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MODEL OF COMPETENCE OF EXPERTS IN THE COMPUTER DECISION SUPPORT SYSTEM

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Abstract: The paper presents the module of competence management of experts that has been developed for computer decision support system (DSS 2.0). At the top of the hierarchical structure of the model is the European standard of core competencies, the decomposition of which allows the mapping of different specializations. The flexible structure of information competence module allows defining any set (profile) of qualifications of experts and the strength of their impact in solving specific problems of decision-making.

Keywords: expert competence, competency management, decision support system

INTRODUCTION

Fundamental competency management issues revolve around the creation of models (profiles) of competences. The concept of such a model is understood as an ordered set of competencies specific to the job, the role of the organization, the profession, which is used as a multi-purpose tool in the management of human capital [Oleksyn 2006]. Appropriate models of competence clearly define the skills that are necessary and required to achieve that objective, the strategy adopted by the company and the applicable regulations and standards (in institutions, professional group). Creating models is an extremely difficult and complex task. They should accurately reflect the goals and at the same time be flexible in relation to changing environmental conditions and take into account patterns of human behaviour. A common problem in the literature is the lack of use of a universal list of competencies for all job post profiles [Borkowska 2006].

The paper presents the module of competency management of experts that has been developed for computer decision support system DSS 2.0 [Budziński, Becker, 2008-2013]. The advantage of this solution are flexible information structures that allow for modelling of expert competency profiles required in supporting specific decision problems. These issues are presented in the form of mathematical models (decision-making tasks), whose components are variables, parameters and constraints [Becker 2010]. The decision support information system assumes that the values of the decision-making tasks are: the result of a group of expert assessments (ratings linguistically expressed or numerically), defragmented into the components and assessed together (including preferences) and transposed to the desired output forms, such as the scope of binary common in multi-step tasks.

COMPETENCE MODELLING STANDARDS

The theory and practice of management has developed (in general and specific) many definitions that describe the concept of competence. One of them states that they usually include relatively stable characteristics of a man making a causal cause and result relationship with the high or above average work results, which have universal dimensions [Pocztowski 2003]. Today, in the literature there are two strands to define the notion of competence. The first is directly related to the person who has the power and it defines as the knowledge, skills, responsibilities and powers of action [Oleksyn 2006]. He identifies them with a set of behaviours that some people take over better than others, which makes them operate more efficiently in a specific situation [Sidor-Rządkowska 2006], as well as abilities, interests, personality traits, as examples of the parameters that differentiate between them [Levy- Lboyer 1997]. The second trend combines the skills of their work or duties related to his office. Therefore, this term shall include a set of characteristics of a person, which includes, among other things: motivation, personality traits, skills, self-esteem associated with the functioning of the group and the knowledge [Witaszek 2011].

Competencies can be grouped into the following categories:

- *core competencies* required from all employees (teamwork, integrity, customer orientation, communication skills),
- *competencies specific to the role*, which allows the employee to play a certain attitude in the organization (team management, planning long-term, strategic thinking),
- *competencies specific to the function*, required from employees, depending on the area of your business (eg, sales and negotiation skills, knowledge of the industry and the local market).

Competencies management, from the point of view of the organization, begins with the development kit (models, profile) competencies needed to perform the work [Witaszek 2011]. At the same time the management of professional competence consists in following a personnel policy, in which the concept of competence combines activities in different areas of human resource management, such as recruitment and selection, employee evaluation, training, developing, motivating and rewarding. Therefore, there are two methods of supporting the process:

- expert – work on the identification and description of competencies and developing implementation procedures performs a team of external and independent experts,
- participatory – creation of appropriate competency profiles required number of workshops, involving specific positions within the company and their supervisors, and in some cases customers.

The mission of competency management is to ensure that the adequate resources in the company, necessary to achieve its strategic objectives.

