Hierarchical Model of Assessing and Selecting Experts

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Abstract. Revealing experts' competences is a multi-objective issue. Authors of the paper deal with competence assessing methods of experts seen as objects, and criteria of qualities. An analytic hierarchy process of assessing and ranking experts is offered, which is based on paired comparison matrices and scores, quality parameters are taken into account as well. Calculation and assessment of experts is given as an example.

1. Introduction

Decision making is relevant for all spheres of human activities, and it's of special importance for social and economic development of subjects. Judgments of several experts are worthwhile to support objectivity and improve quality of decision making process. Collective expert assessment is made with this purpose, whereas a lot of experts can be divided into some sub-groups with respect to the subject of assessment [1, 2], depending on criteria applied in a hierarchy.

A typical procedure to form an expert panel comprises such phases as defining the number of experts, developing formal and professional eligibility standards of experts, and assessing awareness of each expert [2].

2. Review of expert awareness assessment procedures

Expert panel is to consist of experts, responsible for each group of urban social and economic development factors. It's quite logical to assume, judgments of experts, representing the field, which an indicator to be assessed belongs to, are the most valuable ones. For instance, knowledge on labor economy and sociology, labor legislation, mechanisms of labor market functioning and its regulating, as well as working experience are necessary for experts, assessing personnel issues. At the same time, judgments of other members in expert panel can't be ignored, even if their competence in the field is far from being high because various spheres of urban development can't be assessed separately, all issues are to be addressed as interconnected ones. Therefore, weights of expert importance are required for assessing diverse indicators.

Minimal quantity of experts depends on the number of urban functional spheres. For instance, six groups of indicators of urban social and economic development are given in [3]. Formula N = 0.5 (3/a + 5), where 0<a£1 is a parameter, specifying minimal level of assessment error, is suggested to be used for determining minimal quantity of experts in [4].

Minimal quantity of experts is 4 (if a = 1) in compliance with the above condition. As a rule, at least 7 – 9 experts are necessary for group assessment [3, 5].

An appropriate solution can be found provided that experts are grouped according to the fields: reliability, efficiency and workability of a project. Competence level of each expert is to be determined on the base of all indicators.

A table of expert competence is suggested in [5], which supports selecting experts, assessing their competence within the following functional blocks of urban social and economic development: social and economic, personnel, investment, infrastructural, manufacturing and financial. A constant of variation is suggested to define the measure of agreement of expert assessments. Supposing it exceeds 33% (for rather regular distributions), assessments are not agreed, and experts are to revise them [6].

Social and economic conditions and projects are a vital task, provided that expenditures on assessment are reasonable, experts' judgments are averaged out according to their qualification ("weight"). A hierarchical structure of criteria is suggested for determining weighting factors of experts [7].

Aggregated assessment is calculated from the following formula provided that n experts with various levels of significance are involved in the work

$$a_{ij}^{A} = a_{ij}^{p_1} a_{ij}^{p_2} \dots a_{ij}^{p_n} ,$$

where $a_{ij}^{p_k}$ - assessment of an object done by expert k with a weight factor p_k, here $p_1+p_2+\dots+p_n=1$.

For subjective assessment of experts themselves the following criteria are used: professional experience (practical experience in the field of financial planning, intuition), independent views, working experience in the field, creative attitude to the solution of problems and experience in expert assessments. Supposing working experience of experts is 10, 15 and 20 years, weight of this criterion is 0.222; 0.333 and 0.444, respectively. Having calculated weights of all criteria and averaged them out according to the number, we obtain a generalized weight for significance of expert's judgment.

Basic requirements for an expert are outlined in [4] and include broad mental outlook and practical awareness, scientific papers and practical experience, ability to solve practical problems, independence of standpoints etc. Therefore, assessment of competence and selection of experts is a multi-objective issue.

3. Hierarchical procedure of assessing experts

Method of weighted or weight-averaged sums is most popular and frequently applied by professionals for multi-criteria assessment of alternatives.

We suggest using the following criteria and scales for assessing experts [7]:

1. Level of education: secondary (1 point), secondary special (2 points), higher (3 points), PhD (4 points), Doctor of Science (5 points).

2. Working experience in the subject domain: no experience (0 points), 1 to 3 years (1 point), 3 to 5 years (2 points), 5 to 10 years (3 points), 10 to 20 years (4 points), more 20 years (5 points).

3. Administrative and economic independence in the field: absolutely independent (5 points), acquainted with the company (4 points), employed in the same company but has no direct influence on decision making process (3 points), his/her direct responsibilities include organization (2 points), employed in the same decision making body (1 point).

4. Ability to respond to creative challenges and experience of expert assessing: no experience (1 point), low level ability (2 points), average level (3 points), above the average (4 points), high level ability (5 points) etc.

