THE PROCESS OF SELECTING LOGISTICS SERVICE PROVIDER FROM THE PERSPECTIVE OF THE SUSTAINABLE SUPPLY CHAIN MANAGEMENT

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Abstract

Supply chains include a large number of members, for example suppliers, manufacturers, intermediaries, logistics service providers (hereafter LSPs) and final customers. Manufacturers very often deal only with their core business and ancillary activities such as transport, storage etc. are outsourced by external entities (LSPs). Supply chain sustainability is the management of environmental, social and economic impacts throughout the lifecycles of goods and services. This concept is currently very popular and companies are trying to achieve it. If companies want to follow sustainable supply chain strategy, they have to choose LSPs in accordance with the concept of sustainable supply chain management. The aim of this article is to define an appropriate procedure for selecting logistics service provider with respect to a sustainable supply chain strategy. The selected multiple-criteria decision-making method (technique for order of preference by similarity to ideal solution) will be used for selecting LSP and the criteria for selecting LSP will be defined using literature search in accordance with the concept of sustainable supply chain management. In this case there will be used standards of Global Reporting Initiative for sustainability reporting. The LSP selection procedure will be presented in a case study.

Key words: logistics service provider, outsourcing, sustainable supply chain management, multiple-criteria decision-making, TOPSIS method

JEL Code: M11, M21, L23

Introduction

In recent years the research of supply chains supply chain management and sustainability is very extensive because not only companies but also other stakeholders (suppliers, customers, government authorities and society as a whole) are aware of the environmental, social and economic impact of their daily activities. It is very likely that this trend will continue in the coming years, because efforts to respect the philosophy of sustainable

development are becoming more frequent. If companies want to shift from supply chain management to sustainable supply chain management companies have to make a great deal of select LSP which will respect sustainable supply chain strategy. Only a joint effort of the whole supply chain can reduce negative impacts on environment and a society as a whole.

1 Theoretical background of sustainable supply chain management

Liu, Bai, Liu & Wei (2017) described development trends in recent years in supply chain management. Authors emphasized the importance of production and operations management which continues to change with market conditions, which prompts enterprises to adjust their business strategies. Liu, Bai, Liu & Wei (2017) stated since 1990s, the previous enterprise-centric strategy has been replaced by a customer-centric strategy, which derived a series of emerging production and operation management techniques and methods, including Enterprise Resource Planning, Product Lifecycle Management and Supply Chain Management which firstly appeared in 1982.

The term "sustainable supply chain management" was defined by Linton, Klassen & Jayaraman (2007). Authors mentioned the link to triple bottom line, which is an integration concept of economic bottom line, environmental bottom line and social bottom line. Liu, Bai, Liu & Wei (2017) mentioned that nowadays the focus of sustainable supply chain management has become to optimize the whole supply chain's economy, environment and social performance consideration of triple bottom line.

The concept of sustainable supply chain management is closely related with the concept of sustainable development, which is based on a three-pillar concept according to Elkington (1998). The goal is such development of the business that provides for the balance among the economic pillar, the environmental pillar and the social pillar. Elkington (1998) emphasizes integration the economic, the environmental and the social aspects into company's management.

Liu, Bai, Liu & Wei (2017) mentioned increasing importance and share of outsourcing of logistics activities (especially storage, transportation etc.) from the perspective of sustainable supply chain management. Logistic outsourcing is an agreement in which one company contracts its own internal logistic activity to a different company. Dolgui & Proth (2013) defined outsourcing as an act of acquiring services from an external company if these activities were traditionally carried out internally. The application of the outsourcing strategy especially in the supply chain management has these pros according to Armalyte,

Subramanian & Gunasekaran (2013), Dolgui & Proth (2013), Qiuping, Cunzhi & Zhixiang (2013), Lacity, Solomon, Yan & Willcocks (2011) and Vaxevanou & Konstantopoulos (2015): focusing on core capabilities and injecting client firms with supplier resources such as skills and expertise to improve client's business process performance, scalability and delivery speed, cost saving or cost reducing, companies gain a benefit by taking the advantage of outsourcing non-core activities, staff reducing or minimise the fluctuations in staffing due to changes in demands, employees can concentrate on core activities, companies achieve a greater financial flexibility by selling assets that were formerly used in the outsourced activity in order to improve company's cash flow, companies gain the access to external skills and technologies etc. Liu, Xie, Liu & Liu (2015) emphasized an irreplaceable role of LSPs in relation with sustainable supply chain management, because companies integrate a number of LSPs and purchase transport capacity or storage capacity etc.