Build a model of competence required to determine the level of detail descriptions and competencies. Frequently this decision determines the time required to develop the model and the possibility of its application in various areas of the organization. In practice, a specific competence for one company may be a set of competencies as possible to further disaggregate into various components for another company. The more detailed the model is, the longer its construction lasts and the higher are its development costs. There may also be problems with the comparison of information from a variety of tasks and the people who perform them. Considerable detail to define the competence limits the use of creative, new ways of achieving the desired results. On the other hand, it allows a more accurate description of the expected results and better performance management. However, the most effective results are achieved using computer-integrated management systems. [Kopczewski, Szwarc 2009]

Competency model can be constructed in the form of clusters or arrays of competence. The structure must be clear, understandable and do not contain ambiguous wording or complicated descriptions. All elements of the model should be independent of each other and reflect the specifics of the organization and reflect the true nature of roles and positions.

Competence profiles can describe a particular employee, position, or role in the company, and a group of employees, group of positions (eg, management or employees of financial and accounting department) or the whole company. The primary objective of building a competency profiles it is possibility to assess them. From this point of view, there are two types of competency profiles:

- models of the desired competencies describing relevant properties for action or an ideal situation in the past,
- models of present competencies at our disposal at the time of the description [Kopczewski, Szwarc 2009].

A rule of thumb approach used to identify competence is the use of two or more of the methods and comparing the results obtained. Techniques to identify competencies include: examination of documents, surveys, interviews, direct observation and simulation [Kopczewski, Szwarc 2009]. In business practice, there is a shortage of system solutions, which in an objective manner, taking into account the time factor, would select such candidates to the teams and evaluate their decisions. This is a serious problem, because the skills are the basis for decisions on recruitment, selection, training, opportunities for development and evaluation of employees. Previous studies show that over 90% of the implemented software for competence management is based on simple and inefficient methods [Borkowska 2006], [Dale 2006], [Galen, Dean 2005].

INFORMATION STRUCTURE OF EXPERT COMPETENCE MODULE

Presented in Figure 1 model of expert competence management subsystem has a hierarchical structure, which can be divided into general level (phase 1) and detailed (phase 2 and 3). The highest level of the structure was constructed based on the European Standard of Core Competencies (a set of *K)*, i.e.: k_1 – Communication in the mother tongue, k_2 – Communication in foreign languages, k_3 – Mathematical competence, k_4 – Competences in science and technology, k_5 – Digital competence, k_6 – Learning to learn, k_7 – Social and civic competence, k_8 – Sense of initiative and entrepreneurship, k_9 – Cultural awareness and expression (cf. [Recommendation of the European Parliament ..., 2006]). Denote by *OC* set of evaluators (experts), and the oc_j person from this set (j = 1, 2, ..., m). In the first phase (Figure 2) for each j-expert key competences shall be made, using a point scale or the same as the scale of linguistic levels. They are a set of declared (for example, by self-assessment) of the vector values W^j expressing the levels of competence based on the scientific and proven performance. It was assumed that these indicators take a value between ⟨0; 1⟩:

$$W^j = \{w_1^j, w_2^j, \dots, w_9^j\},\ (j\ =\ 1, 2, \dots, m). \tag{1}$$

In the second phase of the procedure (Fig. 3) and the second level of the hierarchical structure of the model, the standard of competence for the specific problem of decision-making is defined ($z\ =\ 1, 2, \dots, v$). For this purpose a proportional comparison matrix for selected key competencies is built. Then, using the method of Saaty [1980], using the technique of pair wise comparisons [Trzaskalik 2006] a vector scale is defined R^z. The procedure refers to the assignment of competence in the set

