

Specifics of managerial decisions made by the heat-supplying organizations management during the selection of the partner organizations

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Abstract. The issue of the selection of business partners in the conditions of the uniform heat-supplying organizations functioning is considered in the article. The need of quality and timely evaluation of the potential partners for the purpose of the increase in the level of quality of generation, transportation and distribution of heat energy is proved. The author's approach of holding the procedure of selection of the most reliable partner was used with the help of the method of the hierarchical analysis. The method of pair comparisons was also applied within the research, the blocks and indicators of the assessment were defined. The model of additive convolution was chosen as the method of the aggregated criterion creation.

1 Introduction

In modern market conditions special attention is paid to the issues of forming of new communications and interactions among the partner organizations when forming of value creation chain. Business partnership is the form of such cooperation. Business partnership allows to increase the efficiency of activity of each participant by the means of association of resources, including innovations, technologies, capital and labour as well as the means of risk mitigation.

The choice of a partner for the organization is one of the main matters in any organization management. In the modern market there are many firms providing similar goods (services), which reliability and business reputation is determined only by financial performance. Great quantity of potential partners and their variety increases the relevance of the matter of the choice of those which would provide the maximum effect and reliability of implementation of the processes of value creation chain. The process of the partners selection was investigated in the works by Berkovich V. [1], Bukhonov S. [2] Suloyev S. [3], Yashin A. [4], etc. Most of scientists are unanimous in the opinion that the solution of this task is the multistage process and consists of several stages which are in continuous communication with each other: search of the potential partners, their analysis and evaluation of cooperation.

This subject is especially important in the heat supply industry where the main role of coordination and regulation of process of heat supply within certain territory, belongs to the uniform heat-supplying organizations (HSO). It is obvious that HSO interacts with great quantity of partners within its activity. Therefore, when determining the circle of partners of HSO the authors group them according to the sign of

participation in the main and auxiliary processes of the value creation chain.

The partners involved in the implementation of the main processes have rigid territorial binding, i.e. all the organizations which generate and deliver power, are deployed within the zone of functioning of HSO. Such organizations include the heat-supplying organizations having the large generating capacities with combined heat and power plants, similar organization with less powerful sources (boilers, heating systems specializing in transportation and distribution of heat energy through the high-level and distribution networks to consumers). Suppliers of fuel resources for generation of heat energy represent certain exception. That allows to increase the options of their choice [5, 6, 7, 8, 9].

The lack of rigid binding to the territory of HSO. functioning is the feature of the choice of strategic partners who treat the auxiliary processes of value creation chain. It is possible to distinguish such partners as educational institutions, consulting organizations, suppliers of resources, organizations rendering rated and financial services, investors and others.

It should be noted that if the partner organizations having territorial binding are strictly limited in the performance of their functions by the one of HSO. functioning, then the availability of great quantity and variety of firms in the market, the potential business partners of HSO. located out of the territory of its functioning, providing similar goods and services offers great prospects of their choice [9, 10, 11].

Nowadays scientists and practitioners note, that the process of selection of partners within HSO. has no due justification and it is carried out on the basis of the accidental choice: personal preferences, experience of last transactions, analysis of the financial documents, put in the general access, tender procedures and so on. As a

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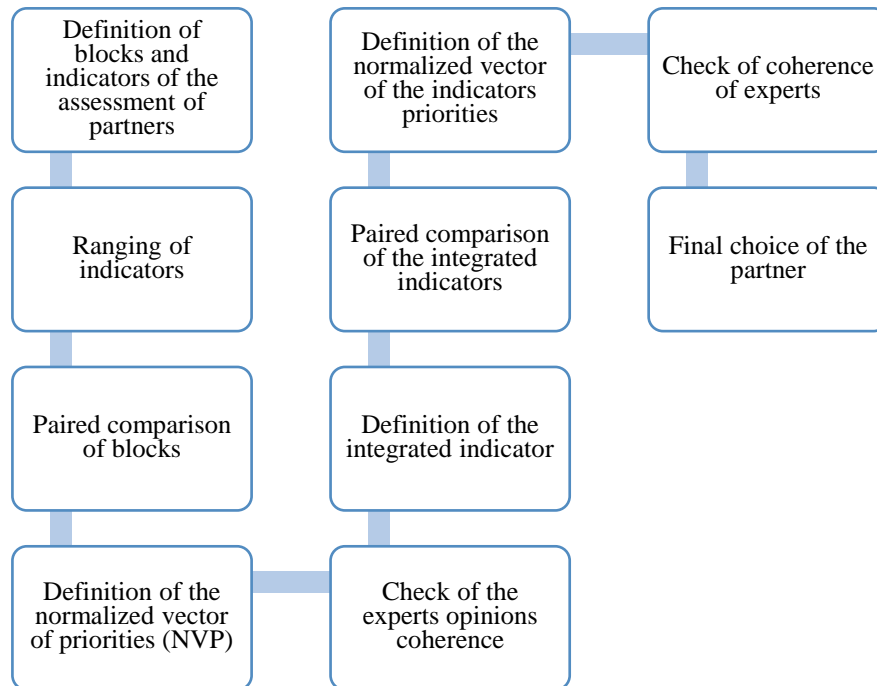


