

## COMPETENCE ASSESSMENT METHOD OF THE EXPERT GROUP

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**Abstract** The article deals with the approach to complex assessment of expert group competences. Author analyzes group of experts, who is responsible for credit and factor assessment of work complexity.

**Key words:** competence; job model (type of job); sociometric status; work complexity assessment.

### 1. Stating the problem

Expert group formation is becoming the primary task in modern terms of tasks complexity and in limited time. The main goal of these groups is to elaborate the strategies for tasks solving based on the collective decision-making. There is a lot of material dedicated to the issue of expert group formation but the author suggests considering the method of expert group formation which is responsible for work complexity analysis as well as credit and factor model development. This question is not covered sufficiently nowadays due to the huge amount of psychological and social factors [1, 8, 9].

Precise attention is paid to expert group formation as it will be responsible for analysis and decision making based on its results. All this incorporated in the model developed as well as in modeling algorithms of work complexity [6, 7, 10].

### 2. Research analysis

Based on analysis of scientific papers in this field [2-4, 9], author has concluded that basic approaches are usually used for competence assessments and they do not consider particular qualities of the certain field of expertise. This significantly increases the probability of imprecise assessment and reduces the coherence of the expert's estimates in the certain field of knowledge. In this regard the author considers the certain expertise area namely work complexity assessment as well as suggests the approach to comprehensive assessment of the expert group competence.

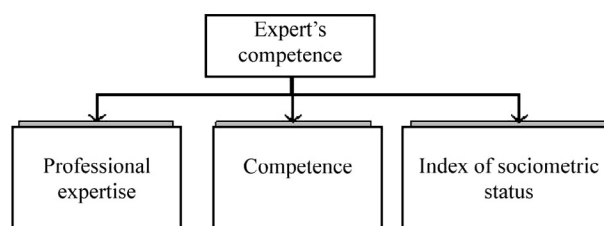
The purpose of this article is to formalize the concept and structure of competence for the certain area of expertise and describe its mathematical model for comprehensive assessment of the expert group competence.

### 3. Research results

The concept of professional competence as a grade of expert's qualification in work analysis and

evaluation should be determined. This concept is somewhat narrower than the conventional and will be used for particular purpose namely expert group formation for work analysis.

The author suggests considering competence as the composite index which characterizes an expert's possibility to perform efficiently the examination of the given issue within the expert group. Competence consists of 3 components: professional expertise, competence and index of sociometric status (fig. 1).



**Fig. 1.** Expert's competence components

The author proposes the method for expert's professional competence assessment that calculates the competence coefficient  $K_{PC}$ .

The following items should be considered during the expert group formation process:

1. The amount of projects in the field where an expert took direct part –  $k_p$ .
2. Expert's experience in the subject field (human resource management, regulation and labor economics) –  $k_e$ .
3. Scientific and methodological research in the field of work analysis –  $k_{sw}$ .
4. Scientific degree –  $k_{sd}$ .

It is necessary to introduce the scale for the quantitative assessment of the aspects mentioned above (tables 1–4), where each number of the scale gets its own value  $v_i$ .

**Table 1.** Number of the projects

№	Scale description	$v_i$
1	Did not participate	0
2	Participated in 1-2 projects	1
3	Participated in 3-5 projects	2
4	Participated in 5-10 projects	3
5	Participated in more than 10 projects	4

The correction coefficient  $b_c$  should be introduced. The coefficient has to consider the scope of the projects from the viewpoint of work analysis (1):

$$b_n = \begin{cases} 0,50 & \text{up to 10 works analysis} \\ 0,75 & \text{up to 20 works analysis} \\ 1,00 & \text{more than 20 works analysis} \end{cases} \quad (1)$$

The composite score for the aspect is calculated using the formula (2):

$$k_n = \sum_{i=1}^5 v_i \cdot b_{n_i} \quad (2)$$

**Table 2.** Work experience

№	Scale description	$v_i$
1	Experience in related activities	0
2.	Up to 2 years in the research field	1
3	Up to 5 years in the research field	2
4	More than 5 years in the research field	3
5	Is a member of the expert groups, committees of branch ministries, legislatures in the field under analysis (labor regulation)	4

The composite score for the aspect is calculated using the formula (3):

$$k_o = v_i \quad (3)$$

**Table 3.** Scientific and methodological research

№	Scale description	$v_i$	$b_i$
1	Scientific and methodological materials are not developed	0	0
2	BPresentations on the workshops related to the field of work which is under the analysis	0,5	1
3	Published articles on the subject	1	$b_c$
4	Published articles on the subject abroad	1,5	$b_{ck}$
5	Participation in research studies	2	$b_{nop}$
6	Published text books and manuals	3	$b_{nn}$
7	Published monographs on the subject	4	$b_m$