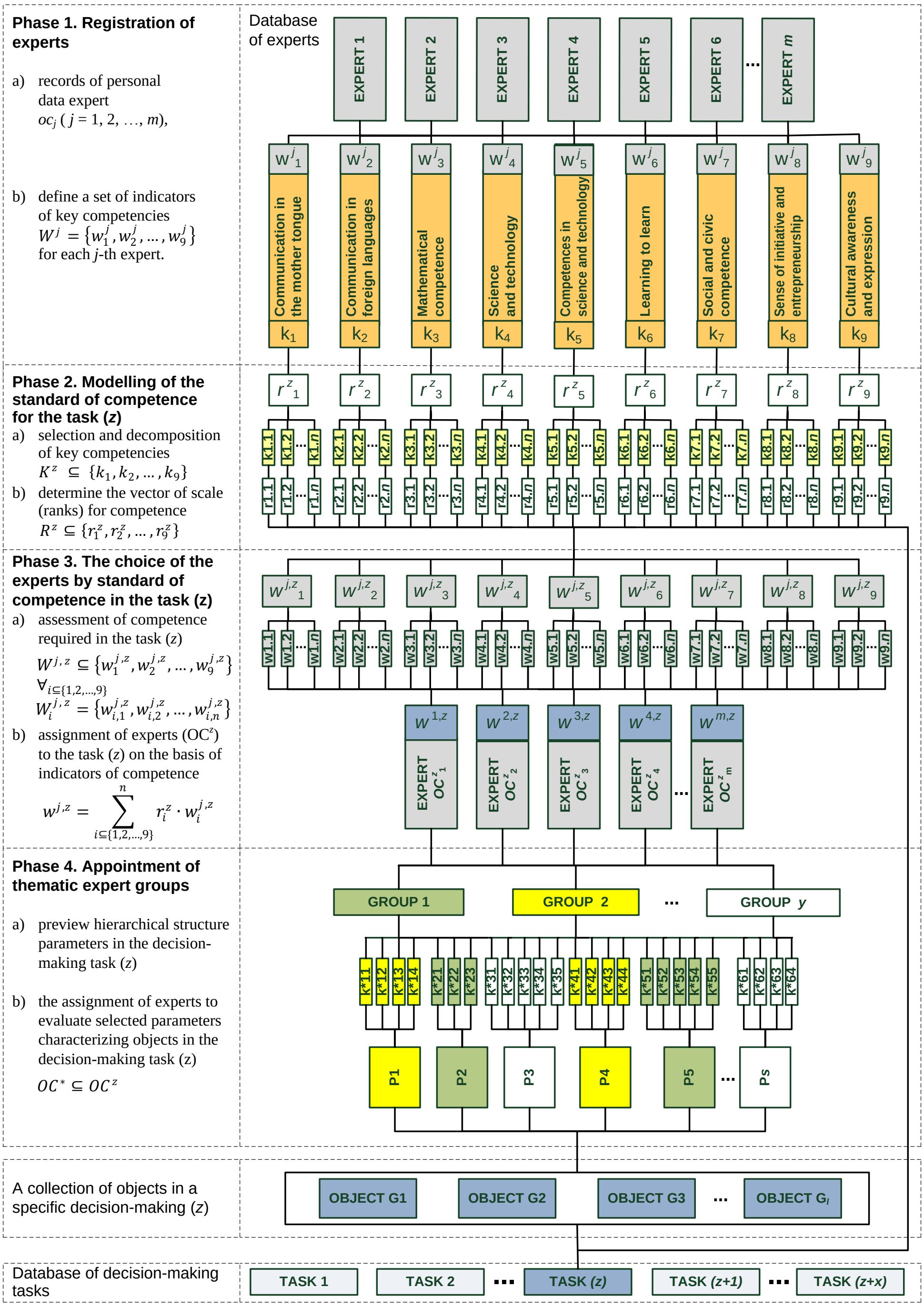
$$K^z\ \subseteq\ \{k_1, k_2, \dots, k_9\}, (z\ =\ 1, 2, \dots, v) \tag{2}$$

