THE METHODOLOGY OF PERFORMANCE EVALUATION OF NEW SUPPLIERS

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Abstract: This paper presents the results of the PhD thesis "The Performance of Supplier Customer Relationships in first Stage of the Supply Chain" from the author Ekaterina Chytilova (Sutormina). In this paper authors work out modern methods of evaluation of new suppliers. Authors work out the different opinions on the system of criteria to evaluation suppliers at the first stage. Authors describe suppliers' evaluation as the way to create a robust and flexible supply chain. The new theoretical evaluation methodology of new suppliers at the first stage for small and medium-sized enterprises will be presented in this paper. This paper presents differences a new theoretical method of supplier evaluation. This paper presents complex system of quantitative evaluation the supplier in the first stage.

Keywords: Supply Chain Management, the evaluation of supplier, selection procedure, small and medium-sized manufacturing enterprises, new supplier

1. Introduction

Nowadays small and medium-sized enterprises (SMEs) make up a large part of European and world's economy. It may be necessary to have different supply chains because of the very nature of the products [11].

Authors don't find own methodology of suppliers' evaluation for SME's.

SME can have some different types of business and in this case need the universal system of evaluation. In post-crisis period the problem of universal evaluation is one of the biggest, because companies had to use all resources and all possibilities to develop their own business. Only the right evaluation of supplier and the high quality of supply chain can help to make a profit for firms and win the war about customer.

We have to find the universal mechanism of supplier's evaluation for operation management in SME. Literature reviews help us to work out modern methods and trends of evaluation of suppliers. This problem can be solved if we establish criteria and formulas for universal evaluation of suppliers and supply goods.

2. Literature review - related work
2.1 Materials and methods
2.1.1 Selecting evaluative criteria

While using cluster analysis, one can prefix the number of clusters but cannot control the number of elements in the clusters. Since the supply base reduction problem requires reducing the number of suppliers in the supply base to a prefixed value, cluster analysis does not appear to be suitable for supply base reduction. However, we visualize a different use of cluster analysis in our proposed method for supply base reduction. It can be effectively used to group the selection criteria into long- and short-term categories [2].

Much of the information on unknown suppliers, collected through Internet,

peer feedback and onsite visit, will lack quantitative measurement. Even information on known suppliers may not have been stored in a form that lends itself to a quantitative conversion [2].

The fuzzy set theoretic approach to supplier evaluation decision problem satisfies two of the four rationales:

1. the do not know rationale and
2. the don't need rationale.

In a supply base reduction problem, the scores on each factor are not known with precision to justify the use of conventional methods of supplier evaluations (the first rationale). It is also not necessary that factor values are known very precisely (the second rationale) [2].

Jafar Razmi, Hamed Rafiei, Mahdi Hashemi [10] wrote about 6 evaluative criteria. An enterprise intended to outsource construction of their second building. Four construction companies are introduced as the alternatives. The enterprise regards 6 criteria:

- price, C1;
- quality, C2;
- finish time, C3;
- company's rank, C4;
- company's antecedents, C5, and
- company's economic status, C6.

In the next step, criteria are grouped into two clusters; company's status (including C1, C2, and C3), and performance (including C4, C5, and C6).

Quality-based supplier selection Yuan (1991) [12] proposed a ranking method which is satisfied with four reasonable criteria on sorting fuzzy numbers such as fuzzy preference presentation, rationality of fuzzy ordering, distinguish ability, and robustness.

De Toni and Nassimbeni present a framework for the evaluation of supplier's co-design effort. They suggest capabilities in co-design activities, most of them are concurrent engineering techniques, offered by

suppliers in the development stages as evaluation criteria such as support in product simplification, support in component selection, and support in design for manufacturing/ assembly activities, etc. It has been stated in the literature that the use of these techniques lead to substantial improvement in quality, cost and delivery performance. Hence, it is essential to consider these factors in supplier evaluation [1].

2.1.2 Selecting procedure

Literature review on supplier selection and evaluation. Many methods have been suggested for supporting supplier selection decisions. De Boer [6] reported that a supplier selection problem typically consists of four phases:

I. Problem definition.
II. Formulation of criteria.
III. Qualification of suitable supplier (or pre-qualification) and
IV. Final selection.

