Project-oriented management of adaptive teams' formation resources in multi-project environment

Nataliia Dotsenko[1[0000-0003-3570-5900]], Dmytro Chumachenko[1[0000-0003-2623-3294]] and Igor Chumachenko[2[0000-0003-2312-2011]]

[1] National Aerospace University "Kharkiv Aviation Institute", Chkalow str., 17, Kharkiv, Ukraine
nvdotsenko@gmail.com
dichumachenko@gmail.com

[2] O. M. Beketov National University of Urban Economy in Kharkiv, Marshal Bazhanov str., 17, Kharkiv, Ukraine
ivchumachenko@gmail.com

Abstract. The subject of the research is the processes of project-oriented resource management of the formation of adaptive teams in a multi-project environment. The aim of the work is to create models and methods of project-oriented resource management of the formation of adaptive commands in a multi-project environment. A model of project-oriented resource management in a multi-project environment has been developed. A set of methods for determining human resource management strategies in a multi-project environment is proposed. It is proposed to use a stratified representation of resource management processes in a multi-project environment, which will allow an analysis of human resource management processes. A method for stakeholder-based human resource management of projects in a multi-project environment has been developed. A model of the process of constructing a functional-backup team has been developed.

Keywords. project management; multi-project environment; project portfolio; project team; project-oriented management; stakeholders; reservation.

1 Statement of the Problem (Introduction)

Resource management in a multi-project environment is a complex multi-criteria task that requires managers to apply modern management approaches. The growth in the number of projects implemented by the company, fierce competition for resources, the need to ensure the flexibility of project teams, the increasing interconnection of projects, additional constraints imposed by stakeholders, lead to the need to develop effective methods for managing resources in a multi-project environment.

2 Analysis of recent research and publications

By a multi-project environment (MPE), we mean a set of projects that are not necessarily functionally related, but use the same resources from the company's general pool of resources. Multi-project management is a short-term tactical management of many projects that share the same resources [1].

In papers [1-3] an analysis of approaches to human resource management in a multi-project environment is presented. The criteria for the classification of approaches were the degree of centralization, the degree of focus on human resources, optimization algorithms. The main approaches are:

- Heuristic OR;
- Buffer management approaches like critical chain;
- Agile by using scrum of scrums;
- Multi-agent auction based;
- Resource sharing policies with dedicated and core teams and shared resource pools;
- Systems management.

As a result of the analysis, it was determined that, in most cases, approaches to human resource management in a multiproject environment are based on automated centralized decision making. The use of Agile Scrum, Scrum-of-Scrums flexible methodologies will ensure decentralization and self-regulation, which is especially important when managing projects in IT companies.

The use of flexible project management methodologies has led to the need to solve a number of tasks caused by the self-organization of teams [4-5]:

- changing resource requirements;
- engaging senior management in project-level sponsorship;
- achieving cross-functionality and effective team-level evaluations;
- the statement of independence and independent assignment of resources at the individual level;
- lack of eligibility criteria and dependencies at the task level.

Resource management in a multi-project environment includes planning, distributing, balancing and coordinating resources in individual projects, as well as resolving resource conflicts between different projects in order to achieve an optimal allocation of resources between projects in a multi-project environment.

The use of Critical Chain Method (CCM) for multi-project resource management is based on the assumption that resource constraints between different projects mainly occur in the critical paths of projects that form a multi-project environment. The redistribution of resources in this approach occurs in accordance with the priority of each project. To prevent delays in performing work that lies on a critical path, it is proposed to use a resource buffer [6].

Within the framework of promoting sustainable use of resources in business organizations (Green human resource management) and ensuring environmental sus-

tainability, additional requirements are put forward for project teams: high level of technical and managerial skills among collaborators, environmental values, environmental interests of stakeholders. Accounting for these restrictions in the formation of teams (Green selection) will provide further induction and improve the efficiency of the organization [7-8].

When forming Agile teams, it is necessary to take into account factors [5]:

- competences (availability and level);
- team climate;
- team variety;
- team innovation;
- characteristics of team members: technical and personal competencies of team members;
- presence of corporate culture;
- values;
- group leader behavior;
- top management support: project management commitment;
- emotional intelligence;
- communication skills.

Additional requirements for the project team can be formed when identifying risks [9]. Risk identification will allow to take into account the need to ensure the reliability of the project team's operation by introducing redundancy into teams and forming functionally-reserved teams.

According to the Standard for Portfolio Management, PMI, human resource management is responsible for maintaining the right balance of staff and competencies based on strategic plan drivers and market pressures [10].

The use of competence-based approach in the formation of the project team [11-15] allows to provide the required level of competence in the teams formed.

The adaptability of the team leads to the ability to respond to changes in the list of currently available business requirements and technical requirements for the project and its product [11].

Since the stakeholder-oriented approach in determining the success of a project (maximally satisfying the expectations of stakeholders) is typical for managing a portfolio of projects, human resource management in a multi-project environment implies finding a balance of interests of the stakeholders in human resource management processes and a compromise that ensures the achievement of the company's strategic goals [16].

In order to automate the decision-making process when choosing a project team, a number of authors propose to use the decision support system for choosing a project team [17].

3 Isolation of previously unresolved parts of a common problem. Objective

The application of the considered methods allows to form project teams, but does not take into account the need to apply an integrated approach in the management of human resources in a multi-project environment. Actual scientific problem is the development of theoretical foundations and tools of human resource management software in the formation, development and management teams of the projects and programs.

The purpose of this article is to create models and methods of project-oriented resource management of the formation of adaptive teams in a multi-project environment.

