Model Evaluation of Suppliers in Terms of Real Company for Selected Criteria

Model procjene dobavljača kao stvarne tvrtke prema zadanim kriterijima

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Summary
The proposed supplier evaluation model defines basic approaches, instructions and principles for the area of supplier quality evaluation. The objective of the model is to increase the maximum supply chain management efficiency which enables better reaction to newly created situations and it will satisfy the needs of the logistics company.

Sažetak
Predloženi model procjene dobavljača definira osnovne pristupe, uputstva i principe u području procjene kvalitete dobavljača. Cilj ovog modela je povećati učinkovitost maksimalnog lančanog menadžmenta kojim se omogućuje bolja reakcija na novonastale situacije i zadovoljavaju potrebe tvrtke za logistiku.

KEY WORDS
assessment
criteria
contractor
Multicriteria Analysis
Saaty matrix
logistics company

KLJUČNE RIJEČI
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kriteriji
ugovaratelj
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Saaty matrica
tvrtka za logistiku

INTRODUCTION

The choice of supplier has long term impact on the company ability to respond effectively to customer needs. The wider possibility of the choice of consumers from foreign markets or the intention of foreign distribution, the more difficult the choice of suppliers is [1], [2].

The significance of the accurate supplier choice is based on the fact that the delays of the planned delivery from the supplier cause customer or final user needs dissatisfaction. The partner of choice (supplier) should be the one who fulfills the best the criteria in combination of quality and price [1], [2].

The essential role in the supply chain management is that the activity – contradiction elimination is integrated into the whole process, and respectively, into the process of gaining competitiveness. New complex process is established and it includes the terms supplier – manufacturer – customer, i.e. the definition of the supply chain. All the companies, which participate in development, production and delivery of the product to final user, belong to this chain. In general we may speak about controlled cooperation exceeding the company so the suppliers are on one side and the customers (by entering and leaving value-creating chain) on the other side

and they are coordinated by business creation processes. This approach is called as supply chain management (SCM) [1, [2].

PROPOSED MODEL FOR THE AREA OF SUPPLIER EVALUATION IN THE LOGISTICS COMPANY

Presented model determines the approaches, instructions and principles for the area of supplier quality evaluation. The objective of the model is to increase supply chain management efficiency which will enable better reaction to newly created situations and it will satisfy the needs of the selected logistics company and all the subject concerned [3], [4].

Supplier evaluation according to the proposed model is based on milticriteria analysis, the criterion choice depends on personal and written practitioners questioning. Importance definition of the particular criteria is based on Saaty method. The Scoring model is used at multicriteria supplier evaluation analysis.

The multicriteria analysis was specified on suppliers in two areas which cause the most of the complaints in the logistics companies [5]:

- Transport area (external transport – shifting towards the customer)
- Handling and storage area (general handling, classification and storage)

The multicriteria analysis with scoring model was used in suppliers' evaluation in the logistics company. Saaty method was used to define importance of the particular criteria [6].

PRACTITIONERS CHARACTERISTICS

The practitioners in the area of the logistics were contacted for the needs of supplier evaluation model creation. The specific characteristic of practitioners [5]:

Practitioner 1 (Area Manager for Central Slovakia) Job description: to ensure management and development of business activities in the logistics company, coordination and control activities, complex setting of all logistic company processes [5]:

Practitioner 2 (Logistics specialist) Job description: to ensure planning and organization of the logistics, preparation of the internal directives for employees, the responsibility for fulfillment of the terms agreed on with business partner, the quality improvement of the services provided by company, the responsibility for effective technology and staff utilization, the communication with business partner, in the case of problem situation the coordination of transport among the company departments, reporting [5].

Practitioner 3 (Outsourcing partner) Job description: team management at package handling [5].

Practitioner 4 (Lead courier) Job description: management of carriers team [5].

THE CRITERION CHOICE FOR SUPPLIER EVALUATION

There are different criteria for suppliers evaluation in the actual market environment and used by companies. The method of questioning (non-standardized questioning) specifically form of in-depth interview with practitioners was used to define and choose the criteria for suppliers evaluation. It ensures the correctness of the criterion choice. It is the method of psychological quality research to acquire wide spectrum of detailed information about respondent´s attitudes and opinions [5], [6].

Compilation of criteria for supplier evaluation was based on personal interviews with the practitioners.