The correction coefficient  $b_i$  which considers the scope of the aspects is to be introduced:

$$b_c = \begin{cases} 0,50 & \text{published up to 5 articles} \\ 0,75 & \text{published up to 10 articles} \\ 1,00 & \text{published more than 10 articles} \end{cases} \quad (4)$$

$$b_{cn} = \begin{cases} 0,50 & \text{published up to 2 articles} \\ 0,75 & \text{published up to 4 articles} \\ 1,00 & \text{published more than 4 articles} \end{cases} \quad (5)$$

$$b_{nnp} = \begin{cases} 0,50 & \text{participation in up to 2 research studies} \\ 0,75 & \text{participation in up to 4 research studies} \\ 1,00 & \text{participation in more than 4 research studies} \end{cases} \quad (6)$$

$$b_{nn} = \begin{cases} 0,50 & \text{up to 2 text books} \\ 0,75 & \text{up to 4 text books} \\ 1,00 & \text{more than 4 text books} \end{cases} \quad (7)$$

$$b_m = \begin{cases} 0,50 & 1 \text{ monograph} \\ 0,75 & 2 \text{ monographs} \\ 1,00 & \text{more than 2 monographs} \end{cases} \quad (8)$$

The composite score for the aspect is calculated using the formula (9):

$$k_{np} = v_1 \cdot 0 + v_2 + v_3 \cdot b_c + v_4 \cdot b_{ck} + v_5 \cdot b_{nop} + v_6 \cdot b_{nn} + v_7 \cdot b_m \quad (9)$$

**Table 4.** Scientific degree

№	Scale description	$v_i$
1	No scientific degree	0
2	PhD in the related field	0,5
3	PhD, senior research associate in the related field	1
4	PhD in the research field (PhD paper covers the subject field)	2
5	PhD, senior research associate in the research field (working in the subject field)	2,5
6	DSc (Doctor of Science in the related field)	3
7.	DSc in the research field (the paper covers the subject field)	4

The composite score for the aspect is calculated using the formula (10):

$$k_{c3} = v_i \quad (10)$$

The aspects have their own weight  $w_i$ . One of the ways to determine these weights is pairwise

comparisons which is represented in the table 5. This also implies finding eigenvectors of a matrix

$$K = \| \|k_{ij}\| \|, i = j = 4.$$

**Table 5.** Weight coefficients of the aspects

	$k_n$	$k_d$	$k_{np}$	$k_{c3}$	$w_i$
$k_n$	1,00	3,00	2,00	2,00	0,420271
$k_d$	0,33	1,00	0,50	0,50	0,121322
$k_{np}$	0,50	2,00	1,00	0,50	0,189879
$k_{c3}$	0,50	2,00	2,00	1,00	0,268529

Professional expertise coefficient is calculated using the formula (11):

$$K_{\text{ПЭК}} = w_1 \cdot k_n + w_2 \cdot k_d + w_3 \cdot k_{np} + w_4 \cdot k_{c3} \quad (11)$$

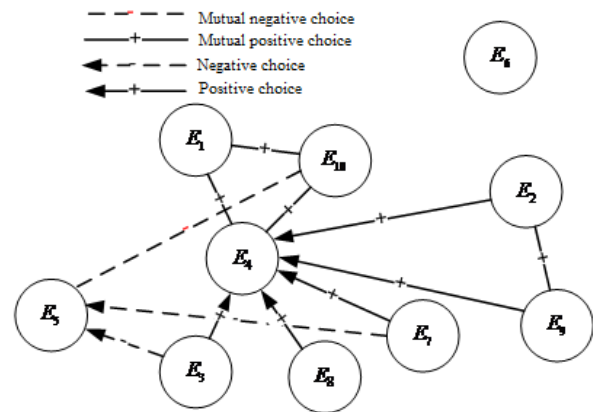
It is necessary to introduce the minimal passing level  $K_{C_{\text{min}}}$  of the professional competence which is enough to include the person to expert group.

As mentioned earlier, the author proposes considering competence comprehensively meaning the direct assessment of the professional expertise and competence, which are required to solve the task of work analysis. Expertise characterizes an expert as a specialist in a certain field with his skills and knowledge (theoretical, practical, methodologies, methods etc). Competence characterizes his possibility to solve tasks and is a psychological feature to some extent.

There are a lot of scientific literature and researches regarding competence assessments, thus the current models will be used for the calculations of the complex assessment's second component.

The third component of the competence is sociometric index. The main purpose of sociometry is an informal study of the structural aspects of the expert group and psychological atmosphere based on sociometric matrix, questionnaires and sociometric indexes. Sociometry has fundamental methods and algorithms which thoroughly describe relationships within the group. The sociogram (fig. 2) is to be considered as the most demonstrative mechanism of the schematic representation of the expert group members'  $E_i$  interactions during the answering the sociometric test.

