FORMALISATION OF THE PROCEDURE FOR SELECTION, EVALUATION AND DECISION-MAKING WHEN FORMING A PROJECT TEAM USING A PHENOMENOLOGICAL MODEL

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The development of any modern production is impossible without taking into account the human factor. Companies seeking to have more competent, proactive, flexible employees should intensify their human resource management system, which includes the selection and recruitment of employees, their training and development, career planning and management, motivation of their work with well-deserved rewards, and strengthening of teamwork.

Introduction

Today, interest in human resource management, group studies, and teamwork has grown significantly, as teamwork and the work of each employee individually play a leading role in achieving tangible results in a project, helping to maintain companies' competitive advantages and efficiency.

The main factor in the competitiveness of any project team is the level of professionalism and creativity of its employees. Human resources are the most valuable resource, and developing their potential is an important strategic task of project team management. Modern organisations need employees who can do their job well in the face of organisational change, help others do the same, and quickly create a collaborative atmosphere.

A group is known to be formed of several interacting employees, each of whom is an independent personality. In the process of solving common practical problems, people enter into complex relationships with each other as a whole. The dynamics of the relationship between an individual and a group seems to be quite complex. To understand and evaluate these relationships, one should take into account both the properties that occupy a certain status and play a certain role in the group and the composition, content of activities and level of organisation of the group, as well as other wider social associations.

Along with general psychological manifestations, a personality has individual psychological properties: temperament, character, abilities, i.e., properties that constitute his or her individual originality. A person always brings his or her individual qualities to the processes of work and group interaction. A manager needs to know and take into account the individual qualities of people in order to implement an individual approach to them, to train them more successfully, to adapt them to the

conditions of professional work and group interaction, and to optimally stimulate the effective performance of team members. Managers need to understand that each person is unique and has his or her own strengths and weaknesses. It is the ability to take into account the individual characteristics of employees that allows you to create an atmosphere of mutual understanding and successfully implement an individual approach to them.

In the context of certain work tasks, people evaluate each other primarily by the level of intelligence formed by the system of cognitive processes. In particular, every manager should be demanding of the qualities of his or her own intelligence, as well as of the mental abilities of his or her subordinates when assessing their suitability for the position and the nature of the production tasks they perform. Knowledge of personality traits is necessary for predicting individual and group behaviour and for the correct placement of personnel. Therefore, managers in management systems need to determine these qualities in the production environment by observing and analysis of the activities.

Features of the human resources interaction process in the project

Today, the development and improvement of the labour market at the national level is becoming an important issue. In this context, the company's strategy in recruiting, training and managing staff plays a key role and is designed to help achieve the organisation's goals.

Until the 1970s, HR management in developed countries was focused solely on the current needs of the organisation. Under this approach, employers expected to have access to the required number of employees without the need for long-term specialised training. An oversupplied labour market provided employers with this opportunity, and staff turnover was not considered a task. However, with the increasing mental workload of organisations and the shortage of highly skilled professionals, it has become important to focus on both current needs and the long-term perspective when building resources. This requirement applies to all types of resources, including human resources [1–3].

Today, a significant number of companies distinguish human resource management and planning as an independent type of human resource management. Thus, human resource management is carried out as a process of implementing certain targeted functions that are closely interrelated and form an integral functional system of human resource management in an organisation. Personnel is beginning to be considered as the main material (intellectual) resource of the company, which primarily determines the success of the entire organisation and, to a large

extent, its market value. This has led to increased attention to strategic issues of organisational management, including in HR policy. After all, in order to achieve optimal functioning, the company must choose the most appropriate and adapted strategy, which, in turn, should be built on strong positions and the use of opportunities, including human resources.

Effective work of any labour collective is possible only if there is high cohesion, which allows to consider a particular group as a collective. The problem of psychological integration of a group is one of the most difficult in modern management systems. Studies conducted within the framework of the activity-based concept have investigated two main issues. On what basis does an initially nominal community of individuals forming a team become a truly productive team capable of effectively solving production problems? What tools ensure the psychological integrity and unity of the team?