Selected criteria for supplier evaluation (HD) are indicated as [5]:
K_i^{HD} i-th criterion for supplier evaluation, where i= 1,2, ..., k

k – total number of criteria for supplier evaluation
- PRICE (K_1^{HD}) – price certainty, agreement – how much the buyer should pay and in what periods. The price represents service purchase price for a unit of delivered amount.
- QUALITY (K_2^{HD}) – provided quality of the realizable services. The suppliers may guarantee the quality of their provide services in different ways: quality certificate, the number of complaints to total amount of provided services,
- RELIABILITY (K_3^{HD}) – deadline (delivery time) compliance
- DELIVERY TIME (K_4^{HD}) – it represents the period from receiving the orders by supplier to execution of the particular service
- FLEXIBILITY (K_5^{HD}) – if there is a demand for change of amount of the provided services, this criteria represents supplier willingness to adapt to changes and percentage expression of the capability to fulfill received orders in time
- RESPONSIBILITY (K_6^{HD}) – it includes the supplier responsibility for the actions during the provision of ordered services/ products, responsibility realization for poor provision of services to company, responsibility for ordered amount, quality, time,
- IDENTIFICATION / RISKS PREVENTION (K_7^{HD}) – willingness to identify accrued risks and their prevention
- SUPPLIER DEVELOPMENT (K_8^{HD}) – supplier willingness to innovate and modernize the cooperation development with supplier, compatibility of informational company system among the subjects.

DEFINITION OF THE CRITERION IMPORTANCE

The Saaty method of multi criteria analysis is used to define the importance of the particular criteria. Saaty matrix for criterion importance definition of the particular criteria is provided in the table 1. (Supplier evaluation) [5], [7-9].

PROPOSAL OF THE SUPPLIER EVALUATION ACCORDING TO SCORING MODEL DEFINITION OF THE CRITERION IMPORTANCE

Scoring model is an instrument for quantitative evaluation of the particular suppliers according to given criteria for the purpose of effective and impartial decision making [5], [7].

The identical importance was set by all the practitioners with the method of equal importance within the proposed model The practitioners are equally reliable in the field of logistics [5], [7].

Table 1 Saaty matrix – criterion importance definition for supplier evaluation

Vendor evaluation	Price	Quality	Reliability	Flexibility	Responsibility	Risk	Development of supplier
Price	1						
Quality		1					
Reliability			1				
Flexibility				1			
Responsibility					1		
Risk						1	
Development of supplier							1

Source: (1) + authors

R-MATRICES COMPOSITION OF SAATY MATRIX FOR A SPECIFIC EXPERT (SUPPLIER EVALUATION)

Table 2 Saaty matrix for a specific practitioner

Vendor evaluation	K_1^{HD}	K_2^{HD}	...	K_{k-1}^{HD}	K_k^{HD}
K_1^{HD}	1				
K_2^{HD}		1			
...			1		
K_{k-1}^{HD}				1	
K_k^{HD}					1

Source: (1) + authors

CRITERION IMPORTANCE CALCULATION

Criterion importance calculation – the importance of the particular criteria is calculated with the aid of Saaty matrix associated with i-th practitioner, it means that every matrix is amended by i-th practitioner. The calculation of the criterion importance by i-th practitioner is presented in matrix [5], [7], [8].

CRITERIA MATRIX COMPILATION MADE BY I-TH PRACTITIONER FROM SPECIFIC AREA OF EXPERTISE

To ensure importance transparency from the practitioners, the table was drafted – criteria importance matrix assigned by the practitioners.

The importance assignment of the selected criteria for supplier's evaluation – impartial importance assignment is stated in the Figure 2 [1], [10], [11].

	Expert 1	K 1	K 2	K 3	K 4	K 5	K 6	K 7	$s_i = \prod_{j=1}^{n} z_{ij}$	$R_i = \sqrt[n]{s_i}$	$v_i = \frac{R_i}{\sum_{i=1}^{k} R_i}$
	Evaluation of supplier	Price	Quality	Reliability	Flexibility	Responsibility	The prevention of risks	Development of supplier			
K 1	Price	1	1	1	5	9	1	9	405,0000000	2,3577	0,2394
K 2	Quality	1	1	2	7	7	7	8	5488,0000000	3,4214	0,3475
K 3	Reliability	1	1/2	1	5	1	3	3	22,5000000	1,5602	0,1584
K 4	Flexibility	1/5	1/7	1/5	1	1/7	1	5	0,0040816	0,4557	0,0463
K 5	Responsibility	1/9	1/7	1	7	1	7	5	3,8888889	1,2141	0,1233
K 6	The prevention of risks	1	1/7	1/3	1	1/7	1	4	0,0272109	0,5976	0,0607
K 7	Development of supplier	1/9	1/8	1/3	1/5	1/5	1/4	1	0,0000463	0,2403	0,0244
									$\sum_{i=1}^{k} R_i$	9,8470	1