1) Quality-based supplier selection and evaluation using fuzzy data [12].

This selecting procedure includes next steps:

Step 1: Select q possible suppliers and collect quality data from them.

Step 2: Obtain the membership function for each supplier.

Step 3: Provide a value.

Step 4: The preferable group of suppliers is determined, where t is the number of preferable suppliers and any two suppliers in the group are indifferent.

Step 5: The decision-makers may randomly select one of the suppliers as the most preferable supplier. Of course, if the decision-makers decide to select more than one supplier to supply the required products, then the same procedure can be used to select the preferable suppliers.

2) Network formation

Network formation comprises two steps described as follows:

Clustering: Some clusters formed with respect to the criteria. Then, the criteria are assigned to the clusters to which are mostly related. Finally, alternatives make a separate cluster.

Connecting: In this step, the related clusters connected with respect to the dependencies between their corresponding criteria [10].

The connections which reflect interrelationships and feedback structure can be either inner (between two criteria within the same cluster) or outer (between two different clusters). An inner connection is like a loop on the corresponding cluster. Connection between two criteria is signed with an arrow from the affecting criterion to the dependent one [10].

3) Pair-wise comparisons

Pair-wise comparisons are performed between each pair of criteria with respect to a control criterion. Control criterion is the criterion to which some other criteria are dependent. In other words, the group of criteria connected to a specific (control) criterion is compared pair-wisely. In addition to the comparisons of criteria, clusters of the network must be compared pair-wisely with respect to the control cluster [10].

4). Fuzzy multicriteria approach for evaluating environmental performance of suppliers

The proposed approach comprises of three steps. In step 1, the criteria for evaluating environmental performance are identified. These criteria are usage of environment friendly technology, environment friendly materials, green market share, partnership with green organizations, management commitment to green practices, adherence to environmental policies, involvement in green projects, staff training, lean

process planning, design for environment, environmental certification, and pollution control initiatives. In step 2, the experts provide linguistic ratings to the criteria and the alternatives. The alternative with the highest score is the one with best environmental performance. In the third and the last step, is performed sensitivity analysis to determine the influence of criteria weights on the decision making process. [3]

2.2 Method of complex evaluation (MCE)

Many authors [4, 7, 8] wrote about problem operation evaluation for supply chain with multi-criteria calculation. This paper presents the results of PhD thesis "The Performance of Supplier Customer Relationships in first Stage of the Supply Chain" from author Ekaterina Chytilova (Sutormina) [5]. This paper is about the method for evaluation of new suppliers. This task can be coped by mathematical methods of evaluation. By means of authors' recommendations and traditional criteria of evaluation authors make up these criteria for suppliers' evaluation. This method is oriented on small and medium-sized companies. Evaluation is oriented on average value. It is universal evaluation because it can be used for different groups of suppliers. Value of each group for enterprise is selected by user. Authors can divide the evaluation into two parts: for new suppliers and for existing suppliers and suppliers selected of customer. Evaluation for new suppliers follows those evaluative groups:

1) Delivery time.
2) Quality of products/services in recommendation regard.
3) Costs.
4) Transportation.
5) Mobility of supplier.

Evaluative group "Delivery time" follows those criteria of evaluation:
- correspondence between life time of product and average delivery time;
- possibility of transportation with suppliers' transport + price of transportation;
- possibility of shortening delivery time and related conditions.

Evaluative group "Quality of products/services in recommendation regard" follows those criteria of evaluation:
- certification;
- foreign experiences with supplier;
- supplier's experience (time on market).

Under traditional quality control, inspection of goods and services (checking to make sure what's being produced is meeting all expectations) takes place at the end of the operations process.[9].

Evaluative group "Costs" follows criteria "Index total costs of purchasing"

Evaluative group "Transportation" follows criteria "Correspondence between distance to supplier and quantity of suppliers in region"

Evaluative group "Mobility of supplier" follows those evaluative criteria:
- Possibility mobility of supplier;
- Related costs.

Each one of that evaluative criteria has own formula of calculation.
For example:

$$CBTLTandADT = \frac{LTP}{\overline{LTP}} * \frac{DT}{\overline{DT}} * \frac{1}{3} EC$$

Where

CBTLTandADT - Correspondence between life time of product and average delivery time for some supplier.

