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SELECTING A LOGISTICS SERVICE PROVIDER: A DEFINITION OF CRITERIA THAT CONSIDER THE REQUIREMENTS OF AN EXTERNAL COMPETITIVE ENVIRONMENT

Summary. A large number of criteria, the very diverse use of terminology and different classifications of criteria used to select a logistics service provider (LSP) reflect the lack of consensus in defining criteria. Moreover, whether the criteria are consistent with external requirements has not been analysed, which are vitally important for the success and competitiveness of the supply chain. This paper therefore presents a carefully prepared and evaluated classification system of criteria aligned with the requirements of the external environment. A multi-stage methodological approach was used. Selection criteria obtained from the systematic review of literature were first carefully analysed to find potential shortcomings. After that, a cluster method was used to reduce the number of criteria and to aggregate similar criteria. A Pareto analysis (75/25 rule) was further used to rank the criteria according to their frequency of use and consequently according to importance. The obtained categories of criteria (vitally important criteria (C1), very important criteria (C2), important criteria (C3) and less important criteria (C4), using the AHP method, were compared by the experts to define their weights. This paper summarizes and extends the recent literature through a six-step methodological approach and proposes a new classification system of selection criteria.

1. INTRODUCTION

Logistics plays an important role in ensuring the competitiveness of the company's supply chain [1]. Logistics services are therefore increasingly being outsourced to LSPs as they are specialized in logistics. However, the selection of appropriate LSP is quite complex and risky. There are many LSPs on the market that usually differ in the scope and complexity of the services that they offer at the level of adopting the service to a particular customer in price and other criteria. There are also many different selection criteria (e.g. requirements of the buyer of outsourcing) and sub-criteria that can be applied when selecting an LSP. Moreover, not all criteria and sub-criteria are equally important and some are even conflicting.

Ninety-five articles published by leading publishers such as Emerald, Elsevier, Inderscience Publisher, Taylor&Francis, Springer Wiley Online Library and many others were written from 1990 to 2015 on the basis of criteria used to select an LSP. 83 of the 95 authors checked their research results in practical cases. Two articles include an empirical study, whereas ten articles do not include either a case study or empirical research.

A careful reading and analysis of 95 publications with respect to the selection criteria detected so many selection criteria terminologies that it was impossible to map them all [2]. More than one hundred different terminologies of criteria were detected. A slightly lower variation was found by criteria classification as a large number of authors did not classify the criteria into groups but only

stated what they were by name. Such an approach was observed by authors who indicated only a few criteria as well as by those who registered over ten criteria. This created even greater confusion in the classification of criteria. Definitions of criteria proved to be the best harmonized. The volume and scope of the criteria covered by each group varied considerably according to different authors.

In summary, it is not clear which group or groups of criteria should be applied when selecting a LSP. Further, it is also unclear which sub-criteria within each group of criteria are most relevant and whether are they harmonized and adjusted to the external environment. The fact is that not all criteria are equally important for the competitiveness of the supply chain. Moreover, they change rapidly and therefore need constant attention from managers [3-5]. Further, we did not observe a systematic selection and grouping of criteria in any of the published articles. In most cases, the authors simply refer to other authors and criteria used without pre-evaluating their relevance or importance. Such an extreme number of criteria and a lack of consensus on their significance make it very difficult for managers and decision-makers to determine which criteria are critical and matter most and which are less relevant and should not necessarily be taken into consideration.

To address the above-mentioned gaps, this study aims to propose a systematic and up-to-date classification system. A multi-stage approach was used (presented in detail in the second chapter), focused on the ranking process and the final evaluation of the proposed taxonomy system with researchers and experts. The clustering and ranking process resulted in an acceptable number of criteria. Pareto analysis further highlighted the group of critically important criteria, but also highlighted other less important criteria. Finally, an evaluation of the criteria rendered the entire system even more aligned with external demands.