The psychological compatibility of staff plays an important role in achieving project goals. There are several levels of psychological compatibility, determined by both the personality traits of employees and the content and complexity of the professional tasks being solved. Psychophysiological compatibility is expressed in the similarity of natural properties of people: temperament, physical endurance, efficiency, emotional stability. Psychological compatibility is manifested in the coincidence of character traits, professional interests, level of intellectual development, and personal qualities. Socio-psychological compatibility is expressed in the similarity of personal properties necessary for social interaction based on commonality and worldview: communication skills, integrity, social attitudes, political views, value orientations [4–7].

If people coincide in all three levels of compatibility, we can speak of their full psychological compatibility. If the characteristics mismatch, a psychological barrier arises when project team members do not want to cooperate in any area.

Methodologically, the starting point for addressing these issues is the idea of socially determined joint activity as the main systemic factor of any social group [8]. It is in the context of educational and professional activities that business and emotional relationships are formed, common group values and norms of behaviour are developed. An integral consideration of the work team requires a holistic study of the system of intra-group activity in the unity of all its aspects.

Thus, although the orientational and goal-oriented aspects of cohesion are the leading ones in the activities of groups with a professional orientation, the emotional sphere of group life and the corresponding emotional cohesion are important conditions for group activity.

The level of cohesion of a particular group can be quantified using the Jacob Levy Moreno sociometric method. Based on the results of the sociometry, the group cohesion coefficient (1) can be derived by counting the number of mutual choices received by all group members [9].

$$Q = \frac{\sum P}{0,5n(n-1)} \tag{1}$$

where $\sum P$ – is the number of mutual positive choices;

n – the total number of possible elections in the team.

The more such links there are, the more the group acts as a synthetic whole, firmly connected not only by external influences (orders, regulations) but also by interpersonal intra-group ties (traditions, sympathies, and the desire for cooperation), which makes such a group highly durable, stable, and productive.

Figure 1 shows diagrams of cohesive (a group with a high level of internal interconnectedness and common goals) and diffuse (a group with looser and blurred boundaries) groups. The diagrams show that in the two groups of 9, in the first case (a) there is a high level of cohesion through single and mutual elections that connect all employees into a single structure. In the other case (b), there is a low level of cohesion: there is a core group of three employees (1, 4 and 5), the other four are connected only to the leader, and two are completely isolated, forming a dyad that is cut off from the rest of the group. Groups with a low level of cohesion are easily disintegrated either by external influences or by the slightest internal conflict.
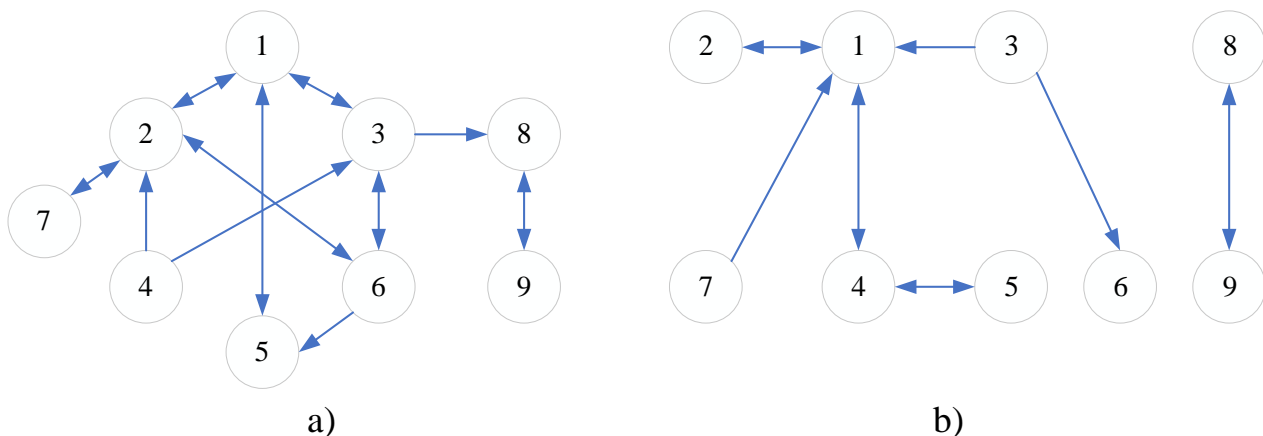

a)   b)

Fig. 1. Levels of group cohesion: a) high; b) low

Clustered groups can be more effective in achieving common goals and meeting the needs of participants because they can provide more support and interaction. On the other hand, diffuse groups can be more flexible and versatile, as participants can move in and out of them freely and have a wider range of communication. It is important to be able to manage and balance both types of groups

to achieve work-life success. The deeper the incompatibility of employees, the higher the likelihood of conflicts and, as a result, the breakdown of the project team. To implement a programme for forming productive working groups, it is necessary to study people, taking into account not only their orientation and individual psychological characteristics, but also their efficiency and compatibility in the team.