of standardized indicators preferences

$$R^z \subseteq \{r_1^z, r_2^z, \dots, r_9^z\}, \tag{3}$$

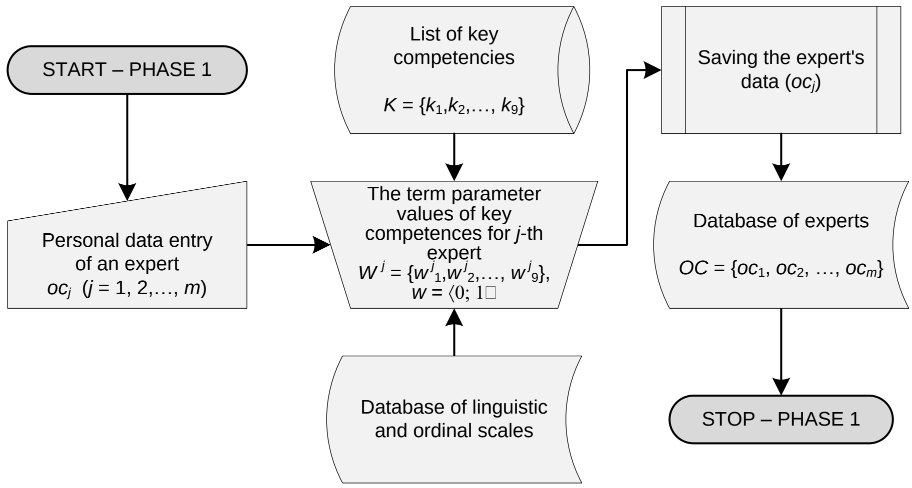
that in a given decision-making tasks (z) allow them to be ranked.

Figure 1. Model of subsystem for competence management in the DSS-class system



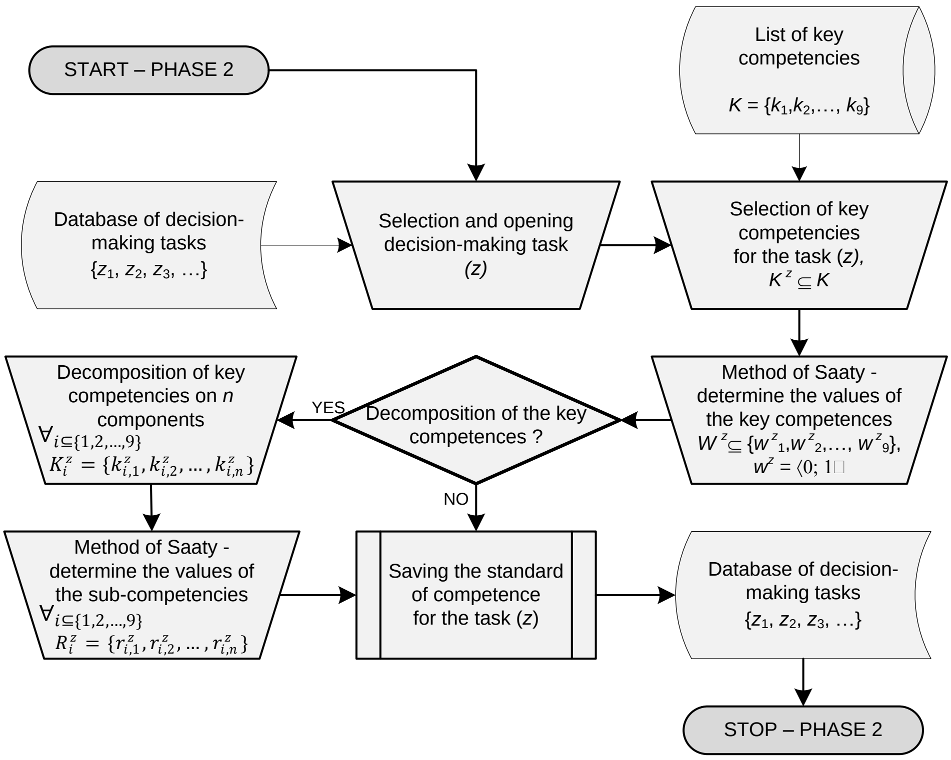
Source: own work

Figure 2. Registration of experts in the DSS –phase 1



Source: own research

Figure 3. Modelling the standard of competence for the task –phase 2



Source: own research

The resulting vector scale R^z is positive and normalized (the sum of its elements equals 1). Non-obligatorily, each core competency can be decomposed into n constituent notes

