The Best Solution of personnel management problem on the basis of Numerical (scalar) optimization

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ABSTRACT: Specific peculiarities of the best personnel management problem "assigning" the latter to multicriterion estimation problem in the fuzzy environment are revealed in the article. Classification of personnel management problem is suggested depending on the extent of estimation objects satisfaction to the shown criteria. In the article description of fuzzy relational model of personnel management problems and method of scalar optimization allowing estimation and ranging of estimation objects in personnel management tasks are described.

Keywords: Personnel management; scalar optimization; fuzzy environment; Iran

INTRODUCTION

The computer engineering finds more and more wide application in management problems. However, application of computer facilities for the solution of administrative problems, introduction of decision-making support systems usually are accompanied by serious difficulties. Difficulty of use of these systems is connected with that the person at the development of decisions often leans not only against methods of the formal analysis of situations and mathematical methods of finding the best result but also on the experience and intuition (Trahtengerts, 2001). For overcoming of the listed difficulties at the decision of administrative problems it is required to develop methods allowing modeling of administrative decisions and introducing of intellectual decision-making support system on their basis. In the present article method of scalar optimization for solution of personnel management problems for working out of intellectual decision-making support system of is offered. Personnel management problems are basis of manpower policy. The correct solution of these problems, acceptance of objective and democratic decisions on administrative problems allows to reach the global purposes put forward before the organization (Sorokina, 2000; Organization and personnel evaluation,1999; Management staff of the organization, 1997). The major direction of personnel work is purposeful process of definition of conformity of personnel qualitative characteristics (abilities, motivation and properties) to position or workplace requirements. Without an objective estimation of the

administrative personnel it is not possible to achieve positive results of activity as the organization as a whole, and each employee separately. In this connection the application of modern methods of personnel estimation of has special significance today.

To the number of personnel managements problems most frequently met in practice the following problems belong:

selection of applicant on a vacant position;

compliance of workers to requirements of a workplace, a position;

determination of payment level and stimulation forms;

formation of a personnel reserve and planning of vocational advancement, career;

selection of people on key positions in operation of business;

distribution of the rights between members of collective;

distribution of duties between members of collective;

work distribution between members of collective;

Awarding, compensation of employees etc.

The problems to be solved in the sphere of personnel management are difficult and various. They are united by the fact that the final number of estimated objects (the workers, trainee, divisions and etc.) characterized by structured set of heterogeneous features is used as initial data.

In fact at the employment it is necessary to define availability or lack of some qualities of an applicant necessary for effective work and to give the description of his peculiarities. Thus, the applicants applying for work (position) concern to the number of estimated objects but direct object of the estimation is knowledge, abilities, personal qualities of the person and it is problematic enough to give an unequivocal quantitative estimation to the latter.

Moreover, knowledge, abilities, personal qualities of the person is characterized by many factors and indicators (Larichev and Sternin, 1998; Dzhabrailova and Nobari, 2006). It is necessary to note that at the solution of this problem obligatory demands are presented to the applicants applying for a position such as availability of higher education diploma, knowledge of foreign language (for example, English) etc. If the applicant does not reply at least to one of such obligatory requirements he is automatically excluded from the list of applicants for a position. Such problems we will name as problems with severe requirements.

For problem of workers' compliance to the position the employees occupying certain positions concern number of estimated objects, the criteria of the estimation is knowledge and abilities of the employee according to the requirements a position or a workplace, i.e. with the profession certificate.

For problems of employees' awarding the staff is concerned as a number of estimated objects, and direct object is their labor activity. For example, to number of indices characterizing labor activity of science officers concern scientific-theoretical activity, scientifically-practical activities, practical activities, extra working activity (sports, culture etc.), discipline, increase of qualifying level etc. and each estimated index is characterized on the basis of factors.

For instance, scientific-theoretical activity of the employee is defined on the basis of such factors, as participation in research works, performances with the report at institute seminars, the publication of scientific articles, a management of post-graduate students and authors of dissertation, work with masters, preparation of books, brochures, monographies, participation in work of conferences, symposiums and scientific actions with a material, scientifically-expert activity and etc. [Monitoring of scientific potential, 2000; Kiselev et al., 1991; Malov, 1991; Mamedov and Dzhabrailova , 2007)

At the solution of this problem the estimation object may be complied at least by one criterion to fall within the

list of awarded. From this point of view of such problems we will name problems with soft requirements.

The analysis of the suggested criteria systematization characterizing estimated objects gives opportunity to draw a conclusion that problems of personnel management become complicated by the following circumstances:

Private criteria can be based both on quantitative characteristics and on qualitative ones as experts basing on the experience and intuition prefers to give advice at qualitative level and in rather vague way. In this case the display of uncertainty of the subjective indistinct nature which cannot be described in habitual probabilistic sense is of course inevitable.

Depending on the areas of professional work, a trade and a profile of the organization the requirements to criteria and indices of estimated object can change and it is natural that these indicators have various relative weight, therefore importance of criteria are obviously unequal, i.e. they bring different contribution to the integral estimation of the object.

