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Management of Competitiveness in Automotive Industry

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Abstract: Kamaz group and other automotive industries constantly have to solve the problem of the competitiveness assessment, both of the vehicles and the companies involved in their production and sales. Nowadays, this research is difficult and time consuming as it includes finding an analog for comparison, the use of a complex calculation algorithm and determining the ranking research objects. In our opinion, one can improve and simplify the task by using a technique based on the priorities setting. With this method, it is possible to solve the tasks with the following statement the researched objects are ranked in ascending or descending order by the degree of one or more parameters. The procedure for obtaining primary data is based on the method of expert evaluations.

Key words: Competitiveness, algorithm, expert evaluations, method of paired comparisons, ranking

INTRODUCTION

It is well known that the process of competitiveness management of researched objects (products, companies, industries) consists of several stages (Elverum and Welo, 2016; Holden *et al*., 1990; Clark and Fujimoto, 1991). Assessment of the achieved level of an object's competitiveness in comparison with that of the reference object. This evaluation is performed by one of the known methods (differential method, complex method, mixed method):

- Ranking the objects of study
- Identifying the factors that had influenced the change in the rating
- Developing measures aimed at improving the competitiveness of the researched object and implementing of these measures

All existing methods of competitiveness valuation are based on comparing of the researched objects by certain parameters. The study showed that despite some advantages, they all share a number of drawbacks (Guerrini and Pellegrinotti, 2016; Townsend and Calantone, 2014; Porter, 1987). These methods:

- Do not contain rules for selecting parameters which determine the competitiveness of the researched object
- Do not contain rules for selecting the researched object
- Do not describe the procedure of expert evaluation
- Do not assess the degree of the expert's opinions consistency
- Do not allow to carry out evaluations at the early stages of designing the researched object

MATERIALS AND METHODS

The proposed technique is applied in several stages (Tiwari *et al*., 2014; Wells, 2013). At the first stage, a group of experts is formed of the leading specialists or managers of automobile industry. Their number and competence are justified. At the second stage, the experts determine the set of the researched object, from which the most competitive one is selected. At the third stage, the experts set the parameters by which to assess the level of competitiveness of the researched objects. At the fourth stage, the experts estimate the importance of each parameter and assign quantitative values to them (Bolton and Lemon, 1999; Cadotte *et al*., 1987). Comparing each time only two parameters with one another, not with the analogue-object, an expert defines the relationship between them as larger than (>) less than (<) or equal (=). The expert should not take into account the results of previous comparisons. The obtained expert estimations constititute a square matrix:

$$A = |a_{ij}|; \qquad a_{ij} = \begin{cases} 1.5 \text{ at } y_i > y_j \\ 1.0 \text{ at } y_i = y_j \\ 0.5 \text{ at } y_i < y_j \end{cases}$$

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where, a_{ij} is a numerical measure which determines the degree of superiority of object i over object j by comparing one of the parameters (a_{ij} extreme values must be located symmetrically relative to 1, for example, the following values may be adopted: 1.8; 1 and 0.2 or 1.2; 1 and 0.8 or 1.5; 1 and 0.5).

Finding the relative weight of each parameter occurs as follows: the sum of the elements a_{ij} is calculated on rows of the matrix for each parameter and the sum of these sums is determined by the column of the matrix, then the relative quantitative values (P_i) of parameters (Y_i) are found by the equation:

$$P_i = \frac{B_i}{\sum_{i=1}^{n} B_i}$$

where, B_i is the sum of elements a_{ij} by the matrix rows:

$$\sum_{i=1}^{n} B_i$$

The sum of elements B_i by the column After receiving the relative estimates of parameters, it is necessary to evaluate all researched objects by each patrameter. At the fifth step, the weighting of each of the n objects by m parameters is carried out. Finally, at the sixth stage, the summarizing of estimates of competitiveness levels of the objects is composed. For expert estimation, it is sufficient to include three people in the expert group-experts in the research area. For example, the quantitative estimates of experts were expressed by the following assessments. Then, the number of experts in the group can be calculated by the following equation (Table 1):

$$A_{CP}^{N} = \frac{0.5+0.5+1.0}{3} = \frac{2.0}{3} \approx 0.67$$

Where:

N = The number of experts, in this case N = 3
A_{CP} = Arithmetic mean of estimates of N = 3 experts
B = 1.0 evaluation of the additional (N+1) expert

We assume it to be equal to the expert estimation, most largely deviating from the average that is equal to one. Calculate the measure of the effect of one expert's judgment on their group assessment, by the following equation:

$$C = \frac{N \times A_{CP}^{N} + B}{(N+1) \times A_{CP}^{N}} = \frac{3 \times 0.67 + 1.0}{4 \times 0.67} = \frac{3.01}{2.68} \approx 1.12$$

Table 1: Quantitative estimates of experts

Experts	1st expert	2nd expert	3rd expert
Evaluation criteria compared	0.5	0.5	1.0

where, C is the measure of the effect of one expert's judgment on their group assessment. We define the effect of the expert N_1 assessment on the arithmetic mean estimation of three experts by the equation:

$$N_1 = \frac{C \times A_{CP}^{N} - B}{A_{CP}^{N} \times (1-C)} = \frac{1.12 \times 0.67 - 1.0}{0.67 \times (1-1.12)} = \frac{-0.25}{-0.08} \approx 3$$

The calculation confirms that the number of experts in the group is sufficient for the expertise, as it ensures the normal effect of one expert's judgment on their group assessment.

RESULTS AND DISCUSSION

Due to the fact that of all the ways to acquire vehicles (cash, bank transfer, credit, leasing), the most popular is purchase of vehicles by leasing, we will assess the competitiveness of leasing companies (Duysters *et al.*, 1999).