LTP - life time of product.

$\overline{LTP}$ - average LTP of all suppliers.

DT - delivery time.

$\overline{DT}$ - average DT of all suppliers.

EC - evaluative coefficient.

Other formulas for supplier' evaluation for this group is shown on Appendix 1. Example of values you can find on Table 1 and in capitol 2.3. „MCE data. Example of application".

Table 1 The evaluation methodology of new suppliers at first stage. Example

Evaluative group	Evaluative criteria	Evaluative coefficient (EC)
1) Delivery time	Correspondence between life time of product and average delivery time (CBTLTandADT)	0,2
	Possibility of transportation with suppliers' transport +price of transportation (PTWST+PT)	
	Possibility of shortening delivery time and related conditions (PSDTandRC)	
2) Quality of products/ services in recommendation regard	Certification (Cert)	0,25
	Foreign experiences with supplier (FEWS)	
	Supplier's experience (time on market) (SE)	
3) Costs	index total costs of purchasing (ITCP)	0,25
4) transportation	Correspondence between distance to supplier and quantity of suppliers in region (CBDSandQSR)	0,1
5) Flexibility of supplier	Possibilities of supplier's flexibility (PFS)	0,2
	Related costs (PFSRC)	

Source: Chytilová E., 2012 Performance supplier-customer relationships in the first stage of supply chain.

2.3 MCE data, Example of application

1) DELIVERY TIME

Correspondence between work life of product and average delivery time

- work life of product (WlP)

1	-0-1 month
2	-1-3 months
3	-4-7 months
4	-8- 12 months
5	-13- 36 months
6	-37-60 months
7	-61-96 months
8	- More, than 96 months

- average delivery time (ADT)

8	-0-12 hours
7	-13-24 hours
6	-25-36 hours
5	-37-48 hours
4	-48-60 hours
3	-61-83 hours
2	-84-108 hours
1	More, than 108 hours

(WlP /average WLP of all suppliers)*(ADT / average ADT of all suppliers)*evaluative coefficient (1) 0,067

Possibility transportation with suppliers' transport +price of transportation

Possibility yes (1)-no(0)

Time of transportation in case possibility of transportation suppliers' transport

8	0-5 hours
7	6-10 hours
6	11-15 hours
5	16-20 hours
4	21-25 hours
3	26-30 hours
2	31-35 hours
1,5	36-40 hours
1	more than 40 hours

Possibility * (Time of transportation /average time of transportation for all suppliers)*evaluative coefficient (1)) 0,067

Possibility shorting of delivery time and related conditions

Possibility shorting of delivery time yes (1)=no (0)

Evaluate of conditions: Conditions single supplier/ average conditions of all suppliers

1. Conditions a single supplier: Shorting time of supply/ related price improvement
2. Average conditions of all suppliers: Average shorting time of supply/ Average related price improvement

Possibility shorting of delivery time*(conditions of shorting of delivery time/average conditions of shorting delivery time)*evaluative coefficient (1)) 0,067

(WlP /average WLP of all suppliers)*(ADT / average ADT of all suppliers)*evaluative coefficient (1) 0,067+ Possibility * (Time of transportation /average time of transportation for all suppliers)*evaluative coefficient (1)) 0,067+ Possibility shorting of delivery time*(conditions of shorting of delivery time/average conditions of shorting delivery time)*evaluative coefficient (1)) 0,067

2) QUALITY OF PRODUCTS/ SERVICES IN RECOMMENDATION

Certification

Existence due certificates of quality, if need will be due patents

Yes (1)- No (0)

Existence optional certificate of quality

Yes (2)-No (0)

(Existence due certificates of quality, if need will be due patents + Existence optional certificate of quality)/average evaluate certification of all suppliers* evaluative coefficient(1) 0,083

<p style="text-align:center;">Foreign experience with supplier</p>

Existence public information about bad experience others consumers with this supplier

Yes (-1)-No (0)

Existence public information about good experience others consumers with this supplier

Yes (1)-No (0)

(Existence public information about bad experience others consumers with this supplier + Existence public information about good experience others consumers with this supplier)/ (average existence selected bidders)*evaluative coefficient (1) 0,083