Besides, there are a lot of criteria. Complexity is that people perceive unduly detailed scales of estimation features or criteria badly. According to the data of psychophysical researches the person confidently distinguishes no more than 7-9 gradation on a scale of some features. If it contains greater number of gradation then neighboring levels begin to merge and cannot be confidently differentiated no more (Miller, 1964).

Thus, on the basis of the above-stated, it is possible to draw a conclusion that personnel management problems have following specific features:

The problem is multiple-factor and multicriterion;

These factors, criteria and indices in most cases have qualitative character;

These factors, criteria and indices are unequal;

In the course of estimation the opinions of various experts are considered;

Hierarchy of criteria estimations characterizing the estimated object is expressed in the fact that each separate criterion of top level is based on aggregation of private criteria of the nearest bottom level etc.

The listed features "assign" personnel management problems into multi-criteria estimation in the indistinct environment and require a choice of adequate formalisms for modeling of these problems, estimation and ranging of the estimated objects, allowing the consideration of fuzziness and qualitative character of indices and fuzziness of the linguistic character connected with formalization of expert knowledge.

As practice shows, under these conditions application of fuzzy mathematics device for the analysis and estimation can be effective enough. Therefore in the present work at the choice of formalism for the solution of personnel management problems with applying expert estimation the preference is given to the device of fuzzy mathematics (Zadeh,1976; Coffman,1965; Orlovsky,1981).

Modeling of personnel management problems

For modeling of personnel management problems fuzzy relational model of knowledge representation is suggested (Abbasov and Mamedov, 1997). Use of the latter presumes to reduce solution process of personnel management problems to a choice of the best alternative among possible ones and that, in turn, gives the chance to make estimations and ranging of alternatives by the generalized criterion.

According to fuzzy relational model of representation of knowledge, if X = {x1, x2, …, xn}   …. is a set of alternatives which are subject to an estimation and ranging, and $K = \{k_1, k_2, ..., k_m\} = \{k_j, j = \overline{1,m}\}$ is a set of criteria characterizing these alternatives then degree of satisfaction of alternative x_i to criterion k_j is represented by

membership function

$$\varphi_{k_j}(x_i) \to [0,1], \quad \text{т.е.:} \quad \varphi_{k_j}(x_i): X \times K \to [0,1].$$

Working out of estimation and ranging of estimation objects for personnel management problems assumes to the availability of following elements:

Defining of alternatives set, i.e. estimation objects (for the task of applicants selection to the position the set of alternatives consists of the list of the applicants for employment, for the tasks of compliance of employees to a position the set of alternatives consists of the list of the employees occupying certain positions, for the tasks of awarding the set of alternatives consists of the list of the employees applying for the award etc.);

Defining of criteria set and the private criteria characterizing alternatives;

Selection of experts group and by their help revealing the criteria of relative importance coefficient and private criteria, standardized scales for private criteria formalization;

Development of the uniform collectively co-coordinated estimation of private criteria;

Selection of a solving rule for multi-criteria estimations and ranging of alternatives.

Problem statement

Let X={x$_1$, x$_2$, ... , x$_n$}= $\left\{ x_i, i = \overline{1,n} \right\}$ - in this case estimated objects of personnel management problems, i.e. the nominees applying for work, for a position or employees applying for the award and etc. are considered as alternative variants which are characterized by set of unequivalent criteria:

$$K = \left\{ K_1, K_2, ..., K_m \right\} = \left\{ K_j, j = \overline{1,m} \right\}$$

Each criterion K_j into set of criteria K, in turn, is characterized by a subset of private criteria, i.e.

$$K_j = \left\{ k_{j1}, k_{j2}, ..., k_{jT} \right\} = \left\{ k_{jt}, t = \overline{1,T} \right\}$$ and elements of these subsets are also unequivalent.

The aim of the problem is obtaining of the systematized list of the individual conclusions by results of the conducted estimation ranging from the worst to the best: X : K → X*, where X* is the systematized list of estimation objects of a considered personnel management problem.

The solution of personnel management problems by scalar optimization method

In the decision-making theory there was collected considerable arsenal of scientific methods for objects regulation in space of characteristic features. To some extent they refer to one of 2 groups of methods ─ vector or scalar optimization (Mikoni, 2009). The first group of methods is based on regulation of objects on the basis of the relation of features predominance.

Methods of scalar optimization are based on transformation of multi-criteria optimization problem into the one-criterion optimization problem with application of multi-criteria membership functions.

Taking into consideration specific features of personnel management problems we suggest method of scalar optimization for the solution of these problems. Thus, also classification of personnel management problems is also taken into consideration, in other words:

Problems where objects of estimation should necessarily satisfy to the criteria required, i.e. problems with

severe requirements;

Problems where the satisfaction of objects to the required criteria is desirable, i.e. problems with soft requirements.