Thus, in the process of solving common tasks, employees must come into contact in order to coordinate their actions. The level of such coordination affects their labour productivity and the performance of work tasks. In turn, this level of coordination is a production variable depending on the degree of employee compatibility.

A formalised model of the decision-making process task in the formation of a project team

One of the possible ways to formalise the procedure for selecting, evaluating and making decisions when forming a project team is to use a phenomenological model. This approach makes it possible to describe the procedure in general terms, regardless of the specifics of the types of work performed, the competencies of the performers and the organisational structure of the enterprise. The phenomenological model makes it possible to systematise the general procedure for analysing candidate characteristics of different content and with the necessary detail.

The mathematical model of the decision-making procedure for selecting personnel for inclusion in a project [10] is formulated as follows. We introduce the following notation:

Z is the task of selecting personnel for the project;

X is the set of required types of work in the project;

R is the set of performers of similar types of work in previous projects;

V – a set of assessments of the characteristics of candidates for the project.

The choice of the list of criteria for evaluating project candidates is determined by the specifics of the project, traditional requirements for employees of the organisation, and other circumstances. To compile a generalised list of requirements, you can use the term "ideal employee", based on the list of characteristics and criteria for their assessment adopted by the organisation to describe the specifics of the planned work, required competencies and personal characteristics. The criterion for evaluating candidates for the project is the closeness of the candidate being evaluated to the "ideal employee". Then, some candidate evaluation function can be considered as a reflection of the Cartesian product in a set of evaluations and a function of the best value of the selection score. In this case,

the task of selecting personnel for a project can be viewed as choosing the following option (candidate):

$$x^* \in X \subset X \qquad (2)$$

where $F\left(x^*, r\right) \cup Q(r)$ at any $r \in R$, where X — lots of pre-selected candidates.

In this case, x^* can be considered a solution to task Z if at $r \in R$ the similarity score $F\left(x^*, r\right)$ is a ratio $\cup$ to the boundary value $Q(r)$ of this r. Thus, task Z is defined by the following set: (X, R, F, Q). An element x^* from X is a solution to Z and is expressed by the predicate:

$$P\left(x^*, Z\right) = x^* \qquad (3)$$

where x^* — a solution to task Z.

In practice, there may be situations when candidates need to be selected only for certain characteristics and evaluation criteria depending on the specifics of individual production operations or critical technological processes, using special equipment.

Then this task can be formulated within the framework of the case considered above for the general task Z. In this case the task Z_m which is being considered, is defined by a set of characteristics $(X_m, R_m, F_m, Q_m$, belonging X to $X_m (X = X_m)$. Thus, the task Z_m is considered as a separate variant of the task Z on the set X_m.

Based on similar considerations, it is possible to further detail the characteristics of the candidate description, focusing on the most important partial indicators required to perform specific types of work. In this case, detailing the characteristics of the candidates forms an independent task Z_j, which can be characterised by the following indicators $\left(X_j, R_j, F_j, Q_j\right)$ [10].

A variety of tasks Z_j, can be represented by some vector $\overline{S_r} = \left(x_1, \ldots x_N\right)$ $j = \overline{1, N}$. The obtained value S_r allows to determine $x_r \in X_r$ and $x_r = T_r\left(S_r\right)$ where T_r — operator for selecting a solution to a particular task from a variety of candidates Z_j.

Continuing to detail the criteria for assessing candidates, we will obtain a multi-level hierarchical structure of assessments, which has such properties as hierarchy, coordination of higher-level tasks with lower-level tasks of detailed

description and modifiability of the characteristics of the candidate description, i.e. their compatibility.