This paper is organized as follows: in section 2, we present the methodology of the paper. Clustering and ranking of selection criteria is performed in the third section. The fourth section analyses the coincidence between factors that critically influence the success of the supply chain and the proposed vitally important criteria. They were then evaluated by experts discussed in the fifth section using the AHP method. Section six presents the proposed classification system. The paper concludes with a brief discussion and identification of limitations.

2. METHODOLOGY

To propose the most useful, systematic and even most contemporary classification system, a six-step approach was used:

1. Analysing a ‘crude’ database of selection criteria derived from a systematic and extensive literature review [2].
2. Clustering mapped criteria in a preparatory manner, using a two-step approach, namely, (1) The criteria, terminology and classification were selected according to the number of terminology repetitions proposed and used by [2]. Terminology of criteria and its classification, which appeared only in a single article, were not recorded. Only criteria applied by at least two authors were listed. (2) Pre-selected criteria were further grouped together based on their similarity in the description. Criterion that appeared most frequently within a group of similar criteria played a so-called dominant role, after which the entire group was named.
3. Ranking selection criteria by frequency of appearance using the Pareto analysis proposed by [6-8].
4. Comparing the vitally important category of criteria with the critical success factors obtained in the literature review presented in chapter 2.
5. Expert evaluation of the results of the Pareto analysis using the AHP method.
6. Presenting the classification system in view of the demands of the external environment.

3. CLUSTERING AND RANKING SELECTION CRITERIA ACCORDING TO THEIR FREQUENCY OF APPEARANCE

A lack of consensus on selection criteria, selection criteria classification and their weight forced us to cluster the criteria at the very beginning to map a reasonable number suitable for further processing. To ensure the greatest possible degree of accuracy and not to ignore any important data in clustering the criteria, a carefully prepared two-step approach was used (presented in detail in chapter 2). The results are shown in Table 1, where the second column presents selection criteria that appeared in at least two articles. Forty-four criteria were found to exist. The terminology of criteria that appeared most frequently within a group of similar criteria are listed in bold and located first on each line.

Table 1

Ranking of criteria and sub-criteria according to their frequency of appearance

i	Selection criteria	Frequency of appearance (f_i)	Percentage of frequency (f_i %)	Cumulative percentage of frequency (F_i %)
1	**prices of basic services**/costs	78	8.25	8.25
2	**information technology (IT) capability**	59	6.24	14.50
3	**accurate delivery time**/reliability of on-time delivery	48	5.08	19.58
4	**technical and technological capability**/vehicle conditions/infrastructure/asset ownership/physical facilities and equipment/size and quality of fixed assets/assets specificity	47	4.97	24.55
5	**flexibility in operations and delivery of service**	43	4.55	29.10
6	**staff quality**/quality of employees	43	4.55	33.65
7	**network coverage**/market share/market structure/international scope	41	4.34	37.99
8	**degree of reputation and position in industry**/brand building	39	4.13	42.12

9	**culture recognitions**/compliance with organization culture and tradition/compatibility with user (values, goals, size, culture)	38	4.02	46.14
10	**experience/** experience specific to your industry/market knowledge/experience in similar products or with similar companies	38	4.02	50.16
11	**service level**/service quality	35	3.70	53.86
12	**information exchange ability**/information sharing	32	3.39	57.25
13	**customer satisfaction**/continuous improvement in customer satisfaction	29	3.07	60.32
14	**accurate delivery place**	26	2.75	63.07
15	**risk management**/safety/security	26	2.75	65.82
16	**strategic partnership/**risk sharing/ability to understand needs of contractor	26	2.75	68.57
17	**transport services**	24	2.54	71.11
18	**accurate quantity and quality of goods**	24	2.54	73.65
19	**financial stability**	23	2.43	76.08
20	**storage**	20	2.12	78.20
21	**breadth of services**/range of services	19	2.01	80.21
22	**distribution services**	18	1.90	82.12
23	**reliability**	16	1.69	83.81

