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**METHODOLOGICAL PROVISION OF HUMAN RESOURCES  
MANAGEMENT IN A MULTI-PROJECT ENVIRONMENT**

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**МЕТОДОЛОГИЧЕСКОЕ ОБЕСПЕЧЕНИЕ УПРАВЛЕНИЯ  
ЧЕЛОВЕЧЕСКИМИ РЕСУРСАМИ В МУЛЬТИПРОЕКТНОЙ СРЕДЕ**

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**МЕТОДОЛОГІЧНЕ ЗАБЕЗПЕЧЕННЯ УПРАВЛІННЯ ЛЮДСЬКИМИ  
РЕСУРСАМИ У МУЛЬТИПРОЕКТНОМУ СЕРЕДОВИЩІ**

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*The object of research is the processes of human resource management of projects in a multi-project environment. The studies are based on the use of a combinatorial-logical approach to the construction of formal models for the formation and functioning of project teams in a multi-project environment, a stakeholder-oriented approach to the formation of resource requirements, and a donor-acceptor approach to the distribution of resources between projects. The main hypothesis of research is the assumption that the effectiveness of project management depends on the effectiveness of human resource management of projects and programs. This can't be achieved without taking into account the existing resource constraints and requirements that are determined by key project stakeholders. The issues of creating a methodological support for human resources management of forming adaptive teams in a multi-project environment are considered. The interrelation of the proposed methodology of project-oriented resource management for the formation of adaptive teams in a multi-project environment with modern approaches to human resource management is shown. A conceptual model of project-oriented resource management of the formation of adaptive teams in a multi-project environment is developed. A method of forming resource requirements is proposed, based on an analysis of stakeholder interest in human resource management processes, taking into account the loyalty of interested parties. The features of the process of forming requirements for the project team are considered. To reduce the complexity of the task of forming an adaptive team, it is proposed to carry out a number of checks. It is necessary to ensure the consistency of the requirements of the stakeholders, the compliance of the level of competencies of applicants with the required, the initial verification of reserve factors, the check for the presence of prohibited combinations and the initial analysis of the matrix of applicants. An example of the formation of a team with given restrictions is considered. Restrictions are the level of competence and cost.*

*The application of the proposed approach allows to build a project team with given functional requirements, possessing the maximum level of competence at the minimum cost of the team. The increase in the efficiency of the project team formation process is shown due to the complex application of the developed methodological support for human resource management of projects in a multi-project environment.*