Figure 1 Criterion importance calculation by i-th practitioner

Source: (1) + authors

	Vendor evaluation	Specialist 1	Specialist 2	Specialist 3	Specialist 4
K_1^{HD}	Price	0,2394	0,0373	0,1570	0,1981
K_2^{HD}	Quality	0,3475	0,1778	0,1570	0,2353
K_3^{HD}	Reliability	0,1584	0,2603	0,1570	0,1092
K_4^{HD}	Flexibility	0,0463	0,0808	0,1365	0,0562
K_5^{HD}	Responsibility	0,1233	0,1511	0,1288	0,0624
K_6^{HD}	The prevention of risks	0,0607	0,1368	0,2252	0,1659
K_7^{HD}	Development of supplier	0,0244	0,1560	0,0384	0,1729

Figure 2 Criteria importance matrix assigned by the practitioners

Source: (1) + authors

THE SCORING GRID PROPOSAL FOR COMPARISON OF THE INDIVIDUAL CRITERIA BY THE PRACTITIONERS AND FOR IMPORTANCE ASSIGNMENT

Scoring grid for importance assignment of the individual criteria is stated in the following Table 3 [10].

Table 3 Scoring grid for importance assignment of the individual criteria

Scoring table	
1	criterion (i) is equivalent to (j)
2	The Intermediate Stage
3	criterion (i) is weakly preferred (j)
4	The Intermediate Stage
5	criterion (i) is strongly preferred (j)
6	The Intermediate Stage
7	criterion (i) is very strongly preferred (j)
8	The Intermediate Stage
9	criterion (i) is an absolute (very strongly) preferred (j)

Source: (1)

THE CALCULATION OF THE FINAL CRITERIA IMPORTANCE ASSIGNED BY THE PRACTITIONERS

$$wK_i^{HD} = \sum_{j=1}^{r} v_j \cdot w_{ij} \qquad (1)$$

Where:

wK_i - Final importance of i-th criterion for the evaluation

Final importance of the first criterion $((K)_i^{HD})$ for the evaluation

- i = 1,2, …, k
- vj = importance of the j-th practitioner
- j = 1,2, …, k
- wij = importance of the i-th criterion assigned by j-th practitioner

ENLISTING THE FINAL IMPORTANCE

Enlisting of the final importance – the final importance of the individual criteria for supplier evaluation may be enlisted as:

$$wK^{HD} = (wK_1^{HD}, \; wK_2^{HD}, …, wK_k^{HD}) \qquad (2)$$

ASSIGNMENT OF THE CRITERION MATRIX FOR SUPPLIER EVALUATION

For the right decision on choosing the supplier, it is necessary to establish the criterial matrix (see Table 4) [1], [10], [11].

Table 4 Criterion matrix

Vendor evaluation	K_1^{HD}	K_2^{HD}	…	K_{k-1}^{HD}	K_k^{HD}
D_1					
D_2					
…					
D_{p-1}					
D_p					

Source: (1) + authors

SUPPLIER EVALUATION ACCORDING TO SCORING MODEL

It is important to assess numerical scale for scoring model. It is clear that the more points the supplier gains, the better position he gets. Every logistics company may define their own numerical scale – according to their needs. The proposed numerical scale was consulted with the practitioners by the method of questioning (personal interview) [1], [3], [11].

Table 5 Numerical scale

Level indicator	excellent	very good	good	satisfactory	poor
The number of points	5	4	3	2	1

Source: authors

TABLE COMPOSITION WITH THE POSSIBLE LIMITS FOR SCORING OF THE INDIVIDUAL CRITERIA

A compilation of the possible boundaries for each scoring criteria is the next step in multicriteria decision table [5], [7].

PROPOSAL OF THE POSSIBLE LIMITS FOR SCORING OF THE INDIVIDUAL CRITERIA

Individual limits of scoring were designed with the aid of brainstorming method and personal interviews with practitioners. Figure 3 is focused on the field of transport and individual scoring limits have been proposed for handling and storage area (normal handling, sorting and storage). For this article, only limits as for transport are shown [5], [7], [10].