Sociogram analysis begins with definition of the most authoritative group members, mutual pairs or groups of people for further formation of sub-groups or on the contrary experts with low sociometric index should be excluded.



**Fig 2.** Expert group's sociogram

There are personal (PSI) and group (GSI) sociometric indexes. PSI describes the individual social and psychological characteristics of expert as a member of the group; GSI shows the numerical characteristics of the integrated sociometric configuration, namely characteristics of the group communications.

It is necessary to use the main PSI – index of sociometric status for expert  $i$  in the group (12) – which is a characteristic of an expert as a member of the group to occupy certain spatial position in it.

$$C_i = \frac{\sum_{i=1}^n (R_i^+ \pm R_i^-)}{n-1}, \quad (12)$$

where  $R_i$  – choices of expert  $i$ ;

$R_i^+$  – positive choices of the expert  $i$ ;

$n$  – number of the expert group members.

Index values are in the range  $C_i = \{-1 \div 2\}$ , thus from absolutely negative choice made by the team members regarding an expert up to the complete positive support.

Index of psychological mutuality should be calculated for group stability analysis (13):

$$G_g = \frac{\sum_{i=1}^n \sum_{j=1}^n A_{ij}^+}{\frac{n}{2}(n-1)}, \quad (13)$$

where  $A_{ij}^+$  – number of positive reciprocal relations; max value is calculated using the formula:  $A_{ij\text{max}}^+ = 0,5 \cdot n^2 + 0,5 \cdot n - 6 \cdot 10^{-13}$ .

Index value is in the range  $G_g = \{0 \div 1\}$ , thus from the absence of reciprocal relations up to full agreement between experts.

Approach reliability primarily depends on the proper selection of the sociometric criteria which should be determined by the research program and peculiarities of the group.

Once sociometric assessment of the group is done, the third coefficient of the expert's competence vector model  $\vec{k}_i = (K_{K_i}, K_{PK_i}, \pm C_i)$  (fig. 3) can be considered.

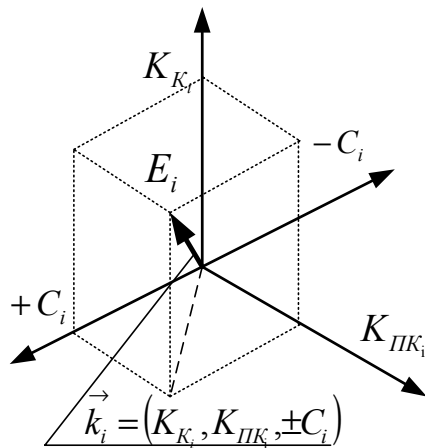


Fig. 3. Vector model of the competence

As shown in the figure, expert's competence is represented as vector in the space of three variables:

Professional expertise –  $K_{PC}$ , – competence –  $K_{K_i}$  and sociometric status index  $\pm C_i$ . Competence credit is calculated as a length of the corresponding vector (14):

$$|\vec{k}_i| = \sqrt{K_{PK_i}^2 + K_{K_i}^2 + r_n |\pm C_i|^2} \quad (14)$$

Since index of sociometric status could be negative ( $+C_i, -C_i$ ) and could be in the range  $C_i = \{-1 \div 2\}$ , formula uses the square modulus of the index and regulation coefficient, which is determined depending on the sign of the index:

$$r_n = \begin{cases} 5,0 & -C_i \\ 2,5 & +C_i \end{cases} \quad (15)$$

#### 4. Summary

The article considers an integrated approach to calculating the competence of the expert group in terms of the expertise of the work complexity (types

of work). Suggested approach extends the current methods and algorithms of assessment based on proposed three-dimensional model which considers the professional knowledge in the given field of expertise, expert's competence and sociometric status of the expert in the group.

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**П. М. Павленко<sup>1</sup>, С. В. Толбатов<sup>2</sup>. Метод оцінки компетентності фахівців експертної групи**

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Результатом роботи є метод оцінки компетентності фахівців експертної групи в рамках запропонованої математичної моделі. Розроблений метод оцінки компетентності фахівців експертної групи може розглядатися як технічне завдання для розробки та реалізації відповідного програмного забезпечення у вигляді автоматизованих робочих місць фахівців, які відповідають на підприємствах за реалізацію політики нормування та оплати праці.

**Ключові слова:** компетентність; модель роботи (виду роботи); оцінка складності робіт; соціометричний статус.

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Результатом работы является метод оценки компетентности специалистов экспертной группы в рамках предложенной математической модели. Разработанный метод оценки компетентности экспертной группы может рассматриваться как техническое задание для разработки и реализации соответствующего программного обеспечения в виде автоматизированных рабочих мест специалистов, которые отвечают на предприятиях за реализацию политики нормирования и оплаты труда.

**Ключевые слова:** компетентность; модель работы (вида работ); оценка сложности работ, социометрический статус.

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