**Keywords:** *project management, multi-project environment, project team, project stakeholders.*

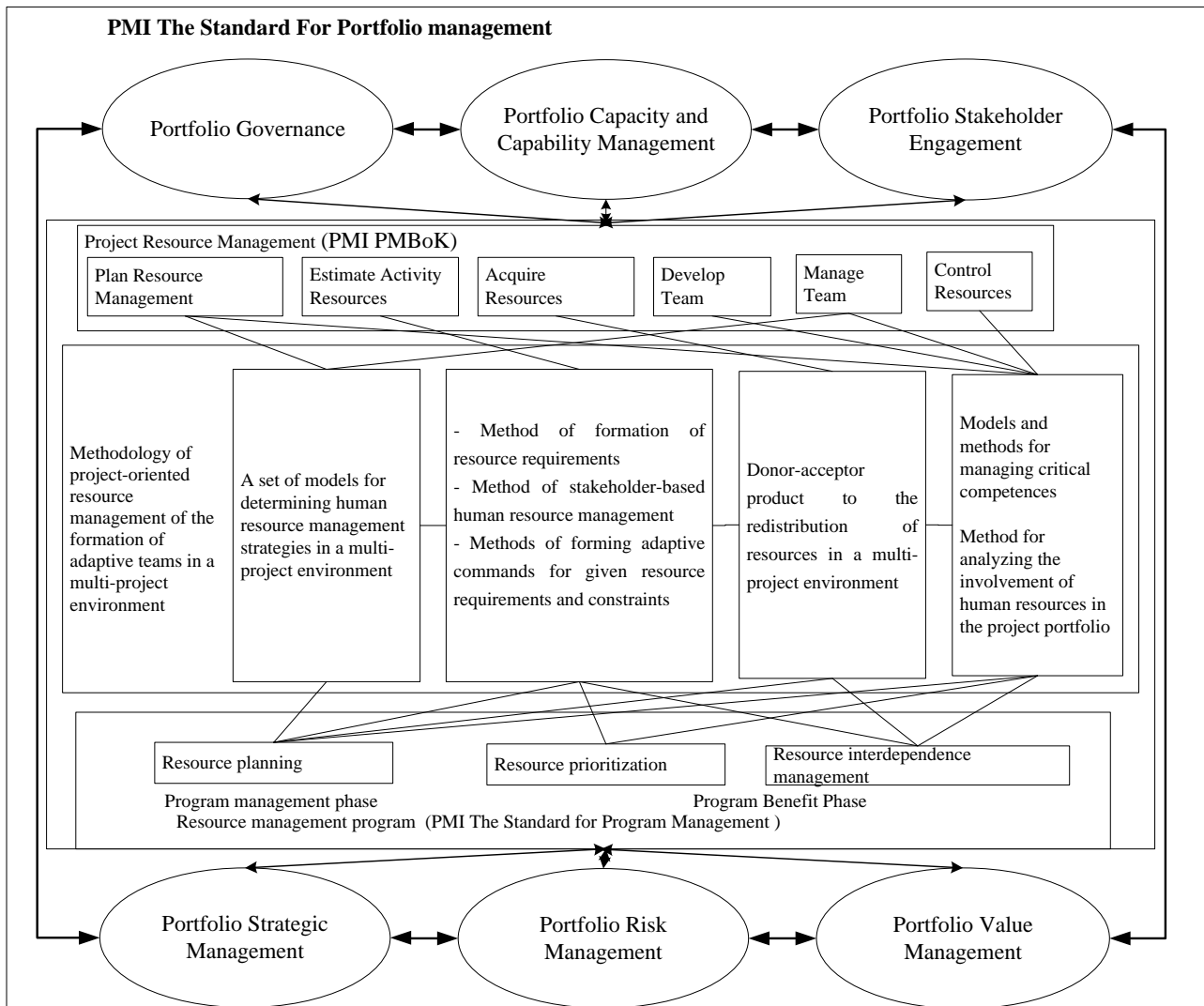
## **1. Introduction**

The implementation of multi-project management as an element of ensuring the viability of a company places additional demands on the human resource management of projects in a multi-project environment [1]. Forming consistent resource requirements of the stakeholders is crucial for ensuring effective project management in a multi-project environment. The proposed methods are based on the competence approach [2], game-theoretic models of the formation and functioning of teams [3, 4]. Thus, the development of methodological support for human resource management in a multi-project environment is an urgent task. The object of research is the processes of human resource management of projects in a multi-project environment. The aim of research is creation of a methodological support for human resource management in a multi-project environment.

## **2. Methods of research**

The conducted studies are based on the application of the approaches described in [5–7]. The main hypothesis of the study is the assumption that the effectiveness of project management depends on the effectiveness of human resource management of projects and programs. This is impossible to achieve without taking into account the existing resource constraints and requirements that are determined by the project stakeholders. Based on the analysis of PMI standards [8–10], taking into account the methodology of project-oriented resource management of the formation of adaptive teams in a multi-project environment [7], a conceptual model is proposed (Fig. 1). When forming adaptive project teams, it is proposed to use the method based on formal transformations [6].

A method of forming resource requirements is proposed, based on an analysis of stakeholder interest in human resource management processes, taking into account the loyalty of interested parties.