24	**value-added services**	16	1.69	85.50
25	**flexibility in billing and payment**/terms of payment	13	1.38	86.88
26	**order processing**/order fulfilment/order cycle time/number of orders	11	1.16	88.04
27	**long-term relationship**/the duration of contract	11	1.16	89.21
28	**human resource management**/employee satisfaction level)	10	1.06	90.26
29	**responsiveness to unexpected events**/responsiveness to customer needs	9	0.95	91.22
30	**trust**	9	0.95	92.17
31	**recycling ability**	8	0.85	93.02
32	**innovation capability**	7	0.74	93.76
33	**variable prices**/extra costs	7	0.74	94.50
34	**any environmental expenditures**/recycling product transportation fee rate, redelivery costs, environmental staff training expense, the investment spent on equipment)	7	0.74	95.24
35	**performance measurement**	7	0.74	95.98
36	**frequency of cargo delivery**	6	0.63	96.61
37	**value-added services** (reassembly, repackaging, remanufacturing, refurbishment and waste disposal activities)	6	0.63	97.25

38	**management quality**	5	0.53	97.78
39	**environmental consideration**	5	0.53	98.31
40	**pollutant emissions**/pollutants released	4	0.42	98.73
41	**energy consumption**	4	0.42	99.15
42	**optimization capability**/continuous improvement/the ability to meet or exceed promises/development potential	3	0.32	99.47
43	**quality certification**/ISO standards	3	0.32	99.79
44	**clean materials and energy use**	2	0.21	100
	Total:	945	100	

The criteria listed in Table 1 were still too numerous to use in practice. Moreover, it was not clear which of the criteria is crucial (e.g. vitally important) for the success of supply chain and should not be missed when selecting LSP and which is only useful, but not critical and should not necessarily be used. To highlight criteria that are most valued, the ranked criteria presented in Table 1 in the first column were first grouped according to their frequency of application in the literature (f_i). Then, the Pareto analysis (the so-called 80/20 rule) was used as a tool for distinguishing between critical and less critical factors [9-12]. However, as f_3 and f_4 were almost equal and significantly higher than the next frequencies, the ratio 75/25 was used instead of the 80/20 rule.

The first 4 selection criteria (coloured in grey; Table 1) represent 25 % of all found criteria and are therefore so-called 'vital' elements (C_1). The rest of the 40 criteria are not vitally important, but still useful; some of them are even very useful. As f_{20} is much higher than for example f_{44}, we chose to divide criteria into 3 categories with the same range of probability (25 %). In the first category (coloured in blue; Table 1), there are 6 criteria (C_2) and in the second category (coloured in green; Table 1) there are 9 criteria (C_3). In the last category, there are 25 criteria (C_4) as their marginal use could result in their exclusion during the decision-making process.

Criteria that comprise each category have the same requirement:

- C_1 – vital elements (elements that are so-called “must have” in any selection process. They must be included to be successful as they are required by the market.)
- C_2 – very important elements (It is advisable to use them. Some are even vitally important and others can be left to the discretion of the decision-maker.),
- C_3 – important elements (Elements that can be mostly left to the discretion of the decision-maker, with the exception of strategic partnership-related criteria.),
- C_4 – less important elements (Completely left to the discretion of the decision-maker. Only a few are relevant and might be applicable in all cases).

From the adapted Pareto analysis, it is possible to conclude that the weight of category C_1 is $w_1 = 0{,}75$ and the other weights sum to $0{,}25$.

4. COMPARISON BETWEEN PROPOSED CLUSTERS AND CRITICAL SUCCESS FACTORS

Even after clustering and ranking criteria, it was still unknown whether or not they were appropriate (coordinated with the demands of the external environment) [13-15]. To find the most critical factors for the success of the supply chain, a brief literature review was performed focused on a search of only articles in journals directly related to supply chain management and published in the last ten years. 'Supply chain management' AND 'success factors' were the search terms used. Nine articles were found (Table 2). Two of them were literature reviews.