$$\forall_{i\subseteq\{1,2,\ldots,9\}} K_i^z = \{k_{i,1}^z, k_{i,2}^z, \ldots, k_{i,n}^z\} \quad (4)$$

and evaluated for their vector scale (rank) in the same way as for the key competences

$$\forall_{i\subseteq\{1,2,\ldots,9\}} R_i^z = \{r_{i,1}^z, r_{i,2}^z, \ldots, r_{i,n}^z\}. \quad (5)$$

The adopted two-level structure of competence allows for mapping a wide variety of expertise specialities required in the decision-making procedure (z).

The selection of experts for research included two stages:

1) the pre-selection of people on the basis of the generic competences W^j and evaluation (assessing) of the competence of the persons selected according to a certain pattern of competence $\{K^z; R^z\}$ for the task (Fig. 4, phase 3),
2) the formation of teams of experts to assess individual performance criterion characterizing objects (variants of decision) are reported to the system, for example in the form of applications (Fig. 5, phase 4).

The initial steps in phase 3 are to respect individual competence (K^j) to a defined pattern (K^z) for the task. This action takes the form of dialogue and is made by the analyst (DSS system user). As a result, the selection shall be given a set of people $OC^z \subseteq OC$ with the highest competence, in accordance with the task (z). The analyst has at his disposal the tools to prioritize and retrieval of experts (database records) according to any logical conditions. The query can be either coarse, consisting of ranking of the average values of standardized coefficients of competence $\overline{w}^j$, consistent with the K^z for each expert. The search can also be more precise, based on a comparison of the elements of the vector W^j in the database of given experts.

In the next step of phase 3 the degree of competence of the experts pre-qualified for the task (z) is assessed (estimated). For each element of the set K^z, a set within the scope of ⟨0; 1⟩expressing the degree of competence of *the main competencies,* should be determined using a point scale or identical linguistic scale

$$W^{j,z} \subseteq \left\{w_1^{j,z}, w_2^{j,z}, \ldots, w_9^{j,z}\right\}. \quad (6)$$

Exceptions to this rule are the competence (of the set K^z) which decomposed at n component notes as set out in (4). Competence particulars referred to as a model for the task are subject to the same process of evaluation, the result is a set of ratings

$$\forall_{i\subseteq\{1,2,\ldots,9\}} W_i^{j,z} = \left\{w_{i,1}^{j,z}, w_{i,2}^{j,z}, \ldots, w_{i,n}^{j,z}\right\}, \quad (7)$$

for each pre-qualified j-th expert. Individual indicators for general competence ratings are calculated as the sum of products of elements of the vector rank (5) and vector of partial marks (7):

