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THE APPLICATION OF METHOD SUPPLIERS' COMPLEX EVALUATION. CASE STUDY.

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Abstract

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The main goal of this article includes the illustration of selecting bidders evaluation with help Method of complex evaluation of suppliers (MCE). Nowadays the evaluation of suppliers has more importance is in the supply chain management. For SMEs with discontinuous custom manufacturing supplier evaluation at first stage becomes a priority to maintain and enhance the competitiveness of farm output and overall competitiveness. This article presents results of control MCE. The results of this article are results of suppliers' evaluation conditions and eliminations of MCE application on the base of real enterprise data. MCE is oriented to small and medium-sized enterprises with discontinue manufacturing to order. Research is oriented to selecting procedure of existing suppliers at the first stage of supply chain. Nationality and geographic location haven't importance to MCE application. Illustrative case study presents the evaluation process to the specific conditions and subsequently demonstrated viability of MCE.

supplier selection procedure, existing supplier, case study, scoring-model, supply chain

At present, building a strong and flexible supply chain is considered fundamental for a successful business. There are several methods of supplier evaluation. A scoring model is seen as the basic method. There are several views on the choice of evaluation criteria.

Therefore, currently SCM is playing an important role. The objective of SCM is to achieve efficient use of all resources entering into the process, timely delivery of all goods and services, speeding the process, minimizing downtime and zero losses (Christopher, 2005).

According to Zelený (2006), the current business conditions can be characterized by the following:

1. Large companies become networks of outsourced resources. Small companies are grouped into alliances, partnerships and cooperation networks. Traditional company transforms into a flexible business network. For building a strong business network, a certain amount of information on suppliers (first instance) and subcontractors (higher degrees) is required.
2. Cooperation supplements or replaces competition. While the enterprises in the network or alliance cooperate, it is the networks that compete with each other. Because of this, choosing suppliers in the first instance is one of the basic steps in building a supply chain.
3. Global customers require more and more products and services "tailored". Mass customization and individualization are replaced by mass production. Selling first and then custom-produce is a new paradigm of global competitiveness.
4. Increasing outsourcing creates long-term, stable relationships. The success of companies increasingly depends on partnerships with suppliers and customers.
5. Co-location. The customer does not buy just parts and components, but also functional parts and components.
6. Small and medium enterprises build cooperation networks. They are actually the necessary environment for effective outsourcing and offshoring (Zelený, 2006).

MATERIALS AND METHODS

The main goal of this article is presentation of MCE in real enterprise conditions.

The main goal of the article can be determined into partial goals:

- Presentation the existing methods of suppliers' evaluation,
- Presentation the business conditions on the basis of real data from enterprise,
- The presentation of suppliers' evaluation with help MCE on the basis of real data from enterprise,
- Determining the future work on the basis of MCE illustrated evaluation' process and results.

1. Methods of article

For results of this article was used qualitative research in the form of single case study.

Case study research is an inductive research method. It is usually accompanied by an analysis of qualitative data (Collis and Hussey, 2003). A case study is considered the emerging prototype – explorative research (Líška, 2009), characteristic of qualitative research. Yin, Collis and Hussey distinguish five types of case studies:

- Research (exploratory) – used in areas where there are few theories and there is a lack of knowledge.
- Descriptive (descriptive) – the aim of these case studies is to describe the limitations of current practice.
- Illustrative – the purpose of the illustrations (sample) of new innovative processes, applied in specific companies.
- Experimental – This approach examines the difficulties in implementing new procedures and techniques in organizations and also evaluates benefits.
- Explanatory – existing theory is used to explain what is happening.

In terms of the design, case studies can be divided into single type case studies and multiple case studies (comparative) (Yin, 2003).

To present the results of this paper, the format of a single illustrative case study was chosen.

Single illustrative case study uses changed data from a real middle-sized enterprise

The result is individual case study conclude the terms of possible applications in practice MCE selected type of company to increase the performance of supplier – customer relations with the supplier at the first stage. The method of this article is illustrative single study, because it's presentation of possibility of application MCE in real enterprise conditions.

2. The methods of suppliers evaluation

(1) Selecting evaluative criteria

To evaluate suppliers against the factors mentioned earlier, the buying team has to resort to subjective, qualitative assessment, using their mental perceptions. Zadeh (1999), while presenting the computational theory of perceptions, emphasises the key role perceptions play in human recognition, decision, and execution processes. Rather than leave out the suppliers with such incomplete, qualitative information, we propose experts' opinion for a subjective evaluation of suppliers followed by a fuzzy set theoretic analysis to take care of the fuzzy nature of these evaluations. The use of crisp numbers to quantify human perceptions does not reflect the imprecision and partial truth that surrounds human perception and decisions (Sarkar, Mohapatra, 2006).