The set of tasks for selecting candidates to form a project $\otimes$ team in terms of set theory can be represented as a Cartesian product of sets using the following expression:

$$\otimes \in R * M * D \times W * \Gamma * L * \overline{P} * \left\{ Z_j \middle| j = \overline{1, N} \right\} * \left\{ Z_m \right\} *$$
$$* \left\{ \otimes'_j \middle| j = \overline{1, N} \right\} * \left\{ \otimes''_j \middle| j = \overline{1, N} \right\} * \left\{ \otimes_m \right\} * \left\{ CP \right\} * \left\{ TP \right\}, \tag{4}$$

where $\{TP\}$ − a variety of possible solutions for selecting a candidate for the project;

M − a variety of local lower-level characteristics;

$D, W, \overline{P}$ − a variety of possible solutions to selection tasks based on local criteria;

$$D = \left\{ xD_j \middle| D_j = \left\{ d_j^p \right\}, j = \overline{1, N} \right\}$$

$$W = \left\{ XW_j \middle| W_j = \left\{ w_j \right\}, j = \overline{1, N} \right\}, \overline{P} = \left\{ \overline{p} \right\};$$

Γ, L − a variety of input coordinating signals for local lower-level tasks.

$$\Gamma = \left\{ x\Gamma_j \middle| \Gamma_j = \left\{ v_j \right\}, j = \overline{1, N} \right\}, L = \left\{ l \right\}$$

$\{CP\}$ − a variety of operators for evaluating and selecting candidates based on local lower-level criteria (lower-level mathematical models for assessing psychological, personal characteristics, competencies, etc.):

$$CP : R \times M \to \{TP\}.$$

Then the task of selecting candidates from the available set can be formulated as follows:

− for lower-level tasks:

$$Z_j : R * \Gamma_j * D_j \to M_j, j = \overline{1, N};$$

− for the tasks of selecting candidates by classes (groups) of parameters (personal, competences, etc.):

$$Z_m : R * L_m * \left\{ W_j I_j = {}^- \left(\overline{1, N} \to \left\{ x\Gamma_{-j} \middle| -j = {}^- \left(\overline{1, N} \right) \right\} \right) \right\};$$

− for top-level tasks:

$$Z_n : R * \overline{P} \to L.$$

Next, we define the composition of operators for solving the tasks of the lower level of the hierarchical system for the following tasks Γ:

$$Q'_j : R * \left\{ xM_j \right\} j = \overline{1, N} \to D_j$$

$$\otimes_j = \{Q'\}, \ j = 1, N - \text{task solving operator } Z_j$$

$$Q_j : R * \{xM_j | j = \overline{1,N}\} \to D_j$$

where, $\otimes''_j = \{Q''_j\}, \ j = \overline{1,N} -$ a variety of information conversion operators from the second level of the hierarchy for tasks Z_j.

$$Q''_j : R * \{xD_j | j = \overline{1,N}\} * \{x\Gamma_j | j = \overline{1,N}\} \to W_j$$

The coordination of tasks at different levels is characterised by the degree of coherence of information exchange processes between the levels of the decision-making hierarchy.

A formal description of this principle can be provided by the following restructured representation of operators Z_j, Z_m:

$$\forall_{ji} \in \Gamma_j : Z_j(\delta_j) : R * D_j \to M_j, \ j = \overline{1,N} ; \qquad (5)$$

$$\forall l \in L : Z_m(l) : R * \{XW_j | j = \overline{1,N}\} \to \{\Gamma_j | j = \overline{1,N}\} \qquad (6)$$

Expressions (5), (6) define the dependence of operators Z_j, Z_m on the coordinating signals δ_i and L, coming from the higher level.

Higher-level coordination is ensured by the requirement that there is a common solution to the upper-level task and a set of selected lower-level tasks, which can be formally represented as the expression:

$$\left(\forall_j = \overline{1,N} \exists (\partial_j, m_j) \wedge \exists (l) : \left[P(m_j, Z_j(\partial_j)) \wedge P(\partial_j, Z_m(l)) \wedge P(l,Z) \right] \right. \qquad (7)$$

The coordination of hierarchy levels in the procedures of information exchange under the system in special programme-oriented teams should be confirmed by a system of coordinated functional goals and objectives between the levels of the hierarchy of candidate characteristics. The final portrait of the candidate (top level) is formed on the basis of the characteristics of the lower level in the class of professional, personal, psychological and other characteristics according to the relevant set of evaluation criteria. The characteristics of this level, in turn, are formed from a set of lower characteristics inherent in the assessment of the corresponding level. Thus, it can be argued that the task of the higher level is to form the candidates' grades on the basis of the grades for the characteristics of the lower levels, which are selected through a system of coordinating signals of a substantive functional nature. This procedure is ensured by the requirement of compatibility of the informational and functional content of the simultaneously used candidate assessments in the project. Thus, the task of compatibility is determined by

the same goals and criteria for assessing the characteristics of the methods of coordinating the levels of the hierarchy, etc.