Problem solution let

$$\{\varphi_{k_{j_1}}(x_i), \varphi_{k_{j_2}}(x_i), \dots, \varphi_{k_{j_T}}(x_i)\} = \{\varphi_{k_{j_t}}(x_i), t = \overline{1,T}, j = \overline{1,m}\} \quad (1)$$

is membership function of alternative x_i to private criteria kj_1, kj_2, … ,k_{jT} and

$$\{w_{j1}, w_{j2}, \dots, w_{jT}\} = \{w_{jt}, t = \overline{1,T}\} \quad (2)$$

are coefficients of relative importance of these private criteria. It should be noticed that for all private criteria kj_1, kj_2, … ,k_{jT} characterizing K_j criterion the following condition $\sum_{t=1}^{T} w_{jt} = 1$ is satisfied.

The stage-by-state solution of estimation problem and ranging of estimation objects of personnel management problems.

1. Each criterion of top level is estimated by means of aggregation of private underlying level criteria (indices) (Sevestyanov, 2001). In other words if (1) and (2) are known then by the construction of private criteria k_{j1}, k_{j2}, …, k_{jT} convolution the member function of alternative x_i to generalized criterion K_j, is defined. Depending on the classification of problems (referring to criteria) convolution is carried out on the basis of following formulas, accordingly:

$$1)\ \varphi_{K_j}(x_i) = \prod_{t=1}^{T} \varphi_{k_{jt}}(x_i)^{w_{jt}},\ 2)\ \varphi_{K_j}(x_i) = \sum_{t=1}^{T} w_{jt}\, \varphi_{k_{jt}}(x_i).$$

2. On the basis of obtained $\{\varphi_{K_j}(x_i), j = \overline{1,m}\}$ for x_i, $\{i = \overline{1,n}\}$ defining of membership functions of alternatives x_i, $\{i = \overline{1,n}\}$ to the generalized criterion K (table 1.) :

$$3)\ \varphi_K(x_i) = \prod_{j=1}^{m} \varphi_{K_j}(x_i)^{w_j},\ \ 4)\ \varphi_K(x_i) = \sum_{j=1}^{m} w_j \varphi_{K_j}(x_i)$$

CONCLUSION

The offered method of scalar optimization for multi-criteria estimations and ranging can be applied both to the solution of personnel management problems, and for the solution of other problems arising in sphere of human activity. However, with all this it is necessary to generate preliminary criteria, the indices of an estimation characterizing estimated objects and to define their factors of importance with use of corresponding methods.

Table 1. Defining of membership functions of alternatives x_i, $\left\{i = \overline{1, n}\right\}$ to the generalized criterion K

Alternatives	K				
	K_1	…	K_j		K_M
x_1	$\varphi_{K_1}(x_1)$	…	$\varphi_{K_j}(x_1)$	…	$\varphi_{K_M}(x_1)$
…	…		…		
x_1	$\varphi_{K_1}(x_i)$	…	$\varphi_{K_1}(x_i)$	…	…
					$\varphi_{k_{M1}}(x_i)$
…	…		…		
	$\varphi_{K_1}(x_n)$	…	$\varphi_{K_j}(x_n)$	…	
x_n					…
					$\varphi_{k_{M1}}(x_n)$

$$\varphi_K(x_i), \quad i = \overline{1, n}$$

3. Here the alternative with maximum membership grade to generalized criterion K is selected:

$$\varphi(x^*) = \max\left\{\varphi_K(x_i), i = \overline{1, n}\right\}$$

where n is a number of alternatives (table 3). The chosen alternative is "the best" alternative (for example, the applicant with the highest estimation among applying for a vacant workplace will take of the first position in the list of applicants and will take the lead in ranked list).

Table 2. The ranked list of alternatives ranging from the worst to the best

	alternatives	K
	x^*	$\varphi_{K_1}(x_1)$
X^*	…	
	x_1	…
	…	$\varphi_{K_1}(x_i)$
	x^P	…
		$\varphi_{K_1}(x_n)$

It is obvious that the alternative with the lowest estimation will take of last position in the systematized list of alternatives ranked from the best to the worst. For such alternative $x^P \in X$ $\varphi(x^p)$- membership grade will be equal to the generalized criterion:

$$\varphi(x^p) = \min\left\{\varphi_K(x_i), i = \overline{1, N}\right\}$$

For estimation and ranging of estimated objects of personnel management problems on the basis of the

suggested method it is necessary to define factors of relative importance of the criteria characterizing alternatives and their private criteria (subcriteria or criteria of the second grade) and membership function of alternatives to private criteria, i.e. degree of satisfaction of alternatives to private criteria.

In order to define factors of relative importance criteria and their elements method of expert estimation on 10 point system (Varfolomeev and Vorobyov, 2001) or a method of paired comparison of simultaneously considered criteria (Rothstein and Shtovba, 2001) may be used. For defining of membership function of alternatives to private criteria mathematical formalization of private criteria is realized (Bellman and Zadeh, 1970; Levin, 2001).

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