Aouam *et al.* (2003) used outranking intensity represented by a fuzzy number to evaluate competing alternatives. Kahraman *et al.* (2003) used fuzzy AHP for the multi-criteria supplier selection problem. Cheng and Lin (2002) evaluated the best main battle tank using expert opinions that are described by linguistic variables. Raj and Kumar (1998, 1999) used linguistic variables for capturing expert's opinion and proposed a methodology based on weighted average method for aggregating the individual scores.

1. Dickson (1966) listed 23 criteria as the most important ones had been considered to date, however more recently, Verma and Pullman (1998) had an investigation on decision criteria in this field and found that the quality is the most important factor from managers' points of view. It is also declared by them that managers actually select their suppliers mostly upon suggested prices from suppliers. By the way, as today criteria have changed from the past ones, some other criteria, such as environmental criteria (Humphreys, McIvor, Chan, 2003; Celebi and Bayraktar, 2007), have been devoted in the field.
2. 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) to choose the best company to which out sources the building (Razmi, Rafiei, Hashemi, 2009).
3. Environmental management

   These criteria are usage of environment friendly technology (C1), environment friendly materials (C2), green market share (C3), partnership with green organizations (C4), management commitment to green practices (C5), and other (Awasthi, Chauhan, Goyal, 2010).
4. Quality-based supplier selection. Shu, Wu (2009) lists four reasonable criteria on sorting fuzzy numbers such as fuzzy preference presentation, rationality of fuzzy ordering, distinguish ability, and robustness (Shu, Wu, 2009).
5. The MCE Scoring Model

   Evaluation of existing suppliers and contractors selected by the customer includes the following

evaluation groups: delivery time, the expertise of suppliers, costs, transportation, flexibility of supplier, the results of the audit of the existing suppliers (process organization level) (Chytilová, 2012).

(2) Selecting procedure

Some researchers have tried to give an overview of the different supplier selection problems and methods: (Weber *et al*., 1991; De Boer *et al*., 2001). Recently, De Boer *et al*. (2001) 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. Scoring model for supplier evaluation

Scoring models are among the basic evaluation methods. A scoring model is based on score calculation of suppliers. The highest score determines the most suitable supplier. The total score of a supplier is the sum of the values all the evaluation criteria (Tomek, Hofman, 1999).

1.1 Scoring-model by Tomek, Hofman

Scoring models are among the basic evaluation methods. A scoring model is based on score calculation of suppliers. The highest score determines the most suitable supplier. The total score of a supplier is the sum of the values all the evaluation criteria (Tomek, Hofman, 1999).

1.2 MCE scoring-model

MCE scoring model is oriented to compare with average values. Average value in the total evaluation result is 1. If supplier will have value less than 1 it means that this supplier is subnormal. If supplier will have total value result more than 1 it means that that supplier is above-average. More of the total evaluation result exceeds 1 means more appropriate of supplier. The total evaluation result cannot be negative. The values in the group The results of the audit existing suppliers (level the organization of the production process) are subjective and based on enterprise determined scale (Jurová, Sutormina, 2010).

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.

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 (Razmi, Rafiei, Hashemi, 2009).

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 (Razmi, Rafiei, Hashemi, 2009).

RESULTS

1. The firm presentation

1. The conditions of business (description of the customer's competitive environment, the basic description of the business)

Enterprise NPO SpecTehMash (rus. НПО "Спецтехмаш") has existed for several years. Currently, 80 percent of the production company is producing for the needs of the oil industry; in particular, the company consists of production shafts for electric submersible pumps. Business clients are medium-sized enterprises that fulfill orders for larger companies. The customer then assembles into rods made whole.

Characteristics of a range of requirements: as in most enterprises engaged in manufacture, Spectehmash trying to satisfy each customer. On the other hand, this enterprise has the limited production capacity. At present, expanded its production capacity with new production facilities through which products can produce different sizes. Customer requirements differ in their diversity.

2. Description of first stage supplier's market a product, a description of the product delivery

There are two basic suppliers.