Fig. 1. Scheme of the solution of the problem of selection of business partners for HSO.

result of the accidental and unreasonable approach there are numerous risk situations of ensuring process of heat supply in terms of reliability and quality of implementation of contractual obligations, and high social responsibility of HSO. as the guarantor of providing reliable and qualitative heat supply determines the need of development of the unified model of the choice of the partner during the implementation of process of generation, transportation and distribution of heat energy.

Unlike the works by other authors, the authors' approach to the justification of managerial decisions at HSO during the selection of the external partner organizations on the basis of the developed assessment.

2 Materials and Methods

According to the theory of managerial decisions, making the choice of the business partner of HSO. is one of the unstructured tasks. Their modeling at the quantitative level is difficult, as the majority of parameters of the assessment has qualitative character. In this case the application of expert estimates is appropriate. At the same time decision-making comes down to the choice of one of the alternatives. However, the feature of multicriteria tasks is that there is no alternative which would have the best values according to all the criteria. One of the tools of the solution of multicriteria tasks is the method of the analysis of hierarchies (MAH), developed by T. Saati [12, 13]. This method has special relevance for the practice-oriented tasks of the multicriteria optimization. The main advantages of this method include the possibility of accounting of many both quantitative and qualitative optimality criteria. MAH allows to evaluate the alternative options on the

basis of calculation of priorities (relative importance) by the means of the procedure of pair comparisons. Considering the qualitative nature of information during the solution of the problem of the choice of partners, the application of nonmetric scaling is considered to be more reasonable. Ranging of the scale definition will be carried out by method of pair comparisons within this research.

The sequence of the solution of problem of selection of business partners of HSO. on the basis of their preliminary estimate for the purpose of the choice of the best option, is presented in Figure 1.

Within the conducted research authors distinguished five main blocks of the assessment of potential HSO. partners: "Technology potential", "Conscientiousness of cooperation", "Digital maturity", "Ability to innovations", "Territorial arrangement and infrastructure" (Table 1). When choosing the indicators included in the proper group, the authors was guided by the reference experience of estimation of the organizations used for the determination of potential of their development during the implementation of any projects including interaction of several partnering parties [14, 15, 16, 17, 18, 19, 20, 21].

Let us carry out the procedure of estimation of the priority criteria for the blocks of criteria for the example of the choice of suppliers of resources according to the offered scheme. Four suppliers whose main functional objective is the delivery of resources for operation of the heat supply system apply for the role of the business partner of HSO. The group of experts, representatives of the HSO make the decision.

The preliminary ranging of criteria in the decreasing order of importance is carried out for the definition of scales of indicators:

Table 1. Indicators of the assessment of business partners.

##	Blocks of criteria (graphical symbol)	Criteria	Legend
1	"Technology potential" (B1)	Material and technical resources Efficiency of the production processes Level of the products (services) quality Level of the infrastructure development Level of mechanization and automation of production	C1.1 C1.2 C1.3 C1.4 C1.5
2	"Conscientiousness of cooperation" (B2)	Availability of long partner relationship with consumers and partners Rapidity of the response to consumer requests change Level of customer centricity ensuring Possibility of resources sharing Solvency level	C2.1 C2.2 C2.3 C2.4 C2.5
3	"Digital maturity" (B3)	Digital transformation of operational processes Intensity of the use of digital technologies Level of digital maturity of management Level of digital security Intensity of the use of digital technologies	C3.1 C3.2 C3.3 C3.4 C3.5
4	"Ability to innovations" (B4)	Ability to innovations implementation Viability of innovations Experience of the innovation projects implementation Availability of the patents, useful models, developments, put on the company's balance sheet and belonging to the enterprise Provision with investment resources for financing of the innovation programmes and projects	C4.1 C4.2 C4.3 C4.4 C4.5
5	"Territorial arrangement and infrastructure" (B5)	Structure of the industrial territory Climatic, engineering-and-geological and topographical conditions of the area of the partner location Availability of the transport infrastructure Level of the infrastructure development Engineering infrastructure	C5.1 C5.2 C5.3 C5.4 C5.5