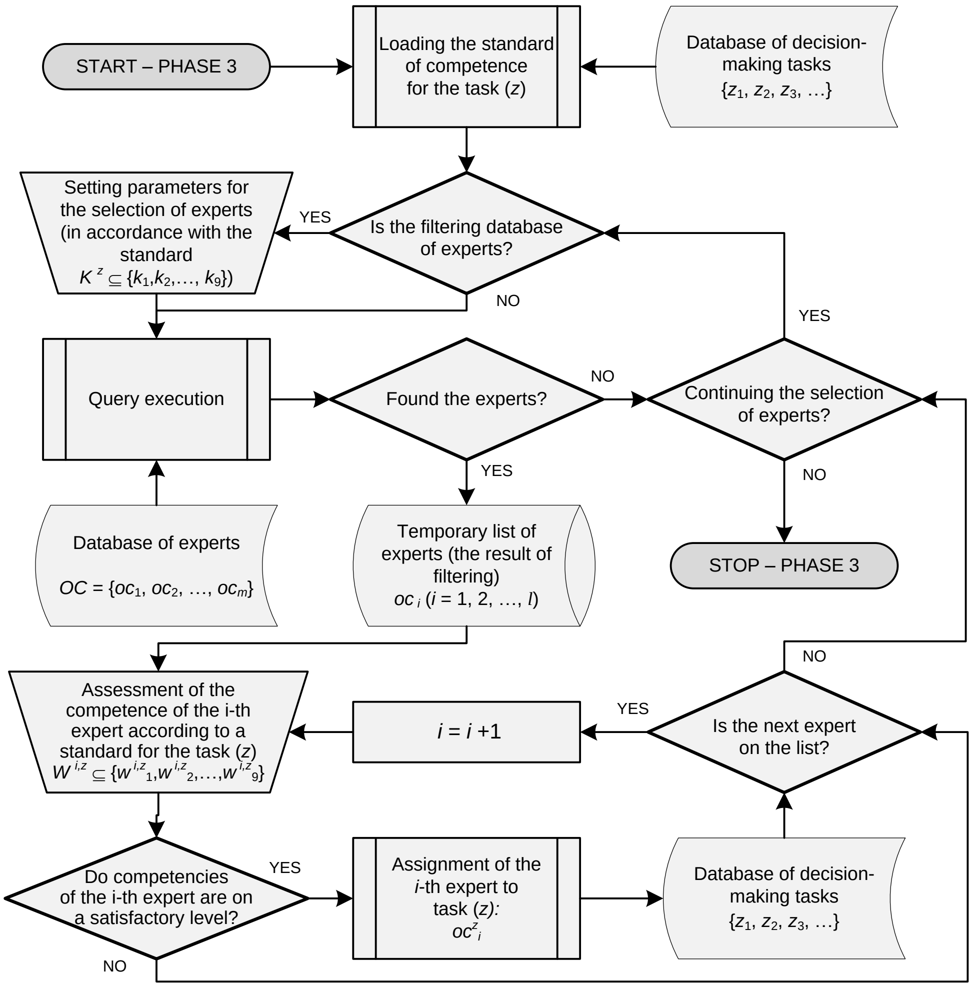
$$w_i^{j,z} = \sum_{s=1}^{n} r_{i,s}^z \cdot w_{i,s}^{j,z}. \quad (8)$$

Similarly, based on the vector ratings (8) and ranks (3) for key competencies system calculates the *global competence indicator of an expert (j) in the task (z)*

$$w^{j,z} = \sum_{i\subseteq\{1,2,\dots,9\}}^{n} r_i^z \cdot w_i^{j,z}. \tag{9}$$

Rate $w^{j,z}$ is positive in the range $\langle 0, 1\rangle$ and expresses the degree of competence (strength reviews) expert in the review of applications, specifically in the evaluation of the parameters characterizing the variations of decision-making in the task. In practice, it should not take too low values (e.g. less than 0.7) for the vast number of selected experts, as this will have a negative impact on the reliability of the results of the analysis of decision-making: choice, ranking and grouping options in the decision-making system.

Figure 4. The choice of the experts to the task –phase 3



Source: own research

In the second stage of the selection of experts (Figure 5, phase 4) it is assumed that each parameter (p^*) With decision-making tasks (z) can be assigned with the individual team of experts $OC^* \subseteq OC^z$. Denoted by oc_j^* an assessor parameter p^* where j = 1, 2, ..., m^*. Then m^* will determine the cardinality of the set OC^*, or expert opinion relating the parameter p^* in each object (variant decision) $G_t(t = 1, 2, ..., l)$ filed into the DSS system in the form of application.

The analyst can determine the parameter p^* a set of sub-criteria k_i^* (i = 1, 2, ..., n^*) and give them the values rang validity r_i^* (preferences of the decision maker). It is assumed that the elements r_i^* single-column matrix of rank R^* express the main parameter of interest p^* and their sum is equal to unity:

$$R^* := (r_i^*)_{n^* \times 1}, \quad \sum_{i=1}^{n^*} r_i^* = 1. \tag{10}$$

No division into sub-criteria will undergo parameter p^* direct assessment ($r_i^* = 1$, $i = n^* = 1$).