Level indicator	excellent	very good	good	satisfactory	poor
The number of points	5	4	3	2	1
Price	more than 15% below the average market price	15 -10% below the average market price	to 10% below the average market price	average market price	more than the average market price
Quality	$N_{NZ} \geq 99\ \%$	$N_{NZ} = 99 - 98\ \%$	$N_{NZ} = 98\text{-}97\ \%$	$N_{NZ} = 97\text{-}96\ \%$	N_{NZ} 96 - 95 %
Reliability	$S \geq 99\ \%$	$S = 99\text{-}98\ \%$	$S = 98\text{-}97\ \%$	$S = 97\text{-}96\ \%$	$S = 96 - 95\ \%$
Flexibility	immediate operational flexibility	adequate	adequate	limited	not
Responsibility	maximum	adequate	adequate	limited	not
The prevention of risks	maximum caution	appropriately cautious	appropriately cautious	closely care	careless
Development of supplier	regularity	adequate	adequate	limited	not

Figure 3 Limits proposal for scoring of the individual criteria in the area of transport

Source: authors

Criterion K_2^{HD} (Quality) in the area of transport may be defined as [12] - [15]:

$$N_{NZ} = \frac{Nz}{Nc} * 100\ (\%) \tag{3}$$

Where:

N_{NZ} – Percentage of the amount of the delivered consignments for certain time period (%)

N_z – number of delivered consignments for certain time period

N_c – total number of consignments for certain time period

Criterion $K3^{HD}$ (reliability) may be defined with the indicator of reliability of delivered consignments in time:

$$S = \frac{N_V^{dor.}}{N_C^{dor.}} * 100\ (\%) \tag{4}$$

Where:

S – reliability of the delivery in time (%)

$N_V^{dor.}$ – number of delivered consignments in time for certain time period

$N_C^{dor.}$ – total number of delivery for certain time period

TABLE ASSIGNMENT

Table assignment (Figure 5) – supplier evaluation proposal, where total number of gained score may be calculated as follows [13], [14]:

$$\sum_{l=1}^{k} wK_l^{HD} * b_l * 100 \tag{5}$$

Vendor evaluation	wK_l^{HD}	b_l	$wK_l^{HD} \cdot b_l.\,100$
K_1^{HD}			
K_2^{HD}			
…			
K_{k-1}^{HD}			
K_k^{HD}			
		celkom	$\sum_{i}^{k} wK_i^{HD}\ b_i.\,10$

Figure 4 Supplier evaluation

Source: (1) + authors

The maximum of total score number of evaluation, which is possible to achieve with selected scale, is 500.

SUPPLIER CLASSIFICATION PROPOSAL

The supplier classification proposal is based on the total number of points which the supplier may achieve during the evaluation [5], [15], [16].

Table 6 Supplier classification

The total number of points	The type of supplier
500 – 450	Excellent supplier
450 – 400	A very good supplier
400 – 350	A good supplier
350 – 300	Matching supplier
less than 300	Unsatisfactory supplier

Source: authors

In the case that the supplier is classified as „excellent supplier", his position in the logistics company is not compromised. The supplier proved excellent results in every area and the cooperation and communication between the supplier and company is at the high level[5].

As long as the supplier is classified as „insufficient supplier", it is necessary so that the logistics company will ask a supplier written submission where the supplier will react to the insufficient evaluation and what are his remedial actions and schedule of their realization. The second option is that the company will look for alternative (new) supplier[5], [12-14].

CONCLUSION

The proposed model for the assessment of suppliers in the logistics enterprise was applied in a real-logistics company. Evaluation of supplier was made in two areas: transport, handling and storage.

The fundamental objective of every logistics company providing services is to achieve optimal level of provided services with minimal costs. Those two crucial factors affect each other in many cases. On the one side, there are constantly increasing demands of the customers on the speed, quality and flexibility of the consignments. On the other side, there is a problem of price competitiveness, so this means a tension on the constant search of potentials on decrease of the logistic costs [12], [16].

The application of the innovative approaches into the measuring and quality evaluation for the companies providing service is very important step. It leads to increasing company success on the transport market. Nowadays, the most of the measurement and quality evaluation systems is just partial in some of the logistics companies, because it is reduced on evaluation of the selected factors whilst many shortcomings in supply chain management stay hidden [14], [16].

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