The first supplier in the vicinity, the possibility to vary the order. Payment in advance, a limited range. Supplier-large manufacturing plant, located in the vicinity of the undertaking in the same city. By 2010 it was the only available supplier. The advantage is the location, operational changes to these products, assortments and legislative (legal, customs, fiscal) transparency. The main disadvantages are inflexible payment terms (45 days before delivery), semi-close range – shaft lower levels (coarser) machining.

The second supplier. Far around, there is no possibility to vary the order, the six-month plan, which requires higher inventory levels, higher bound assets. The possibility of deferred payment, a wide range of assortments, willingness to co-operation on innovation. Contractor is a large manufacturing company, located in Germany. Before the year of the management audit was carried out by visits to manufacturing plants supplier. The main advantage is a greater willingness to cooperate closely, flexible

payment terms, a wider range. Disadvantages: Relatively long order period (six months, planned harvesting schedule), immutability order. This factor makes the company in procurement purchases in uncertain risk to undergo unnecessary binding of capital.

The final price of the product from both suppliers is almost the same. Product from another supplier has a higher total price for customs costs and higher transportation costs.

Product (shaft) under operational conditions in the country is under deepness 1–2 km. Therefore, one of the main requirements to the product as its period of use in operating conditions. Special machining blank for a second supplier for increasing the use of the material element in the operating conditions.

3) Preferred evaluation criteria to suppliers selection

The priorities of the evaluation criteria in relation to changing customer requirements. It may be price or quality. Quality is assessed on the same time as the mandatory certificates of quality and business requirements to the physical properties of the material element (the higher level of quality (accuracy) than expected required quality certificates. Purchase price means the total cost incurred per unit of production.

Another priority in the choice of supplier company at first stage the conditions of delivery, reliability of suppliers. Currently a big role in the evaluation and subsequent choice of suppliers at first stage plays flexibility supplier.

The MCE evaluated using other weights were determined in evaluation of individual groups according to the priorities of enterprise:

In the case of focusing on quality identified additional weight categories of evaluation criteria (Tab. I).

7) The definition of the relationship with the supplier

I. Contractor:

According to the Helper classification (Saccani, Perona, 2007) supplier-customer relationships can be assigned to the exit system.

II. Contractor:

According to the Helper classification (Saccani N., Perona M.,2007) supplier-customer relationship can be assigned to a voice system (customer and supplier is unable because of his reputation is willing to solve problems jointly developing a new product, to the supplier is willing to provide customers the possibility of deferred payments).

In sub-capitol 2 "Application of MCE" will be present process and results of suppliers' evaluation. MCE as scoring-model is oriented to maximum score of supplier.

MCE can help determine the suitability of supplier as above-average result of this supplier in the selection.

2. Application of MCE

On Tab. II are presented the results of evaluation shall concentrated on product quality.

3. The results evaluation (The analysis of illustrated evaluation' results)

On Tab. II are presented the results of evaluation shall concentrated on product quality. MCE is evaluated according to the average values in the selection of suppliers.

MCE is the variant of scoring-model for suppliers' evaluation. MCE has some advantages and as every scoring model, for example:

- The possibility different values of every group according to company's strategy,
- different groups of evaluation with different criteria of evaluation,
- The unique quantitative result,

MCE has some disadvantages as every scoring model, for example:

- Only quantitative evaluation, without any recommendations to total value.
- Selection without qualitative evaluation.

MCE compares the overall competitiveness of individual suppliers in the first stage from the perspective of the enterprise. With MCE can appreciate each evaluation group. The management can see the whole complex of indicators and their components for the granting of the supplier's choice in the first stage. The management can combine deliveries from both suppliers and customer

I: *Values of individual groups of evaluative criteria*

Evaluative criteria groups	Value
delivery time	0,1
The expertise of supplier	0,25
Costs	0,2
Transport	0,1
The results of the audit existing suppliers (level of organization of the production process)	0,2
Flexibility suppliers	0,15
Total	1