Global Reporting Initiative (hereafter GRI) standards are the first global standards for sustainability reporting. They represent the global best practice for reporting on a range of economic, environmental and social impacts of sustainability. GRI standards are divided into three areas according to pillars of sustainable development. Each of these areas is evaluated in many aspects where each aspect contains several indicators. GRI standards define nine indicators for economic area, thirty-three indicators for environmental area and forty indicators for social area. Selected sustainability indicators can be used as criteria for selecting LSP with respect to the strategy of sustainable supply chain management. (Global Reporting Initiative, 2018)

2 Methods

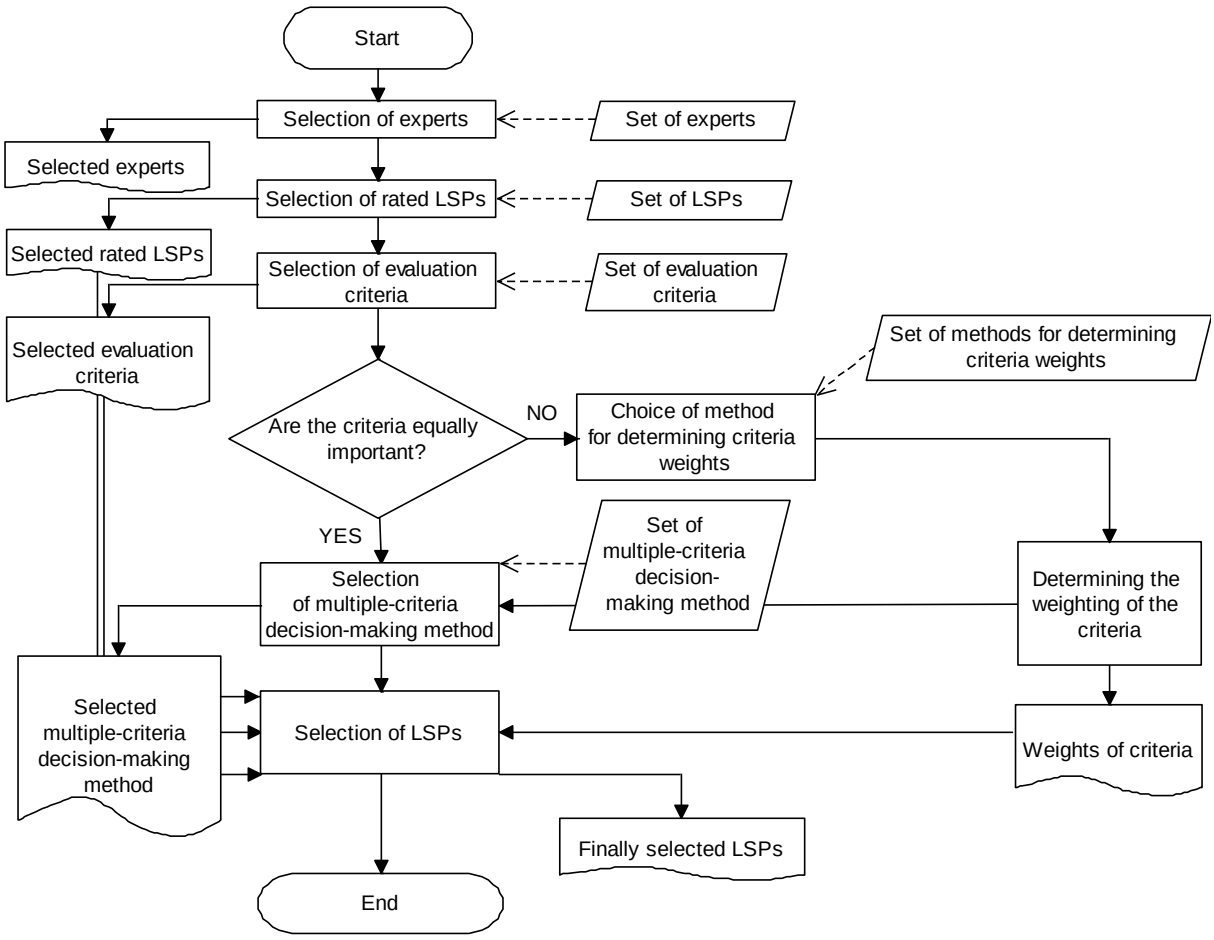
In this chapter the proposed procedure for selecting LSP with respect to the sustainable supply chain strategy will be described (Fig. 1).

The proposed procedure for the LSP selection consists of six steps (Fig. 1). In the first step, experts are chosen (using the expert panel method) from a set of potential experts to select LSP. The result of the first step is a set of selected experts. In the next step, experts select rated LSPs from the set of potential LSPs. The result of the second step is a set of selected LSPs. In the third step, experts select evaluation criteria (using the expert panel method) for selection of LSPs from the set of evaluation criteria based on indicators of GRI standards. The result of the third step is a set of selected evaluation criteria for LSPs.