Table 2

Vitally important factors for the success of the supply chain

Journal	Publisher	Author: critical success factors
Supply Chain Management: An International Journal	Emerald	[16]: enhancing customer satisfaction, products performance, reducing lead time, flexibility, innovation capability, expanding depth of services, cost reduction, customer service (manufacturing, inventory management, distribution management, demand management, import, export management, lead time, quality), digitalization. [17]: collaborative relationship (trust, long-term decisions, sharing of risks, benefits, continuous improvement assessment efforts, flow of communication, flexibility, faster adaptation), information technology (enterprise resource planning (ERP), manufacturing resource planning (MRP), distribution resource planning (DRP), IT-integration, effectively managing the flow of material (less inventory, lower logistics costs, reliable forecasts), creating corporate culture and commitment (communication, involvement of top management, corporate compatibility), identifying performance measurements. [18]: sustainability, partner-, process-, IT-integration, customer-orientation, short lead time, lower costs. [15]: trust, experienced managers, education and training, information sharing, comprehensive measures, supply chain partner alignment, lower costs, technological innovations, management skills.
International Journal of Physical Distribution & Logistics Management	Emerald	[19]: strategic planning (size of the business, location, relationship, customer focus, infrastructure, activities), resource management (inventory management, number of infrastructure, suprastructure), information management (ERP system), technology utilization (communication technologies), human resource management (number of employees, training and education, culture), continuous improvement (reliability,

		flexibility, lead time, costs effectiveness, value-added, key performance indicator), collaboration, process quality. [20]: organizational commitment (top management support, IT support, infrastructural commitment), organizational governance (governance infrastructure to enhance communication and coordination).
EuroMed Journal of Business	Emerald	[11]: use of IT, top management commitment, partnership/integration, service quality, process quality, resource capability, government intervention, skilled employee, trust, open communication, market competence, image/reputation, costs, planning and implementation, data security, performance measurement, assurance and empathy, internalization, organizational hierarchy, change management, infrastructure readiness, experience, centralized control, adoption of standards.
Journal of Supply Chain Management	Wiley Online Library	[21]: partner innovativeness, strategic relationship.
International Journal of Supply Chain Management	ExcelingTech Pub	[3]: collaborative partnership (visibility, trust, mutuality, information sharing, openness, communication), information and communication technology (ICT), top management support (committed managers, good communications of managers), human resources (skills, good quality and skilled staff, training, employee commitment).

According to Table 2, the critical success factors were found to be (1) a collaborative partnership, (2) information communication technology (ICT), (3) cost effectiveness, (4) service and process quality, (5) top management commitment, (6) performance measurement, (7) human resource management and (8) resource capability (infrastructure, suprastructure). Other factors were mentioned by less than three authors. They are useful factors, but not vitally important.

Accordingly, the first three elements of C_1 (costs, IT capability and accurate delivery time / service quality) were in line with the above-mentioned results of the literature review. Interestingly, a collaborative partnership found to be the most critical factor by the literature review was only ranked in the third category (C_3) in our proposal. When we examined the causes of this disparity, we found that criteria 16, 27 and 30 could be part of the strategic partnership criterion. The cumulative frequency would in that case be 46 and would therefore be placed in the first category. As we did not want to settle for only this, although very logical explanation, we decided to further evaluate our proposed four categories of criteria with experts from different sectors.

5. EVALUATION OF DEFINED CLUSTERS OF CRITERIA USING THE AHP METHOD

To increase the credibility of the proposed clusters of criteria, we decided to obtain the opinion of three academics in the field of supply chain management, representatives of the faculties in the field of logistics, five top management representatives of the largest domestic and international third-party logistics provider (3PLP) operating in the Slovene logistics market and five top management

representatives of buyers of logistics outsourcing. Three of the individuals have a Ph.D. all others have a bachelor's degree. All have been employed in their current enterprise or faculty for more than 10 years.

To evaluate clusters C_1, C_2, C_3 and C_4, a video conference was conducted on 8th March 2016. Before this, each participant received an e-mail with a list of clusters, including sub-criteria to facilitate the discussion. The conference began with a brief explanation of the clusters and continued with a detailed explanation of the peer comparison process. The Saaty nine-stage linguistic comparison scale was used [22], where 1 means equal preference and 9 means extreme preference. After the introductory explanation, a constructive discussion on the relevance of each category of criteria began.