Source: Chytilová, 2012

II: *The results of evaluation shall concentrated on product quality*

Koef.	Evaluation group	Evaluation criterion	Evaluation indicator	Koef	S1	S2
0,1	Delivery time	compliance the period of application of material element in the operating conditions and the average delivery time	The period of application of material element in the operating conditions	0,033	5	7
			average delivery time		5	7
			Calculation		0,023	0,045
		Possibility transportation to final customer with supplier's transport + time transportation	Possibility transportation to final customer with supplier's transport	0,033	0	0
			The time of transportation in case possibility of transportation supplier's transport		0	0
			Calculation		0	0
		Possibility shorting lead times and associated conditions	Possibility shorting lead times	0,033	0	1
			shorting lead times		0	3
			Associated increasing price		0	1
			Calculation		0	0,067
		Calculation			**0,023**	**0,112**
0,25	The expertise suppliers	Certification	Existence compulsory quality certificates	0,063	1	1
			Existence of a voluntary quality certificates		0	2
			calculation		0,031	0,093
		supplier position on markets	Time on market	0,031	6	4
			calculation		0,038	0,025
		The reliability of supplier	actual number of supplied pieces	0,125	115	100
			planned number of supplied pieces		125	110
			calculation		0,115	0,114
		Calculation			**0,184**	**0,232**
0,2	Costs	index the full cost of purchase	Purchasing value	0,2	25	15
			Transport costs		1	5
			The cost of packaging		2	2
			The cost of storage		1,5	3,1
			costs duty		0	7
		Calculation			**0,139**	**0,128**
0,1	Transport	distance suppliers	distance suppliers, km	0,1	14	1
		Calculation			**0,28**	**0,02**
0,2	results of the audit existing suppliers (level of organization of the production process)	level of business management	management's responsibility	0,067	3	5
			training and staff		2	4
			financial considerations in quality management		2	4
			process safety		5	5
			Calculation		**0,107**	**0,16**
		level of organization of production process	spatial resolution	0,133	2,5	4
			information security		2	5
			course material flow		3	4
			Calculation		**0,146**	**0,254**
		Calculation			**0,253**	**0,414**
0,15	supplier flexibility	Possibilities	Possibility of online orders	0,075	0	1
			The possibility of modification of the product under the business requirement		0	1
			The communication options in creating custom-made product		1	1
			The possibility of deferred payment		0	1
			The possibility of transfer activity		0	1
			Calculation		0,0625	0,3125
		Corresponding costs	Corresponding costs	0,075	4	3
			Calculation		0,1286	0,0964
		Calculation			0,191	0,409
outcome of the evaluation					**0,999**	**1,311**

Source: Chytilová, 2012

needs. The first supplier has a higher value in the evaluation group costs, transportation (due to geographical proximity of suppliers). The second supplier has a higher value in the evaluation group mobility suppliers, audit results, delivery time (due to longer time of use of material element in the operating conditions), and the classification of the supplier (for optional certificates).

For use this system existing suppliers should have information about audit quality processes and quality of goods.

DISCUSSION

New method can improve the total evaluation of supplier in SMEs.

New method is the variant of scoring-models, which has some own differences, such as:

- orientation on different groups of suppliers,
- orientation on SME,
- orientation on average values,

After control of MCE authors can submit, that new method has own advantages and disadvantages.

Advantages:

- Total evaluation of supplier in the first stage,
- Evaluation different types of business for one company
- Evaluation inside really possibilities – orientation to average values

Disadvantages:

- Different results according to number of suppliers-single-use results.

The actual question of research is why managers of SMEs doesn't apply similar tool as MCE, why managers of SMEs apply only basic criteria to suppliers evaluation?

The future work will be realized in the form of comparing possibilities of SMEs and requirements to MCE application. MCE is tool for instant purchasing decision.

SUMMARY

MCE is evaluated according to the average relationship in the selection of suppliers. MCE compares the overall competitiveness of individual suppliers in the first stage from the perspective of the enterprise (the first customer). The advantage of the optimum method of procedure is the relative simplicity and speed rating for a given amount of information.

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

MCE has some differences, such as:

- orientation on different groups of suppliers,
- orientation on SME,
- orientation on average values,
- different groups of evaluation with different criteria of evaluation,
- User can select important criteria for firm.

REFERENCES

AOUAM, T., CHANG, S. I., LEE, E. S., 2003: Fuzzy MADM: an outranking method. *European Journal of Operational Research*. 145: 317–328. ISSN 0377-2217.

AWASTHI, A., CHAUHAN, S., GOYAL, S. K, 2010: A fuzzy multicriteria approach for evaluating environmental performance of suppliers. *International Journal of Production Economics.* 126, 2: 370–378. ISSN 0925-5273.

CELEBI, D., BAYRAKTAR, D., 2007: An integrated neural network and data envelopment analysis for supplier evaluation under incomplete information. *Expert Systems with Applications.* 3, 4: 1698–1710. ISSN 0957-4174.

CHENG, C., LIN, Y., 2002: Evaluating the best main battle tank using fuzzy decision theory with linguistic criteria evaluation. *European Journal of Operational Journal*. 142: 174–186. ISSN 0377-2217.