Central Federal District (CFD) is leading in the number of KAMAZ cars in the park. This region accounts for over 40% of the Russias total park of cars in this class, KAMAZ cars constitute 52% of the park.

CFD is also a leader by the number of cars which businesses purchase by leasing. Entrepreneurs own 2% of the entire park of trucks in this district. This area accounts for 13% of all leasing companies in Russia and 32% of leasing transactions. This makes the assessment of the leasing companies competitiveness in the region of great practical importance. To assess the competitiveness of KAMAZ leasing companies, the experts of these companies extinguished the following most important parameters:

- Y_1: Advance payment
- Y_2: Percentage of price rise a year
- Y_3: Maximum term of lease
- Y_4: Package of documents
- Y_5: Efficiency of decision-making on financing
- Y_6: Lease payments

The value of parameters established by the experts and quantitative estimates assigned to them is given in Table 2. The ranked series of parameter estimates: Y_1-0.24; Y_3-0.19; Y_4-0.17; Y_2-0.15; Y_5-0.14; Y_6-0.11. The next stage

Table 2: The unit matrix of expert estimates of the parameters Y_j (j=1-6)

Variables	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	$\sum_{j=1}^{6} Y_j$	P_j
Y_1	1.0	1.5	1.5	1.5	1.5	1.5	8.50	0.16
Y_2	0.5	1.0	1.0	1.0	1.0	5.5	0.15	0.24
Y_3	0.5	1.0	1.0	1.5	1.5	1.5	7.00	0.19
Y_4	0.5	1.0	0.5	1.0	1.5	1.5	6.00	0.17
Y_5	0.5	1.0	0.5	0.5	1.0	1.5	5.00	0.14
Y_6	0.5	1.0	0.5	0.5	0.5	1.0	4.00	0.11
$\sum\sum Y_j$							36.00	1.00

Table 3: Unit matrix of CFD leasing companies estimates. parameter Y_1 (advance payment)

Y_1	X_1	X_2	X_3	X_4	X_5	$\sum_{i=1}^{5} X_i$	P_i
X_1	1.0	1.0	0.5	0.5	1.0	4.0	0.16
X_2	1.0	1.0	1.5	1.5	1.0	6.0	0.24
X_3	1.5	0.5	1.0	1.0	1.5	5.5	0.22
X_4	1.5	0.5	1.0	1.0	1.5	5.5	0.22
X_5	1.0	1.0	0.5	0.5	1.0	4.0	0.16
$\sum\sum Y_j$						25.0	1.00

Table 4: Summaring table of estimates of CFD leasing companies' competitiveness levels

Leasing companies in CFD	Y_1	Y_2	Y_3	Y_4	Y_5	Y_6	$\sum x_i y_i$	Rating
LC KAMAZ	0.038	0.018	0.043	0.020	0.020	0.030	0.169	4
LC Element Leasing	0.058	0.024	0.043	0.037	0.033	0.022	0.217	3
LC Leasing Maximum	0.053	0.042	0.043	0.037	0.033	0.022	0.230	1
LC Stone XXI	0.053	0.033	0.043	0.037	0.030	0.022	0.218	2
LC UralSib	0.038	0.033	0.023	0.037	0.022	0.010	0.163	5

of the experts' work is to compare companies leasing "KAMAZ" by each of the nominated parameters. The objects of study were the following leasing companies of CFD:

- X_1: LC "KAMAZ"
- X_2: LC "Element Leasing"
- X_3: LC " Leasing-Maximum"
- X_4: LC "Stone XXI"
- X_5: LC "UralSib"

Using the above procedure, the experts have constructed the following unit matrices of leasing companies estimates of the central federal district (Table 3). The ranked series of estimates of leasing companies by Y_1 parameter (advance payment): X_2-0.24; X_3 and X_4-0.22; X_5 and X_1-0.16. Similarly, we obtain the ranked series of estimates of leasing companies by the remaining parameters. Thus, according to the parameter Y_2 Percentage of price rise per year, the ranked series of estimates is as following: X_3-0.28; X_4 and X_5-0.22; X_2-0.16; X_1-0.12; by the parameter Y_3 "Maximum term of lease": X_1-X_4 0.22; X_5 0.12; by the parameter Y_4 "Package of documents": X_2-X_5-0.22; X_1-0.12; by the parameter Y_5 "Efficiency of decision-making on financing": X_2 and X_3-0.24; X_4-0.22; X_5-0.16; X_1-0.14; by the parameter Y_6 "Lease payments": X_1-0.28; X_2-X_4-0.20; X_5-0.12. Draw up a summarizing table of estimates of CFD leasing companies' competitiveness levels by all extended parameters (Table 4). The research has shown that the ranking of leasing companies in the Central Federal District of Russia rank as follows: LC "Leasing-Maximum" is leading by all parameters, LC "Stone XXI" takes the 2nd place, LC "Element-Leasing" is in the 3rd place, LC "KAMAZ" is in the 4th place and LC "UralSib" finishes the rating.

CONCLUSION

Construction of economic-mathematical models requires consideration of a large number of interrelationships that are usually difficult to detect and even harder to quantify. However, the costs required for this, do not pay off. Furthermore, prior to testing it is not possible to conduct a preliminary experiment. In most cases, the situation is aggravated by tight deadlines for decision-making.

Testing of the proposed method showed that it allows to quickly obtain the quantitative estimates of a large number of different factors. The task of the expert is to identify the most significant factors by logical analysis. The advantages of the proposed method are: efficiency and ease of use. The proposed method can be a versatile tool for setting and effeicient solving of economic mathematical problems.

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