<p style="text-align:center;">Experience of supplier (time on market)</p>

1	-0-12 months
2	-13-30 months
3	-31-48 months
4	-49-84 months
5	-85-110 months
6	-More than 110 months

Experience of single supplier/ average of experience of selected suppliers* evaluative coefficient (1) 0,083

(Existence due certificates of quality, if need will be due patents + Existence optional certificate of quality)/average evaluate certification of all suppliers* evaluative coefficient(1) 0,083+(Existence public information about bad experience others consumers with this supplier + Existence public information about good experience others consumers with this supplier)/ (average existence selected bidders)*evaluative coefficient (1) 0,083

 + Experience of single supplier/ average of experience of selected suppliers* evaluative coefficient (1) 0,083

<p style="text-align:center;">3) COSTS</p>

<p style="text-align:center;">Index of total costs of purchasing;</p>

Purchasing value

Transportation costs (Ct), we evaluate here cost on transportation, before we were evaluated possibility changes and related costs

Packing costs(Cp)

Warehousing costs (Cw)

Customs costs (Cc)

(average of purchasing value / purchasing value + (average of (Ct + Cp + Cw + Cc))/ (Ct + Cp + Cw + Cc) of selected supplier) *evaluative coefficient (1) 0,25

<p style="text-align:center;">4) TRANSPORTATION</p>

<p style="text-align:center;">Correspondence between distance to supplier and quantity of suppliers in region</p>

Distance to supplier; km (DS)

14-	0-10
13-	11-30
12-	31-60
11-	61-100
10-	101-200
9-	201-300
8-	301-400
7-	401-500
6-	501-600
5-	601-700
4-	701-800
3-	801-900
2-	901-1000
1-	1001 and more

quantity of suppliers in region (QS)

1	-1supplier
2	-2-3 suppliers
3	-4-6 suppliers
4	-7-10 suppliers
5	-11-15 suppliers
6	-16-20 suppliers
7	-More than 20 suppliers – (DS /average of DS)*(QS/average of QS)*evaluative coefficient (1) 0,1

<div align="center">5) FLEXIBILITY OF SUPPLIER</div>
<div align="center">Possibility mobility of supplier</div>

Possibility of online ordering

1-0 Yes=No

Possibility of modification product in agreement with demands of firm

1-0 Yes=No

Possibility of communication at creating of ordering product

1-0 Yes=No

Possibility of transfer a part of processes (activities)/services (services for customer transfer to supplier)

1-0 Yes=No

(Possibility of online ordering + Possibility of modification product in agreement with demands of firm+ Possibility of communication at creating of ordering product Possibility of transfer a part of processes (activities)/services (services for customer transfer to supplier))/average of possibilities*evaluative coefficient(1)0,1

<div align="center">Related costs:</div>

4+1-3%

3+4-9%

2+10-15%

1+16-30%

0Vice než 30%

Related costs/ average of related costs*evaluative coefficient(1)0,1

(Possibility of online ordering + Possibility of modification product in agreement with demands of firm+ Possibility of communication at creating of ordering product Possibility of transfer a part of processes (activities)/services (services for customer transfer to supplier))/average of possibilities*evaluative coefficient(1)0,1+ Related costs/ average of related costs*evaluative coefficient(1)0,1.

6. Conclusions

By this method authors evaluate average value for group of suppliers. The best supplier has the highest value. There are two groups of evaluate: for new suppliers and for existing suppliers. In this paper authors present the methodology of evaluation for new suppliers.

By means of this method user can select important groups of evaluation. Each group has some evaluative criteria. One of these groups is mobility of supplier. By means of this evaluate group firm can find the best supplier and build supply chain with higher quality.

New method has some differences, such as:

- orientation on different groups of suppliers;
- orientation on SMEs;
- orientation on average value;
- different groups of evaluation with different criteria of evaluation;
- user can select important criteria for firm.

For this paper were established the values of criteria and groups. Results are presented in capitol 2.3.

This system can be used in SMEs, which have businesses in different groups. This system is used for the total evaluation of suppliers and to provide the high quality of supply chain.

New method can improve the total evaluation of supplier in SME. This method will be used in planning software for firm.

This method will be controlled by really dates from firms-partners.

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