**Fig. 1.** The conceptual model of project-oriented resource management of the formation of adaptive teams in a multi-project environment

Method of formation of resource requirements:

*Stage 1.* Checking the consistency of stakeholder requirements (agreeing on a resource allocation strategy; coordinating the competence threshold; agreeing on resource requirements for project operations; agreeing on priorities for resource allocation between projects).

*Stage 2.* Primary check of the feasibility of the requirements [5].

*Stage 3.* Formation of generalized resource requirements [6].

*Stage 4.* Correction of the source data (performed if necessary).

*Stage 5.* Monitoring changes in team requirements.

Formed requirements for a project team are the initial data for building project teams [5, 6].

### 3. Research results and discussion

Initial data: the set of applicants  $Q = \{q_1, q_2, \dots, q_{14}\}$ , the set of functions  $A = \{a_1, a_2, \dots, a_6\}$ , the matrix of characteristics  $C_1$  (level of competence),  $C_2$  (cost) (Table 1). Determine the composition of the team with the maximum level of competence and

minimum cost (priority – the level of competence) with the prohibition of combinations.

**Table 1**

Initial data

Q/A	Characteristics C <sub>1</sub>						Characteristics C <sub>2</sub>					
	a <sub>1</sub>	a <sub>2</sub>	a <sub>3</sub>	a <sub>4</sub>	a <sub>5</sub>	a <sub>6</sub>	a <sub>1</sub>	a <sub>2</sub>	a <sub>3</sub>	a <sub>4</sub>	a <sub>5</sub>	a <sub>6</sub>
q <sub>1</sub>	0	200	0	220	0	240	0	700	0	950	0	900
q <sub>2</sub>	300	0	0	270	0	0	700	0	0	500	0	0
q <sub>3</sub>	250	0	300	0	0	275	800	0	600	0	0	67
q <sub>4</sub>	0	140	0	200	0	0	0	700	0	850	0	0
q <sub>5</sub>	0	0	350	0	180	230	0	0	800	0	950	800
q <sub>6</sub>	310	0	310	0	0	200	700	0	1000	0	0	900
q <sub>7</sub>	350	150	0	0	0	0	890	790	0	0	0	0
q <sub>8</sub>	300	0	320	0	200	0	800	0	600	0	750	0
q <sub>9</sub>	0	170	0	200	0	260	0	400	0	300	0	900
q <sub>10</sub>	0	0	290	0	190	0	0	0	500	0	800	0
q <sub>11</sub>	0	0	280	245	180	0	0	0	800	700	900	0
q <sub>12</sub>	290	0	0	0	200	0	800	0	0	0	1000	0
q <sub>13</sub>	0	190	0	260	0	0	0	900	0	800	0	0
q <sub>14</sub>	0	0	0	290	210	0	0	0	0	900	750	0

Decision.

Stage 1. Define logical functions that describe the performers who are able to perform the corresponding functions:

$$\begin{aligned}
 A(Q,1) &= (q_2^1 \vee q_3^1 \vee q_6^1 \vee q_7^1 \vee q_8^1 \vee q_{12}^1); & A(Q,2) &= (q_1^2 \vee q_4^2 \vee q_7^2 \vee q_9^2 \vee q_{13}^2); \\
 A(Q,3) &= (q_3^3 \vee q_5^3 \vee q_6^3 \vee q_8^3 \vee q_{10}^3 \vee q_{11}^3); & A(Q,4) &= (q_1^4 \vee q_2^4 \vee q_4^4 \vee q_9^4 \vee q_{11}^4 \vee q_{13}^4 \vee q_{14}^4); \\
 A(Q,4) &= (q_5^5 \vee q_8^5 \vee q_{10}^5 \vee q_{11}^5 \vee q_{12}^5 \vee q_{14}^5); & A(Q,5) &= (q_1^6 \vee q_3^6 \vee q_5^6 \vee q_6^6 \vee q_9^6).
 \end{aligned}$$

Stage 2. Compose a generalized logical function  $F$  [6].