Let τ is the number of linguistic values $a^{(\alpha)}$ (α = 1, 2, ..., τ) , which form a system-defined simple scale in the DSS (e.g. $a^{(1)}$: small, $a^{(2)}$: medium, $a^{(3)}$: large). Considering a simplified technique of scaling, which is to divide the range evaluated parameter (p^*_{min}, p^*_{max}) on τ-1 equal sections, assignment $a^{(\alpha)} \mid p^{(\alpha)}$ is obtained by calculating:

$$p^{(\alpha)} = p^*_{\max} + \frac{(p^*_{\max} - p^*_{\min}) \cdot (\alpha - 1)}{\tau - 1}, \text{ for } \tau > 1. \tag{11}$$

If the parameter p^* was divided into n^* sub-criteria k_i^* (i= 1, 2, ..., n^*), which underwent a collective assessment by m^* people OC_j (j = 1, 2, ..., m^*) then we obtain an individual scoring matrix

$$\mathrm{A} := (a_{i,j}^{(\alpha)} \mid p_{i,j}^{(\alpha)})_{n^* \times m^*}. \tag{12}$$

For each sub-criterion k_i^*, a row in the matrix A, we calculate the arithmetic mean of the partial, creating a matrix column

$$\mathrm{P} := (\bar{p}_i)_{n^* \times 1}, \ \ where \ \ \bar{p}_i = \frac{\sum_{j=1}^{m^*} p_{i,j}^{(\alpha)}}{m^*}. \tag{13}$$

Then, multiplying the vector of average grades of group P by the vector of ranks (preferences) of decision-makers R^*, we obtain the vector of values of sub-criteria K^*:

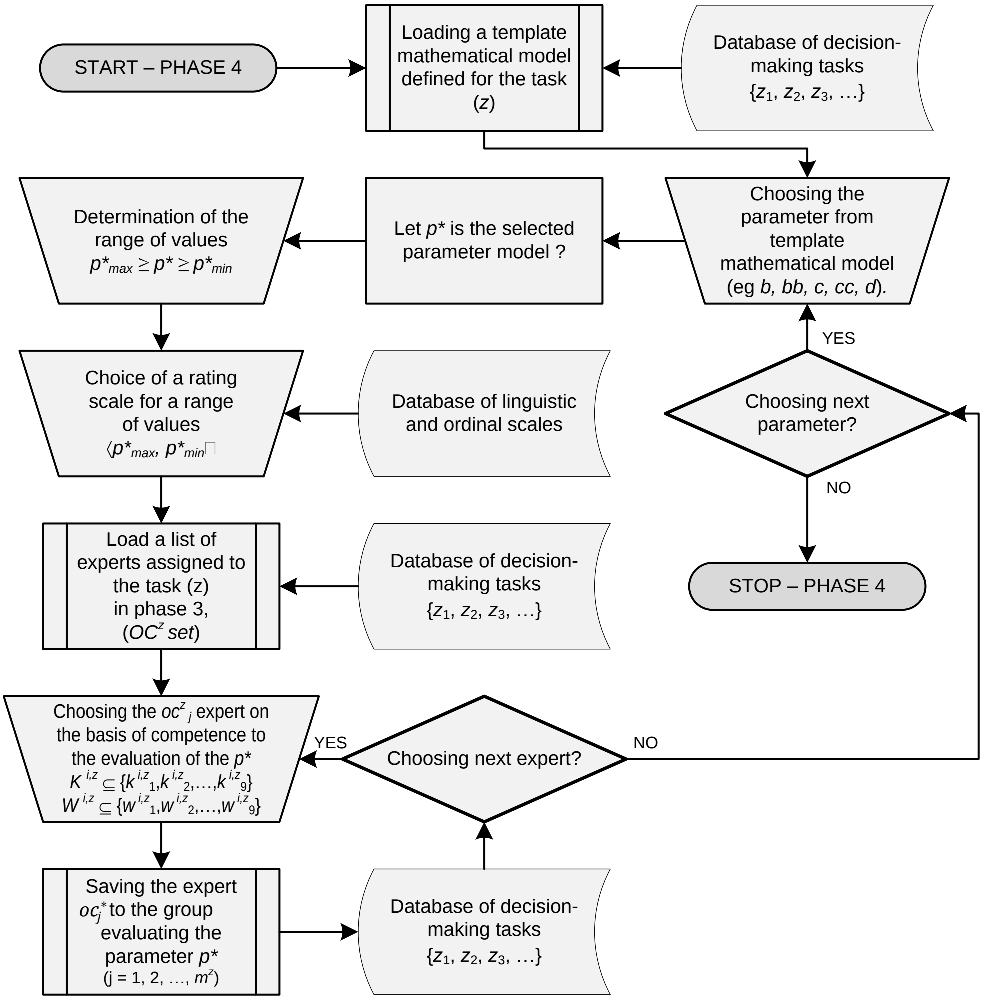
$$\mathrm{K}^* := (k_i^*)_{n^* \times 1}, \ \mathrm{K}^* = \mathrm{P} \times \mathrm{R}^*. \tag{14}$$