$$w(C_1) > w(C_2) > \dots > w(C_n) \quad (1)$$

Then it is necessary to carry out the paired comparison of blocks and indicators on their importance according to the nine-mark scale. The corresponding matrix of comparisons by dimension (n n) is formed for that purpose. Then the assessment of each of the chosen criteria according to certain scale, which priority estimates are: equal importance – 1; moderate superiority – 3; significant superiority – 5; strong superiority – 7; very strong superiority – 9; the use of even estimates is possible in intermediate cases: 2, 4, 6, 8.

The results of pair comparisons of the importance for blocks are provided in Table 2.

Table 2. Matrix of estimates of the importance of blocks of the business partners assessment.

Blocks	B1	B2	B3	B4	B5
B1	1	3	3	4	5
B2	1/3	1	2	3	3
B3	1/3	1/2	1	3	2
B4	1/4	1/3	1/3	1	4
B5	1/5	1/3	1/2	1/4	1
Total	2.117	5.167	6.833	11.250	15.000

The normalized vector of priorities (NVP) is estimated as follows:

a) the average geometrical in every line of matrix is calculated:

$$a_i = \sqrt[n]{\prod_{j=1}^n a_{ij}}, \quad i = 1, 2, \dots, n. \quad (2)$$

$$a_1 = \sqrt[5]{1 \cdot 3 \cdot 3 \cdot 4 \cdot 5} = 2,82$$

Then we found similarly: $a_2 = 1.43$; $a_3 = 1$; $a_4 = 0.64$; $a_5 = 0.38$.

b) the amount of average geometrical values is calculated:

$$S = \sum_{i=1}^n a_i \quad (3)$$

$$S = 2.82 + 1.43 + 1 + 0.64 + 0.38 = 6.28$$

c) components of NVP are calculated:

$$NVP_i = \frac{a_i}{S},$$

$$l = 1, 2, \dots, n. \quad (4)$$

$$NVP_1 = \frac{2.82}{6.28} = 0.44$$

Similarly, we found: $NVP_2 = 0.22$; $NVP_3 = 0.16$; $NVP_4 = 0.10$; $NVP_5 = 0.06$;

Coherence of estimates in the matrix is checked. Three characteristics are counted for this purpose:

a) own value of the matrix:

$$\lambda_{max} = \sum_{i=1}^n NVP_i * \sum_{j=1}^n a_{ij}$$

$$\lambda_{max} = 0.44 * 2.11 + 0.22 * 5.1 + 0.16 * 6.83 + (5) \\ + 0.10 * 11.25 + 0.06 * 15 = 5.28$$

b) approval index:

$$AI = \frac{\lambda_{max} - n}{n - 1} \quad (6) \\ AI = \frac{5.28 - 5}{5 - 1}$$

c) coherence relation:

$$CR = \frac{AI}{IAC} \quad (7)$$

where IAC is the indicator of accidental coherence, defined for the case when the estimates in the matrix are provided in a random way, and depending only on the size of the matrix (Table 3).

Table 4. IAC values.

Size of the matrix	1	2	3	4	5	6	7	8	9	10
IAC	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49

According to Table 4, the indicator of accidental coherence for five criteria is 1.12.

$$AI = \frac{0.07}{1.12} = 6.36$$

The estimates in the matrix are considered to be coordinated if CR is 10...15%. If the value exceeds the threshold, it is necessary to carry out the assessment repeatedly. This indicator is 6.36% in our case, therefore the estimates of blocks in the matrix can be considered to be coordinated.

The similar procedure of comparison is carried out for all the groups of indicators in each block. The final procedure of calculation of priorities of the indicators is carried out by multiplication of the priorities of each indicator by priorities of the corresponding blocks. Final vector of priorities of indicators within certain blocks for

Table 3. Final assessment of the potential partners.