Stage 3. The generalized logical function is reduced to a non-collision form. After transformations, the function has the form:

$$\begin{aligned}
 F &= q_1^2 q_2^1 q_3^3 q_4^4 q_5^5 q_6^6 \vee q_1^2 q_2^1 q_3^3 q_4^4 q_5^5 q_9^6 \vee q_1^2 q_2^1 q_3^3 q_4^4 q_5^5 q_8^6 \vee q_1^2 q_2^1 q_5^3 q_6^6 q_8^5 q_{13}^4 \vee \\
 &\vee q_1^6 q_2^1 q_4^2 q_5^3 q_6^4 q_{13}^5 \vee q_2^1 q_3^2 q_4^3 q_5^4 q_6^5 q_{13}^6 \vee q_2^1 q_4^2 q_5^3 q_6^4 q_9^5 q_{13}^6 \vee q_2^1 q_4^2 q_6^3 q_8^4 q_9^5 q_{12}^6 \vee \\
 &\vee q_1^6 q_2^1 q_4^2 q_8^3 q_9^4 q_{14}^5 \vee q_2^1 q_3^2 q_4^3 q_8^4 q_9^5 \vee \dots \vee q_5^6 q_{10}^5 q_{11}^3 q_{12}^1 q_{13}^2 q_{14}^4 \vee \\
 &\vee q_6^6 q_{10}^5 q_{11}^3 q_{12}^1 q_{13}^2 q_{14}^4 \vee q_9^6 q_{10}^5 q_{11}^3 q_{12}^1 q_{13}^2 q_{14}^4.
 \end{aligned}$$

The obtained result reflects the possible variants for building a team and the distribution of functions between performers.

*Stage 4.* For given matrices of characteristics  $C$ , determine the total characteristic of the implementation of functions by the command  $C_1^{com}$  and  $C_2^{com}$ . Table 2 shows the characteristics of variants and the distribution of functions in variants.

**Table 2**

Variants of building project teams

Variant	Performers														$C_1^{com}$	$C_2^{com}$
	$q_1$	$q_2$	$q_3$	$q_4$	$q_5$	$q_6$	$q_7$	$q_8$	$q_9$	$q_{10}$	$q_{11}$	$q_{12}$	$q_{13}$	$q_{14}$		
1	2	1	3	4	5	6	0	0	0	0	0	0	0	0	1380	4700
2	2	1	3	4	0	6	0	0	0	0	5	0	0	0	1380	4650
3	2	1	3	0	0	6	0	0	4	0	5	0	0	0	1380	4100
4	2	1	0	4	5	6	0	0	0	3	0	0	0	0	1370	4600
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
24	0	0	1	2	5	6	0	0	4	0	3	0	0	0	1250	4450

Team building variants 1–3 have a maximum level of competence – 1380. The third variant has the minimum cost:  $q_1, q_2, q_3, q_6, q_9, q_{11}$ . The application of the proposed approach allows reducing the cost of the project team by 13 % while ensuring the specified restrictions.

#### 4. Conclusions

The issues of creating a methodological support for human resources management of forming adaptive teams in a multi-project environment are considered. A conceptual model of project-oriented resource management of the formation of adaptive teams in a multi-project environment is developed. Its peculiarity is the establishment of the relationship between the processes of project-oriented resource management of the formation of adaptive teams in a multi-project environment with the resource management processes of projects, programs and project portfolios. A method for the formation of resource requirements is proposed. Its essence lies in the fact that based on the analysis of the requirements of stakeholders, the generalized agreed resource requirements for projects in a multi-project environment are formed. By analyzing the interest of stakeholders in human resource management processes and taking into account the loyalty of stakeholders, it is possible to formulate agreed resource requirements for the task of forming an adaptive project team. An example of the formation of a team with given restrictions is considered. The application of the proposed approach will improve the efficiency of project management in a multi-project environment by forming teams that meet certain requirements.

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