.

In order to determine the consistency index, eigenvalue λ_{max} of pairwise comparison matrix could be calculated.

$$\lambda_{max} = \sum_{j=1}^n \frac{(A \cdot v)_j}{n \cdot v_j} \quad (4)$$

where: λ_{max} – the largest eigenvalue of matrix A; n – means number of independent rows in the matrix; v_j – eigenvalue of the matrix.

If experts’ pairwise comparison matrix A is consistent, $\lambda_{max} = n$ if there are minor p_{ij} changes and matrix A does not satisfy the consistency condition, then the λ_{max} value is close to n . After the value of λ_{max} is computed, consistency ratio CR could be calculated as follows:

$$CR = \frac{(\lambda_{max} - n) / (n - 1)}{RI} \quad (5)$$

where: CR – consistency ratio; RI – random index.

Random index is calculated from table 1, which was suggested by P. J. M van Laarhoven and W. Pedrycz (1983).

Table 1. Values of Random Index (RI)

N	1	2	3	4	5	6	7	8	9	10
IR	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49

Besides, consensus index introduced by K. D. Goepel (2013) was calculated.

$$S^* = \frac{1/\exp(H_\beta) - \exp(H_{\alpha\min})/\exp(H_{\gamma\max})}{1 - \exp(H_{\alpha\min})/\exp(H_{\gamma\max})}, \quad (6)$$

where: S^* – consensus index; H_α – Shannon alpha diversity; H_β – Shannon beta diversity; H_γ – Shannon gamma diversity.

AHP consensus index compares experts' numerical estimations of criteria. Typically the results can vary from 0 to 100%, and show the level of agreement between the experts. Only if all these consistency criteria are met, the data is considered as reliable and further analysis is being carried out.

5. Research results

An expert survey in the course of the research was conducted during a direct interview, due to the specifics of the questionnaire. The direct questionnaire method was chosen, because the same process can be perceived differently in different spheres, as well as because of the different level of academic comprehension of the respondents, which could allow them to perceive questions differently or to assess risk factors differently. It was precisely for these reasons that, in order to avoid ambiguity, meetings were agreed upon during which a questionnaire was completed. After summarizing the data, it turned out that all data is suitable for further analysis. All respondents' questionnaires were filled in logically and matched each other. The consistency ratio varied from a very low level of 0.05 to almost a limit of 0.19, but according to a predefined margin of 0.2, all questionnaires are suitable for analysis.

During the analysis of the data, a harmonized matrix of all expert opinions was drawn up (Table 2). The following figures were obtained when calculating the indicators that show whether the opinions of the respondents are in consistency with each other:

- consistency ratio (CR) – 0.13. It is lower than the predefined margin, which is equal to 0.2, so the research results are reliable and can be used in further analysis;
- expert consensus (Kendall's tau coefficient) coefficient – 0.60, that shows that 60 percent of experts' answers are in consistency to each other.

Taking into account these two indicators, we can say that experts' opinions are consistent, logical and adequate, therefore further studying and analyzing data is worthwhile, and research analysis data can be used in further research.

Table 2. Summarized expert opinion matrix

Risk Factors	Interviewer						
	1	2	3	4	5	6	7
Supply	0.09	0.19	0.17	0.04	0.07	0.1	0.2
Demand	0.09	0.33	0.35	0.2	0.29	0.33	0.35
Operational activities	0.09	0.18	0.18	0.35	0.1	0.16	0.18
Information dissemination	0.24	0.12	0.13	0.17	0.13	0.28	0.1
Finance	0.41	0.12	0.1	0.1	0.29	0.05	0.1
Environment	0.07	0.06	0.06	0.13	0.11	0.08	0.07

The resulting consistency ratio of 0.13 or 13% suggests that expert opinions are mutually consistent, i.e., all respondents look at the problem in a similar way, only the influence of the risk factors on the logistics chain differs, but the distribution of the factors itself is rather similar. The Kendall’s tau coefficient is quite high at 0.6 or 60 percent; this indicator in the hierarchical expert assessment model is sufficiently high and allows further use of the data for the study as they are treated as reliable (Podvezko, 2014).

Summarizing the data obtained during the research, the risk factors can be ranked according the influence on the logistics chain part from the storage location to the end user. The results are presented in the table 3. According impact strength, factors are ranked from 1 to 6. The most influential factor is the 1, the lowest is 6.

Table 3. Ranking of risk factors affecting logistics chain from point of storage to the end user

Risk factors	Normalized eigenvector	Rank
Demand	0.28	1
Operational activities	0.18	2
Information dissemination	0.17	3
Finance	0.17	4
Supply	0.12	5
Environment	0.08	6

As it can be seen from the table above (see Table 3), customer demand emerged as the most important risk factor that has the greatest impact on the logistics chain. These risks, as previously discussed, include factors such as a decline in customer demand due to various unforeseen factors and influences. We can distinguish more factors, what fall into this group, such as increased influence of competitors on customers, quality mismatches on customer expectations, mismatches of customer needs, etc. This risk factor is quite different from all remaining threats, i.e. its index is 0.28, i. e. 0.10 more than the second place, so we can firmly assert that this is the most important factor that companies should deal with first.