CHRISTOPHER, M., 2005: *Logistics & Supply Chain Management: creating value-adding networks*. 3d ed. Pearson Education. 305 pp. ISBN 10: 0-273-68176-1.

CHYTILOVÁ, E., 2012: *Výkonnost dodavatelsko-odběratelských vztahů na prvním stupni dodavatelského řetězce*. Disertační práce. Brno: Vysoké učení technické v Brně, Fakulta podnikatelská, 2012. 165 pp. Vedoucí disertační práce prof.Ing. Marie Jurová, CSc. *In press.*

COLLIS, J., HUSSEY. R., 2003: *Business Research: A practical guide for undergraduate and postgraduate students.* 2. ed. New York: Palgrave Macmillan, 374 pp. ISBN 10: 1-4039-9247-9.

DE BOER, L., LABRO, E., MORLACCHI, P., 2001: A review of methods supporting supplier selection. *European Journal of Purchasing & Supply Management.* 7: 75–89. ISSN 1478-4092.

DICKSON, G. W., 1966: An analysis of vendor selection systems and decisions. *Journal Purchasing*, 2(1): 28–41. ISSN 00224030.

HUMPHREYS, P., MCIVOR, R., CHAN, F., 2003: Using case-based reasoning to evaluate supplier environmental management performance. *Expert Systems with Applications*. 25: 141–153. ISSN 0957-4174.

JUROVÁ, M., SUTORMINA, E., 2010: Modern methods of evaluation existing suppliers and suppliers selected by customer for small and medium- sized companies. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis,* LVIII, 6a: 199–208.

KAHRAMAN, C., CEBECI, U., ULUKAN, Z., 2003. Multi criteria supplier selection using fuzzy AHP. *Logistics Information Management*. 16, 6: 382–394. ISSN 0957-6053.

LIŠKA, V., 2005. *Doctorandus: (průvodce budoucích Ph.D.)*. 2nd ed.. Praha: Professional Publishing,. 149 pp. ISBN 80-86419-93-2.

RAJ, P. A., KUMAR, D. N., 1998: Ranking multi criteria river basin planning alternatives using fuzzy numbers. *Fuzzy Sets and Systems.* 100: 89–99. ISSN 0165-0114.

RAJ, P. A., KUMAR, D. N., 1999: Ranking alternatives with fuzzy weights using maximizing set and minimizing set. *Fuzzy Sets and Systems.* 105: 365–375. ISSN 0165-0114.

RAZMI, J., RAFIEI, H., HASHEMI, M., 2009: Designing a decision support system to evaluate and select suppliers using fuzzy analytic network process. *Computers and Industrial Engineering.* 57, 4: 1282–1290. ISSN 0360-8352.

SACCANI, N., PERONA, M., 2007: Shaping buyer–supplier relationships in manufacturing contexts: Design and test of a contingency model. *Journal of Purchasing & Supply Management*, 13: 26–41. ISSN 1478-4092.

SARKAR, A., MOHAPATRA, P. K. J., 2006: Evaluation of supplier capability and performance: A method for supply base reduction *Journal of Purchasing & Supply Management*. 12: 148–163. ISSN 1478-4092.

SHU, M.-H., WU, H.-C., 2009: Quality-based supplier selection and evaluation using fuzzy data. *Computers and Industrial Engineering.* 57, 3:1072–1079. ISSN 0360-8352.

TOMEK, J., HOFMAN, J., 1999: *Moderní řízení nákupu podniku,* 1. vydání, Praha, Management Press, Ringier ČR, a. s., 276 s., ISBN 80-85943-73-5.

VERMA, R., PULLMAN, M. E., 1998: An analysis of the supplier selection process. *Omega International Journal of Management Science*. 26, 6: 739–750. ISSN 0305-0483.

WEBER, C. A., CURRENT, J. R., BENTON, W. C., 1991: Vendor selection criteria and methods. *European Journal of Operational Research*. 50: 2–18. ISSN 0377-2217.

YIN, R. K., 2003: *Case Study Research: Design and Methods.* 3rd ed. London: Sage. 181 pp. ISBN 0-7619-2552-X.

ZADEH, L. A., 1999: From computing with numbers to computing with words–from manipulation of measurements to manipulation of perceptions. *IEEE Transactions on Circuit and Systems – I: Fundamental Theory and Applications.* 45, 1: 105–119. ISSN 1057-7122.

ZELENÝ, M., 2006: Český management v globální éře, *Fragmenty*. 10,56: 15–21.

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