In the fourth step, experts must decide whether the selected criteria from the third step are equally important (criteria have the same weight). If the criteria have the same weight, experts continue the fifth step. If the criteria are not equally important (criteria do not have the same weight), experts choose the method for determining criteria weights from the set of methods for determining criteria weights, for example: pairwise comparison method, ranking method, scoring method etc. and experts find the weight of individual criteria.

In the fifth step, experts select multiple-criteria decision-making method from the set of multiple-criteria decision-making method. In this case, the TOPSIS method is used. In the final step, experts choose the LSP provider with the use of selected LSPs (the result of step 2), selected evaluation criteria (the result of step 3), selected multiple-criteria decision-making method (the result of step 5) and eventually weights of criteria (the result of step 4).

Fig. 1: Scheme of the LSP selection procedure



Source: authors

In further subchapters scientific methods required for the procedure for selecting LSP: expert panel method (subchapter 2.1) and technique for order of preference by similarity to an ideal solution (subchapter 2.2) will be presented.

2.1 Expert panel method

Expert panel method is based on a large number of experts and the main purpose of this method is to integrate input data from some field of research according to Mulligan & Horowitz (1986).

This method is suitable for solving the problems which requires specific knowledge or knowledge of experts across many scientific disciplines. This method can be modified differently. The Delphi method is expanding the expert panel method (Lopez-Gomez, 2018).

2.2 Technique for order of preference by similarity to ideal solution (TOPSIS)

The TOPSIS method consists of the following seven steps based on Yoon (1987) and Hwang, Lai & Liu (1993). In the first step, all criteria are converted to maximization criteria. In the second step normalized criterial matrix (r_{ij}) is created, where m is a number of alternative logistics service providers and n is a number of evaluation criteria (equation 1).

$$r_{ij} = \frac{y_{ij}}{\sqrt{\sum_{i=1}^{m} y_{ij}^2}}; i = 1,2, \dots, m; j = 1,2, \dots, n. \qquad (1)$$

In the next step, the normalized criterial matrix (r_{ij}) is converted to a normalized criterial matrix (z_{ij}). Each column of the (r_{ij}) matrix is multiplied by the weight (w_j) of the corresponding criterion (equation 2).

$$z_{ij} = w_j r_{ij}; i = 1,2, \dots, m; j = 1,2, \dots, n. \qquad (2)$$

In the fourth step, an ideal (the best) alternative $(h_1, h_2, \dots, h_n)$ (equation 3) and a basal (the worst) alternative $(d_1, d_2, \dots, d_n)$ (equation 4) are created using the elements from matrix (z_{ij}).

$$h_j = \max_i z_{ij}\,; j = 1,2, \dots, n. \qquad (3)$$

$$d_j = \min_i z_{ij}\,; j = 1,2, \dots, n. \qquad (4)$$

The distance from the ideal (the best) alternative (d_i^+) (equation 5) and the basal (the worst) alternative (d_i^-) (equation 6) is calculated in the fifth step.

$$d_i^+ = \sqrt{\sum_{j=1}^{n} (z_{ij} - h_j)^2}\,; i = 1,2, \dots, m. \qquad (5)$$

$$d_i^- = \sqrt{\sum_{j=1}^{n} (z_{ij} - d_j)^2}\,; i = 1,2, \dots, m. \qquad (6)$$

In the sixth step the similarity to the worst condition is calculated (relative indicator (c_i) of the distance of alternatives from basal (the worst) alternative) (equation 7).

$$c_i = \frac{d_i^-}{d_i^+ + d_i^-}; i = 1,2, \dots, m. \qquad (7)$$

In the last seventh step the alternatives are arranged according to non-growing values (equation 8).

$$c_i (i = 1,2, \dots, m). \qquad (8)$$

3 Results

The proposed procedure for selecting LSP (chapter 2) with respect to the sustainable supply chain strategy has been tested at the manufacturing company in the form of case study. The case study is the method of the qualitative research based on the study of one or a small amount of situations for application of the findings for the similar cases according to Nielsen, Mitchell & Nørreklit (2015).

This company selected experts from the set of potential experts through all concerned departments of the company. In the next step, selected experts chose rated LSPs from the set of LSPs. Experts selected five LSPs which are identified in Tab. 1 by letters A – E. In the third step, experts chose eight evaluation criteria $(C_1 – C_8)$ from the set of evaluation criteria defined by GRI standards, there were: directly created economic value (C_1) [mil. CZK], share of local suppliers (C_2) [%], share of recycled material used (C_3) [%], electricity consumption (C_4) [kWh], share of rainwater consumption (C_5) [%], rate of fluctuation (C_6) [%], number of injuries (C_7) [-] and the amount of fines and penalties (C_8) [CZK]. These data were used as the input values of the TOPSIS method. All criteria were converted to maximization criteria (especially criteria C_6, C_7 and C_8), Tab. 1.