Block	Criteria	Итоговые вектора приоритето в критериев	Partner 1		Partner 2		Partner 3		Partner 4	
			Points	Final assessment	Points	Final assessment	Points	Final assessment	Points	Final assessment
B1	C1.1	0.19	3	0.709	1	0.142	3	0.426	5	0.709
	C1.2	0.11	4	0.455	5	0.342	3	0.342	5	0.569
	C1.3	0.09	3	0.272	2	0.109	3	0.163	5	0.272
	C1.4	0.04	3	0.118	5	0.197	2	0.079	5	0.197
	C1.5	0.02	2	0.055	3	0.082	5	0.138	4	0.11
B2	C2.1	0.10	3	0.546	5	0.437	5	0.546	2	0.218
	C2.2	0.06	4	0.19	5	0.239	4	0.191	3	0.143
	C2.3	0.04	3	0.094	4	0.075	4	0.075	5	0.094
	C2.4	0.02	2	0.032	3	0.048	4	0.064	5	0.065
	C2.5	0.01	4	0.041	5	0.031	4	0.042	3	0.031
B3	C3.1	0.05	2	0.168	4	0.337	4	0.337	4	0.337
	C3.2	0.03	2	0.065	5	0.164	3	0.098	5	0.164
	C3.3	0.02	2	0.051	5	0.129	2	0.051	4	0.103
	C3.4	0.02	3	0.062	2	0.041	2	0.041	4	0.083
	C3.5	0.03	4	0.051	3	0.038	5	0.064	3	0.039
B4	C4.1	0.04	2	0.144	4	0.289	4	0.289	4	0.289
	C4.2	0.03	3	0.171	1	0.057	5	0.286	3	0.171
	C4.3	0.02	4	0.073	2	0.037	3	0.056	3	0.055
	C4.4	0.01	5	0.073	3	0.044	3	0.044	5	0.074
	C4.5	0.01	5	0.036	4	0.029	2	0.014	3	0.022
B5	C5.1	0.02	5	0.138	5	0.138	3	0.083	3	0.083
	C5.2	0.01	3	0.039	5	0.065	4	0.052	1	0.013
	C5.3	0.01	4	0.072	4	0.072	5	0.09	5	0.09
	C5.4	0.01	2	0.012	5	0.031	6	0.037	3	0.019
	C5.5	0.01	3	0.028	5	0.047	6	0.057	1	0.009
TOTAL			80	3.695	95	3.22	94	3.665	93	3.959

the choice of partners among suppliers of resources are provided in Table 4.

3 Results

According to the expert estimates, points for all the listed criteria of each block are given to the participants with the help of the uniform scale. The final assessment of the participant is calculated with the use of additive convolution.

Additive convolution is the following:

$$K(x) = \sum_{i=1}^n a_i K_i(x), \quad (8)$$

where $K(x)$ - is the general criterion for alternative x , representing its suitability for the achievement of the goal; x - is the set of initial criteria; n - is the number of the initial criteria; i - is the relative weight (importance) of a criterion. The normalization condition is necessary for the weights, so that the results received in different conditions were comparable.

The results are provided in Table 3. The higher the integrated assessment of the potential partner is, the more it meets the requirements of cooperation.

4 Conclusion

Thus, the most important criterion for the choice of partners among suppliers of resources are the criteria: material and technical resources, efficiency of production processes and availability of long partner relationship with consumers and partners as these organizations in the strategic partnership are responsible for timeliness and uninterrupted operation of the delivery of resources for operation of heating systems. According to the results of this example the Partner 4 is the best, as this partner has overall rating 3.959. At the same time it should be noted that according to final values of points (93 points) it concedes to the competitors: Partner 2 (95 points) and Partner 3 (94 points), but as the offered technique allows to consider the ratings of each estimated criterion in the general set during the decision making, the managerial decision on selection of strategic partners is made with great accuracy. The similar procedure should be carried out for all the potential partners of HSO. Getting the greatest positive points, the potential partner does not become the most attractive in comparison with the competitors, but exist as such a partner. At the same time the methodical provisions, offered for the evaluation of the potential partners in the conditions of their choice, can be applied both during the initial stage of the beginning of cooperation, and with the definite frequency (for example, annually) for the identification of dynamics of the partners development.

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