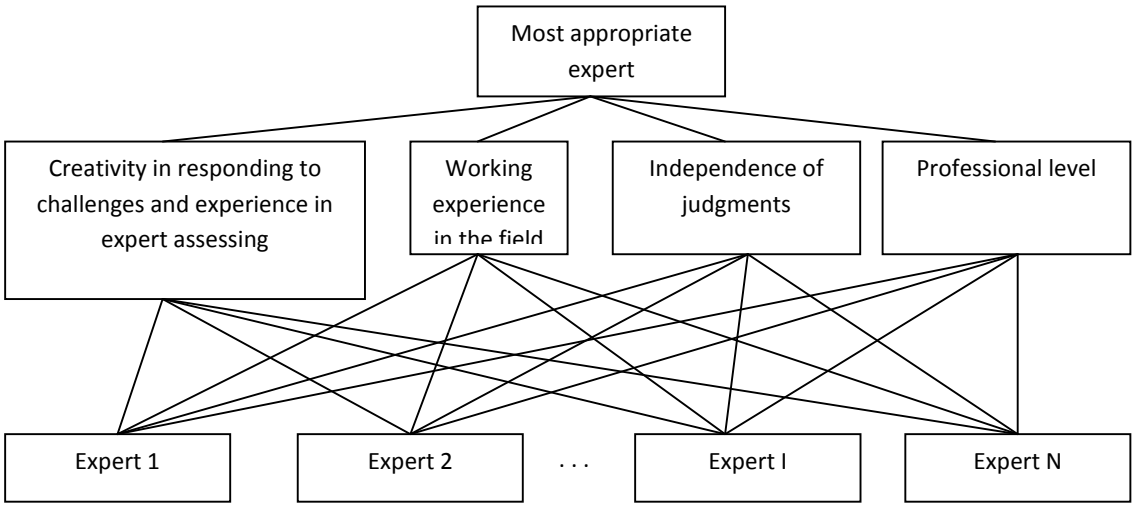

Figure 1. Hierarchy of ranking experts

Criteria of assessing experts can be also averaged out at the level of eigenvectors of paired comparison matrix E (Table 1). Here, the results are equivalent to those obtained at the level of matrix elements provided that homogeneity of formed matrices is sufficient and does not exceed 0.10 [8-13].

Values of priority vector of criterion W are also computed from formula

$$EW = \lambda_{\max} W, \tag{1}$$

where λ_{max} – maximal eigenvalue of matrix E.

Then, comparison matrices for each criterion of experts are to be completed (e.g. for three experts, as it can be seen in Table 3). Priority vectors of professional qualities are designated Wi, i = 1,2,3,4.

Ratio scale is used for paired comparison (Table 2). Tables are completed automatically on the base of paired difference in scores of the same quality when computer processing [7].

Table 1 – Weights of assessment criterion of expert

Assessment criteria of expert	Professional level	Working experience in the field	Independence of judgments	Creativity in responding to the challenges and experience of expert assessing	W
Professional level	1	3	5	3	0.536
Working experience in the field	1/3	1	5	1/3	0.139
Independence of judgments	1/5	1/5	1	3	0.088
Creativity in responding to the challenges and experience of expert assessing	1/3	3	1/3	1	0.136

Table 2 – Ratio scale (level of significance) of a quality

Level of significance	Definition	Explanation
1	Similar significance	Two candidates have a quality of the same level
2	Significance of one professional's quality predominates slightly over that of other professional (weak significance)	The difference in quality level of candidates is one point
3	Considerable or intense significance	The difference in quality level of candidates is two points
4	Obvious or very intense significance	The difference in quality level of candidates is three points
5	Absolute significance	The difference in quality level of candidates is four points
Reciprocal values of above non-vanishing values	Supposing a quality of i candidate has one of non-vanishing values specified above when comparing to a quality of j candidate, a quality of j candidate has a reciprocal value when comparing to a quality of i candidate.	Provided that agreement of qualities was postulated when calculating N numerical values for forming a matrix.

Table 3 – Ranking experts in view of criterion "Professional level"

Professional level	Expert 1	Expert 2	Expert 3	W1
Expert 1	1	3	5	0.72
Expert 2	1/3	1	3	0.18
Expert 3	1/5	1/3	1	0.10

Elements of resultant priority vector of experts are calculated by formula

$$W_э = [W_1, W_2, W_3, W_4] \times W, \quad (2)$$

where W_1, W_2, W_3, W_4 – vectors of weights criteria (qualities of experts).

For instance, it was obtained for the set of criteria considered above:

Wэ= {0.672; 0.218; 0.110}.

Values of elements of the calculated vector demonstrate that the first expert is the most appropriate one in view of criterion-based assessment; his/her judgment is the most qualified and final decision is to be made on the base of his/her judgement.