As a result of the vector sum of the individual values of K vector we obtain a synthetic value of group evaluation (assessment) parameter p^*:

$$p^* = \sum_{i=1}^{n^*} k_i^*. \tag{15}$$

Value p^* will be in the predetermined range (p^*_{min}, p^*_{max}). However, it does not take on the form of equation (9), i.e. *global competence indicator expert in the task*.

Figure 5. The assignment of experts to evaluate selected parameters characterizing objects in the decision-making task (z) – phase 4



Source: own research

The reference of group evaluation parameter p^* to set up in the task (z) level of competence of the experts (j) involves the determination of vector weighted average partial marks

$$\mathrm{P}_{ocn} := (\bar{p}_i)_{n^* \times 1}, \ \ where \ \ \bar{p}_i = \frac{\sum_{j=1}^{m^*} p_{i,j}^{(\alpha)} \cdot w^{j,z}}{\sum_{j=1}^{m^*} w^{j,z}} . \qquad (16)$$

Then, in accordance with the provisions of (14) and (15), a vector is calculated for sub-criteria

$$\mathrm{K}^{*}_{ocn} := (k^{*}_{i(ocn)})_{n^{*}\times 1}\,,\ \mathrm{K}^{*}_{ocn} = \mathrm{P}_{ocn} \times \mathrm{R}^{*} \tag{17}$$

and the value of the parameter group evaluation

$$p^{*}_{ocn} = \sum_{i=1}^{n^{*}} k^{*}_{i(ocn)}\,, \tag{18}$$

which takes into account the strength of competence of the experts on the team OC^{*}.

CONCLUSION

The inclusion of competence management module with the function of the group evaluation (assessment) parameters of objects into the structure of the DSS system, is justified in practice, because it allows for seeing and comparing the results of decision analysis (selection – WPL, ranking – AHP and grouping – Electre TRI) in two sections, including and excluding the impact of the competence of individual experts.

The following methods were used for the creation of a basic criterion which is the analysis of competence *ex-ante* of people taking strategic decisions. A deficiency in decision support systems is their assessment *ex-post*. This assessment is defined as a final score, which is run after the implementation of the various actions, decisions, interventions, programs, projects, etc. The main objective of this review is to determine the quality of teams as well as competence *ex-ante* with respect to the decisions taken. In this way, the utility evaluated the effects of implemented measures. This is due to answer a number of questions. Were people matched well to the teams? Did they have sufficient competencies? Did decisions taken really lived up to expectations? Were the effects of the measures taken sustainable? Evaluation *ex-post* also functions as a feedback on the quality of performed activities and advisory groups in decision-making.

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