To formally describe the above, we use a certain operator f_m, that converts l into signals that provide the process of selecting and deciding on the inclusion of a candidate in the project based on the testing.

$$f_m : L \to M ; \left(m_j, j = \overline{1,N} \right) = f_m(l)$$

Assuming that the inverse operators f_m^{-1}, that make it possible to determine l from m_j are known, then

$$(l) f_j^{-1} = \left(m_j, j = \overline{1,N} \right).$$

Then the principle of compatibility in the hierarchy system can be written as the following expression (8):

$$\left(\forall_j = 1, N \; \exists \left(\partial_j, m_j \right) \wedge \exists (l) : P\left(m_j, Z_j \left(\partial_j \right) \right) \wedge P(M) \Rightarrow \right.$$
$$\left. \Rightarrow \left[P\left(m_j, Z_j(\partial) \right) \wedge P\left(f_j^{-1} \left(m_j, j = \overline{1,N} \right) \right), Z \right]. \right. \tag{8}$$

Interpretation of expression (8) at the verbal level is determined by the statement that lower-level Z_j tasks can be considered adjusted relative to the global task Z if they are adjusted, first of all, relative to the task Z_m (nearer level).

In a number of practical situations, in the process of making decisions on the selection of candidates, it is not possible to ensure the coordination of assessments at different levels due to insufficient information for the required completeness of the assessment, i.e. the exchange system is not provided with the necessary coordinating signals. In this case, it is necessary to take into account the required set of coordinating signals $\overline{\Gamma}, \overline{L}$ and the required number of task characteristics $\left\{ \overline{Z_j} \right\}, j = \overline{1,N}$ and tasks $\left(\overline{Z_m} \right)$, under which (9) and (10) are coordinated. To describe the procedure for making a choice decision in conditions of insufficient coordination, we introduce the following indicators:

$$P_1 = \text{(condition (9) is satisfied)},$$
$$P_2 = \text{(condition (10) is satisfied)}.$$

Then the modifiability requirement (the ability of the hierarchy to change to ensure coherence) can be represented as the following expression:

$$\exists \left(\overline{\Gamma} \subseteq \Gamma \overline{L} \subseteq L; \left\{ \overline{Z_j} \right\} \subseteq \left\{ Z_j \right\}, j = \overline{1,N}; \left\{ \overline{Z_m} \right\} \leq \left\{ \overline{Z_m} \right\} :$$
$$\left(\forall \left(\partial_j \in \overline{\Gamma}, L \in \overline{L}; Z_j \in \left\{ \overline{Z_j} \right\}, Z_m \in \left\{ \overline{Z_m} \right\} \right) \to \left[P_1 \wedge P_2 \right] \right.$$

Thus, by fulfilling conditions (7) and (8) for the selection of appropriate subsets at the hierarchy levels, if necessary, it is possible to achieve compatibility and coordination of selection tasks during decision-making procedures for the formation of project personnel.

Conclusions

Existing research on the analysis of human resource management methods proves that selecting personnel for the project team based on professional characteristics alone does not allow for an objective assessment of the personnel's professional suitability. Currently, when forming the composition of project working groups, more and more attention is being paid to assessing the psychological qualities of candidates and selecting personnel based on professional and personal psychological characteristics. The combination of these types of qualities in candidates can create a symbiosis that will allow achieving the project's goals and objectives more effectively.

It has been established that the main criterion for including candidates in the project team is their qualifications and work experience, but it is also necessary to take into account factors related to team cohesion, the specifics of the work organisation, etc. Such a method of forming a project team can be based on multi-criteria optimisation models, which, unlike existing methods, allows taking into account not only the professional competencies of employees but also the personal and psychological characteristics of candidates in various combinations of their combinations, which contributes to the quality of the team's performance of project tasks depending on the specifics of the project requirements.

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