4. Automation of assessment calculations

Information system (IS) of assessing and selecting experts was developed to process labor-intensive and similar calculations. Phases of selecting experts on the base of the IS are outlined in Fig. 2.

The first phase is concentrated on identifying the list of qualities necessary to form a group. Then a questionnaire is completed and testing is carried out. Testing results in assessment of each candidate's

qualities; data base of information system is filled in. The following phase is focused on ranking qualities, a precise list of qualities is identified; and assessment of a professional is given. Assessing and selecting a group of experts are main points of the final phase.

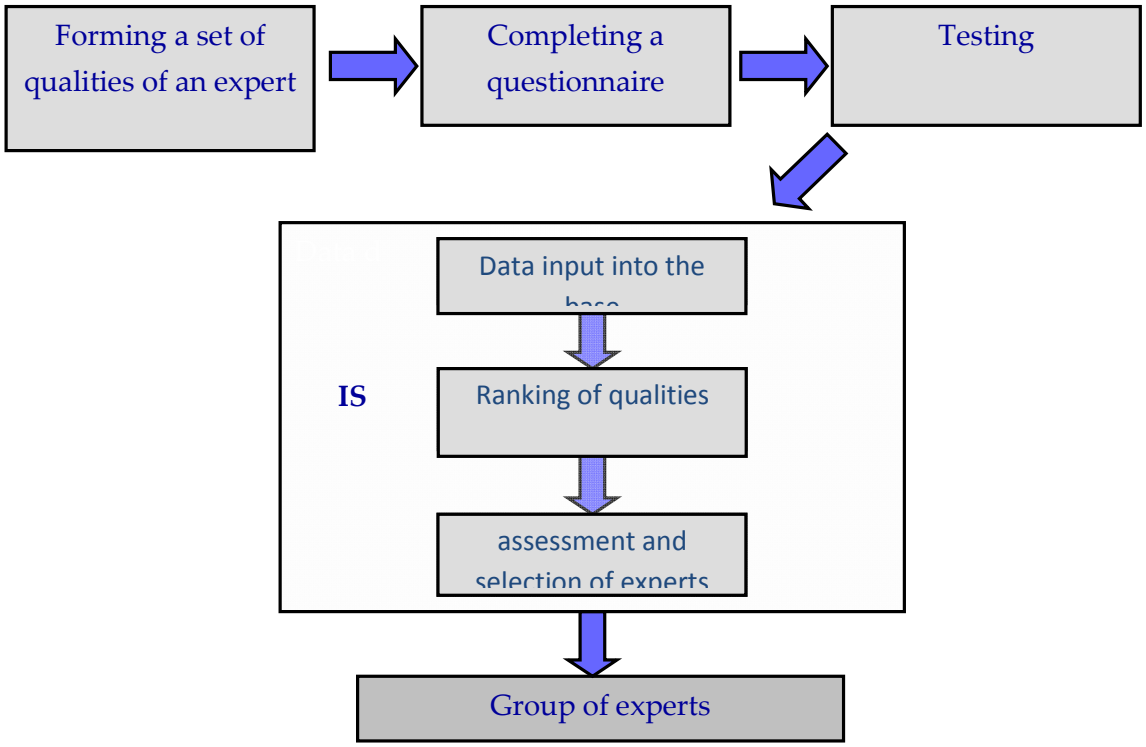

Figure 2. Phases of selecting experts

One of expert assessment procedures is used in the information system – paired comparison of alternatives. It is a procedure of revealing preferred objects when comparing all possible pairs. Qualities of experts are ranked via determining their significance.

Functions of the information system:

- general information, professionally and business relevant qualities are taken into account;
- qualities of professionals are analyzed;
- qualities of professionals are compared;
- business qualities of a professional are assessed via expert procedures;
- experts are ranked on the base of the aggregate of qualities.

Input data:

- personal details of experts;
- information on personal characteristics of experts;
- a list of qualities selected for assessment criteria.

Output data:

- a list of experts meeting the requirements of a user' s enquire;
- a diagram of significant and sufficient qualities of an expert.

A permanent database can't provide well-timed updating of information on experts, as well as data on new experts isn't added in proper time, therefore a questionnaire of a data base can be placed on a company website, where experts have a possibility to edit information on them. This system is developed for a personnel department manager who is responsible for adding data on experts, and it supports decision making by the head of a company, as only most appropriate experts are selected.

5. Conclusion

Determination of experts' competences is a multi-objective issue. Authors of the paper deal with competence assessing methods of experts seen as objects, and criteria of qualities. Four criteria and 5-point scale are suggested for assessing characteristics of experts. An analytic hierarchy process of assessing and ranking experts is offered, which is based on paired comparison matrices and scores, quality parameters are taken into account as well. Algorithm of assessing and selecting experts supports adequate decision making.

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