Tab. 1: Values of rated LSPs by criteria $(C_1 – C_8)$

Criteria / LSPs	C_1 [mil. CZK]	C_2 [%]	C_3 [%]	C_4 [kWh]	C_5 [%]	C_6 [%]	C_7 [-]	C_8 [CZK]
A	0.089	86	9	53 000	0	80	17	0
B	0.653	47	11	46 000	0	92	26	250 000
C	0.227	55	18	59 000	3	67	0	750 000
D	0.473	30	7	42 000	1	71	8	100 000
E	1.237	21	3	51 000	0	84	3	50 000

Source: authors

In the next step the normalized criterial matrix (r_{ij}) was created, where m is a number of alternative LSPs (alternatives A – E) and n is a number of evaluation criteria $(C_1 – C_8)$, Tab. 2.

Tab. 2: Normalized criterial matrix (r_{ij})

Criteria / LSPs	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8
A	0.059469	0.727587	0.372423	0.468990	0.000000	0.451107	0.224300	0.571040
B	0.436328	0.397635	0.455183	0.407048	0.000000	0.518773	0.000000	0.380693
C	0.151679	0.465317	0.744845	0.522083	0.948683	0.377802	0.647978	0.000000
D	0.316054	0.253809	0.289662	0.371652	0.316228	0.400358	0.448600	0.494902
E	0.826550	0.177667	0.124141	0.451292	0.000000	0.473662	0.573212	0.532971

Source: authors

In the next step, the normalized criterial matrix (r_{ij}) was converted to a normalized criterial matrix (z_{ij}). Each column of the (r_{ij}) matrix was multiplied by the weight (w_j) of the corresponding criterion (equation 2). In this case the same importance (equal weight) of all criteria $(C_1 – C_8)$ was considered, Tab. 3. The weight of each criterion corresponded to the value 0.125.

Tab. 3: Normalized criterial matrix (z_{ij}) adjusted by criteria weight

Criteria / LSPs	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8
A	0.007434	0.090948	0.046553	0.058624	0.000000	0.056388	0.028038	0.071380
B	0.054541	0.049704	0.056898	0.050881	0.000000	0.064847	0.000000	0.047587
C	0.018960	0.058165	0.093106	0.065260	0.118585	0.047225	0.080997	0.000000
D	0.039507	0.031726	0.036208	0.046457	0.039528	0.050045	0.056075	0.061863
E	0.103319	0.022208	0.015518	0.056412	0.000000	0.059208	0.071651	0.066621
h_j	0.103319	0.090948	0.093106	0.065260	0.118585	0.064847	0.080997	0.071380
d_j	0.007434	0.022208	0.015518	0.046457	0.000000	0.047225	0.000000	0.000000

Source: authors

In the next step, an ideal alternative $(h_1, h_2,..., h_n)$ (equation 3) and a basal alternative $(d_1, d_2,..., d_n)$ (equation 4) were created using the elements from matrix (z_{ij}). Then the distance from ideal alternative (d_i^+) (equation 5) and basal alternative (d_i^-) (equation 6) were calculated. In the next step the similarity to the worst condition (relative indicator (c_i)

of the distance of alternatives from basal alternative) (equation 7) was calculated. In the last step the alternatives were arranged according to non-growing values (equation 8), Tab. 4.

Tab. 4: Distance from ideal alternative *(d_i^+)*, basal alternative *(d_i^-)* and relative indicator *(c_i)* calculation, ranking of LSPs

LSPs	d_i^+	d_i^-	c_i	Ranking
A	0.168357	0.108635	0.392196	4.
B	0.163668	0.085335	0.342706	5.
C	0.116605	0.168589	0.591137	1.
D	0.135466	0.100445	0.425775	3.
E	0.158201	0.137873	0.465670	2.

Source: authors

The final evaluation of LSPs is as follows: the most appropriate provider in accordance with the concept of sustainable supply chain management and from the perspective of selected experts is LSP "C", because it reached the highest value of the relative indicator *(c_i)*. The order of the other LSPs is as follows: LSP "E", LSP "D", LSP "A" and LSP "B".

Conclusion

The topic of sustainable supply chain management will be much more discussed in the future, because the pressure to reduce not only environmental impacts will increase. Modern turbulent market environment is forcing companies to collaborate and organize themselves into supply chains. This cooperation must also take place with regard to sustainable development and concept of sustainable supply chain management.

Selection of appropriate LSPs can lead to a reduction of the negative effects of the whole supply chain. This article on a case study presented the process of selecting LSP from the perspective of sustainable supply chain management (based on GRI standards) using technique for order of preference by similarity to ideal solution and expert panel method. This procedure can be used in any company. Further research could be carried out in terms of other possible multi-criteria decision-making methods applicable to this type of decision-making problem.

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