The other three risk factors were evaluated by experts very similarly according their importance. Operational activities, dissemination of information and finance, they received an appropriate rating of 0.178; 0.169; 0.168. Therefore, we can say that they all, according to experts, play a very important role in the processes of the company's logistics chain. The fifth factor according the importance, the supply of goods

– 0.12, the assessment of this factor as such a low indicator, differs sufficiently from the analysis of the theoretical literature, there the influence of risk factors is being analyzed. In the theoretical part, this factor is distinguished as one of the most important risk factors affecting the the logistics chain. Such a discrepancy between the assessment of theoretical and practical part of the risk, can be explained by experts' view, which was formulated by particular experience and accumulated knowledge. The respondents were contacted directly during the survey, so part of them stressed that without problems with other risk factors, the threat of supply of goods can be solved through various methods related to customer demand, for example, it has been mentioned that if you deal with a loyal customer relationship, the delay in the goods, or the absence of the required time at the place of storage, does not affect much the entire logistics process. The least important, according to experts, is the environmental factor – 0.08, i.e. various unforeseen environmental conditions. The force majeure is 0.2 points less important than the most important risk factor in the logistics chain part from storage to the end-customer, demand of customers. It can be concluded that this factor has been assessed as the least important because of the fact that respondents mostly operate in the Lithuanian and European markets, while the influence of the environmental impact in this geographical area is not high.

After conducting the study and evaluating the data obtained, we can conclude that the results obtained in the study are suitable for further research and analysis. Data received after pair-wise comparison survey enables to say that the biggest impact to the logistics chain from the place of storage to the end user is being done by the demand of customers. The other three risk factors: operational activities, dissemination of information and finance, are roughly the same, so we can conclude that these threats in the organization should be evaluated and managed structurally as a common system, i.e. taking into account all three processes in the same way, combining them with each other. According the opinion of experts, the supply of goods and the environment are risk factors that influence the logistics chain least.

6. Conclusions

1. After reviewing the scientific literature, and without finding a precise definition of the logistics chain, this concept was systematized and defined. The logistics chain is the arrangement of logistical operations in an effective way allowing achieving the goals of the company. The logistics chain is an integral part of the supply chain, which includes the planning of supply chain activities, efficient delivery of services or goods from the raw material to the end-user in order to meet the customer's needs.

2. After analyzing the researches on the risk factors of the logistics chain, we can state that the main influence on this process is caused by such factors as: customer demand, supply of goods, operational activities, and dissemination of information, finances and the environment. By differentiating risk factors according to priority, i.e. by dividing according to the influence on the activities of the logistics chain,

the company can focus on and address the highest risk factor, thus avoiding the greatest threat.

3. An empirical study has shown that the greatest influence to the logistics chain from the place of storage to the end user makes the demand of customers. Operational activities, dissemination of information and finance, affects this process at a similar level and strongly enough, while the supply of goods and the environment, in the opinion of experts, are least important factors affecting the logistics chain.

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LOGISTIKOS GRANDINĖS RIZIKOS VEIKSNIŲ ĮVERTINIMAS MAŽMENINĖS PREKYBOS VAISTAIS ATVEJU

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Santrauka

Straipsnyje nagrinėjama logistikos grandinę nuo saugijimo vietos iki galutinio vartotojo veikiančių rizikos faktorių įvertinimo problema, remiantis mažmeninės prekybos vaistais atveju. Straipsnio problema – kaip įvertinti ir valdyti logistikos grandinės verslo rizikas mažmeninės prekybos vaistais atveju. Tyrimo tikslas – atlikus mokslinės literatūros analizę ir išskyrus logistikos grandinę veikiančias verslo rizikas, sureitinguoti jas pagal svarbą, taip sukuriant pagrindą jų suvaldymui. Tyrimas atliktas naudojantis Analitinio hierarchinio proceso metodu Lietuvos mažmeninės prekybos vaistais rinkoje. Nustatyta, jog svarbiausias, labiausiai veikiantis logistikos grandinę nuo saugojimo vietos iki galutinio vartotojo yra paklausos rizikos faktorius. Trys po jo sekantys rizikos faktoriai: operacinė rizika, informacijos sklaidos rizika bei finansinė rizika yra beveik lygiareikšmiai savo svarba, o mažiausiai svarbūs yra pasiūlos bei aplinkos veiksniai.

Raktiniai žodžiai: Analitinio hierarchinio proceso modelis, logistikos grandinė, rizikos valdymas, tiekimo grandinė, verslo rizika.

JEL kodai: D81, G32.