Each interviewee was first called to evaluate the importance of every individual criterion. The ratings were recorded by the person who carried out the interview. When all the ratings for each criterion were collected, all the scores were aggregated into a consensual judgement. It was expected that all interviewees would have very similar opinions, and so if necessary, the decision-makers were asked to compromise and agree on a consensus rate. The results are presented below (see comparison matrix *A*). Then, a hierarchy between the categories of criteria was defined using the AHP method [23, 24].

The following steps define the AHP method:

1. Peer comparison of the elements using the nine-stage linguistic comparison scale proposed by Saaty [25].
2. Definition of the positive reciprocal comparison matrix $A = [a_{ij}]$ with $i, j = 1,2,3,4$.
   i. Verifying the consistency of the comparison matrix, computing the consistency index CI.
   $$CI = \frac{\lambda_{max} - n}{n-1}, \quad (1)$$
   where λ_{max} is the maximum eigenvalue and n is 4.
   ii. Computing the consistency ratio $\frac{CI}{RI}$ that in case of consistency must be less than or equal to 0.1. RI is the random consistency index defined by [22] and $RI = 0.90$ for $n = 4$.
   iii. Computing the priority vector using the arithmetic mean method, which defines the weights of the elements [22, 26]:
   $$w_i = \frac{1}{4}\sum_{j=1}^{4} \frac{a_{ij}}{A_j} \text{ for } i = 1,2,3,4. \quad (2)$$
   where $A_j = \sum_{i=1}^{4} a_{ij}$ for $j = 1,2,3,4$;
   and an approximation of the maximum eigenvalue is defined as:
   $$\lambda_{max} = \sum_{i=1}^{4} A_i \cdot w_i. \quad (3)$$

On the basis of the experts' peer comparison of the 4 clusters: C_1, C_2, C_3 in C_4 the comparison matrix was computed:

$$A = \begin{bmatrix} 1 & 3 & 5 & 8 \\ 1/3 & 1 & 4 & 7 \\ 1/5 & 1/4 & 1 & 3 \\ 1/8 & 1/7 & 1/3 & 1 \end{bmatrix}.$$

Using equations (2) and (3), the priority vector and the maximum eigenvalue were computed:

Priority vector	
$w_1 =$	0.55
$w_2 =$	0.30
$w_3 =$	0.11
$w_4 =$	0.05
$\lambda_{max} =$	4.24

Then, using equation (1), the consistency index $CI = 0.08$ was computed and the consistency ratio $\frac{CI}{RI} = 0.09$, which is less than 0.1; thus, the comparison matrix is consistent and the proposed ranking method is also consistent.

6. PROPOSED CLASSIFICATION SYSTEM OF SELECTION CRITERIA

Finally, the selection criteria ranked (presented in chapter 3) were classified according to the results of the comparison of criteria with critical success factors (presented in chapter 4) and according to the results of the AHP evaluation (presented in chapter 5). Four groups of criteria (C_1, C_2, C_3 and C_4) and their weights (w_1, w_2, w_3 and w_4) were proposed (Fig. 1). Groups were ranked according to their relevance. At the top of the classification system are criteria that are vital to the success of the supply chain (C_1). At the bottom are the criteria that are useful, but not critical. Each group of criteria has a different number of sub-criteria with the same weight (w).

A classification system is easy to use (a reasonable number of groups of criteria and sub-criteria and a simple explanation of criteria), is systematic (groups are ranked according to their relevance) and also adapted to current market needs. The aim of this paper was thus achieved.

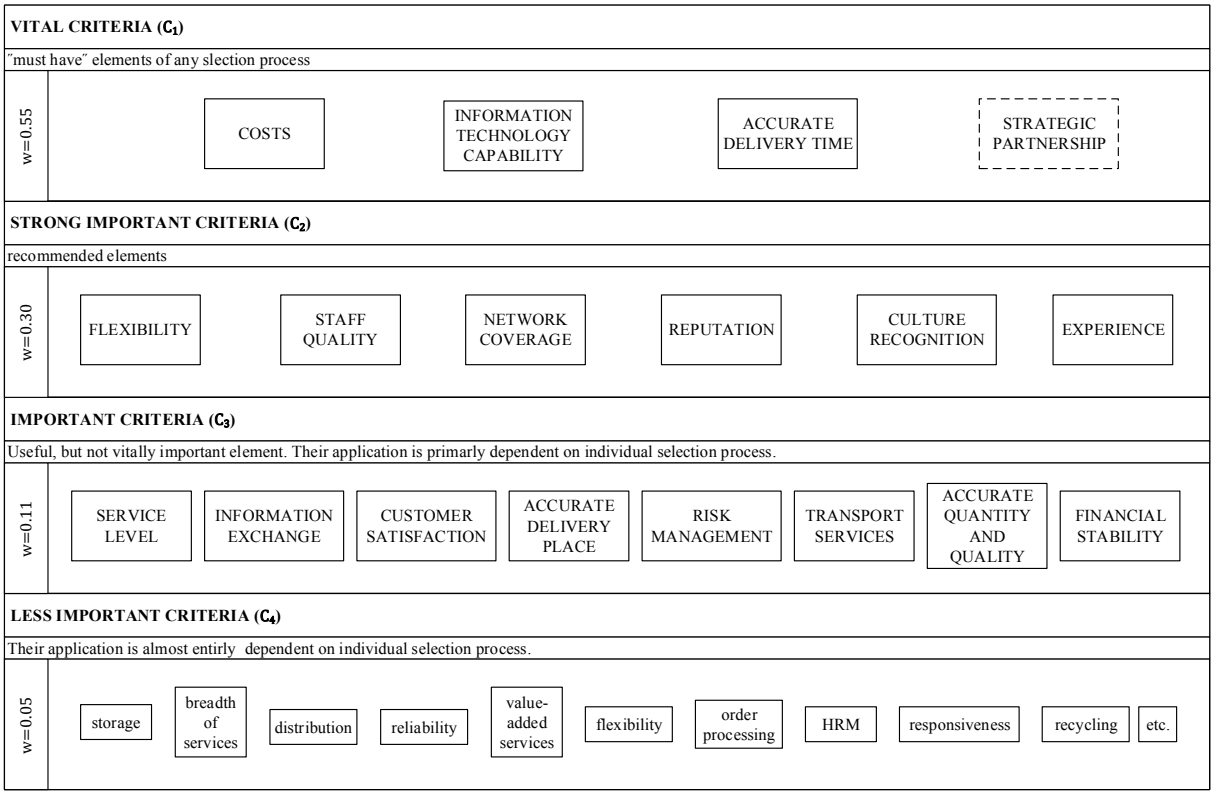

Fig. 1. Classification system of selection criteria in view of the requirements of the external environment and evaluation by the experts from the logistics field

7. CONCLUSION

The literature review on the criteria for selecting an LSP showed that there is no reliable consensus in the field of criteria for selecting an LSP. The criteria were not aligned with the requirements of a competitive environment. A more appropriate selection criteria classification system was therefore

presented based on a literature review analysis and using a cluster method, the Pareto analysis and also, finally, the AHP technique.

Four groups of criteria were proposed, including their weights, which indicate the importance of criteria. The first group are vitally important criteria (C_1), with a weight w_1= 0.55, the second group includes very important criteria (C_2) with a weight w_2= 0.30, the third group represents important criteria (C_3) with a weight w_3= 0.11 and the last group includes less important criteria (C_4) with a weight w_4= 0.05. All vitally important criteria must be applied in any selection process. Very important criteria are recommended, although perhaps not all are necessary, depending on the needs of the individual company. Important criteria and less important criteria are useful, but left entirely to the discretion of the decision-maker. Any other criteria not presented could be used as well.

Although the results are very useful to decision-makers and even open up some questions for future research, the article also has some limitations. The first is the use of Pareto analysis, which was used by many authors in the past for very similar purposes, but does have some shortcomings. Any other appropriate tool could be used. The second limitation is the selection of experts, which was quite individual.

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