The article solves the following tasks:

- creation of a model of project-oriented resource management in a multi-project environment;
- development of methods for determining human resource management strategies in a multi-project environment;
- development of a method for stakeholder-based human resource management of projects in a multi-project environment;
- development of a model for the construction of a functional-redundant adaptive team.

In the study, system analysis was used to formalize the processes of formation and functioning of project teams, the apparatus of optimization theory for formulating and solving the tasks of forming teams of projects in a multi-project environment under given constraints, Boolean algebra and set theory to solve problems of forming teams and redistributing resources.

4 The main research material

The task of providing resources to projects in a multi-project environment can be represented as follows:

- defining a strategy for managing human resources in a multi-project environment;
- formation of requirements for resources;
- formation of adaptive project teams with given resource requirements and constraints;
- monitoring of resource requirements;
- redistribution of resources;
- management of critical competencies;
- analysis of the involvement of resources in the project portfolio.

4.1 Model of project-oriented resource management in a multi-project environment

A model of project-oriented resource management in a multi-project environment (Fig. 1) has been developed, reflecting the relationship of the proposed methodology with project resource management processes (PMI PMBoK), program resource management (PMI The Standard for Program Management), project portfolio resource management (PMI The Standard For Portfolio management) [10, 18-19].

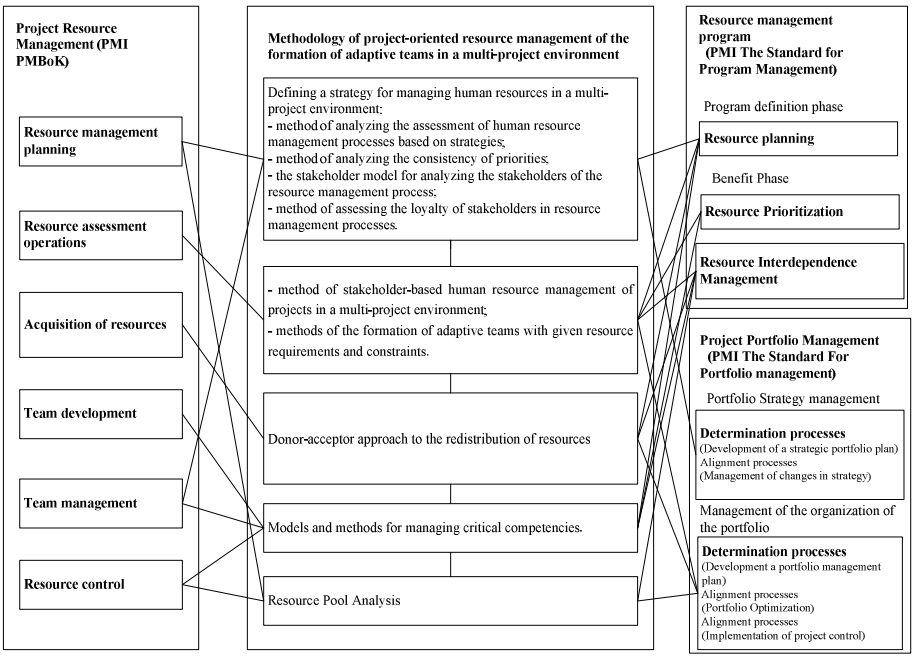

Fig. 1. Model of project-oriented resource management in a multi-project environment

4.2 Defining a strategy for managing human resources in a multi-project environment

Strategic human resource management in a project-oriented organization is aimed at achieving a strategic alignment of the organization's intentions and plans concerning the strategy, policy and practice of human resource management of projects (hiring, searching and selecting employees, building project teams, managing resources in a project portfolio, training and development, motivation) [20].

Depending on the company implementing the portfolio of projects, leadership style, human resource management strategies can be distinguished [21]:

- resource oriented management;
- high performance management;
- management focused on a high level of commitment;

- participatory management.

Since human resource management in a multi-project environment is associated with the influence of certain project stakeholders, the project portfolio, the project organization as a whole, the definition of a coherent human resource management strategy is an important task affecting the efficiency of project implementation and ensuring the viability of the company.

When determining the strategy of human resource management in a multi-project environment, it is proposed to apply a set of methods:

- a method for analyzing the assessment of human resource management processes in the basis of strategies, a method for adapting the strategy of a project-oriented organization to exogenous changes [22];
- a method for analyzing the consistency of priorities [23];
- a method for assessing the loyalty of stakeholders in resource management processes [24].

The use of the stakeholder model for analyzing the stakeholders of the human resource management process [25] allows identifying stakeholders, determining their interest in managing human resources, and evaluating their loyalty.

Each project process that is executed in a multi-project environment is characterized by:

- belonging to the project ($Pr = \{Pr_1, \ldots, Pr_n\}$, n is number of projects implemented in a multi-project environment);
- indicator value of resource management processes in a project $LS_{i,j}$ (showing the level of the j-th process in the i-th project);
- criticality $K_{i,j}$ (the number of critical factors influenced by the jth process in the i-th project).

According to the PMI PMBoK standard, multiple resource management processes for the i-th project can be represented as follows:

$$P_i=\{P_{i,1}, P_{i,2}, P_{i,3}, P_{i,4}, P_{i,5}, P_{i,6}\}, \quad (1)$$

where $P_{i,1}$ – resource management planning;

$P_{i,2}$ – resource assessment operations;

$P_{i,3}$ – resource acquisition;

$P_{i,4}$ – team development;

$P_{i,5}$ – team management;

$P_{i,6}$ – resource control.

When constructing a stratified representation of resource management processes in a multi-project environment, it is proposed to use a three-dimensional coordinate system (system cube) that reflects the achievement of a specific resource management strategy in projects running in a multi-project environment (Fig. 2).

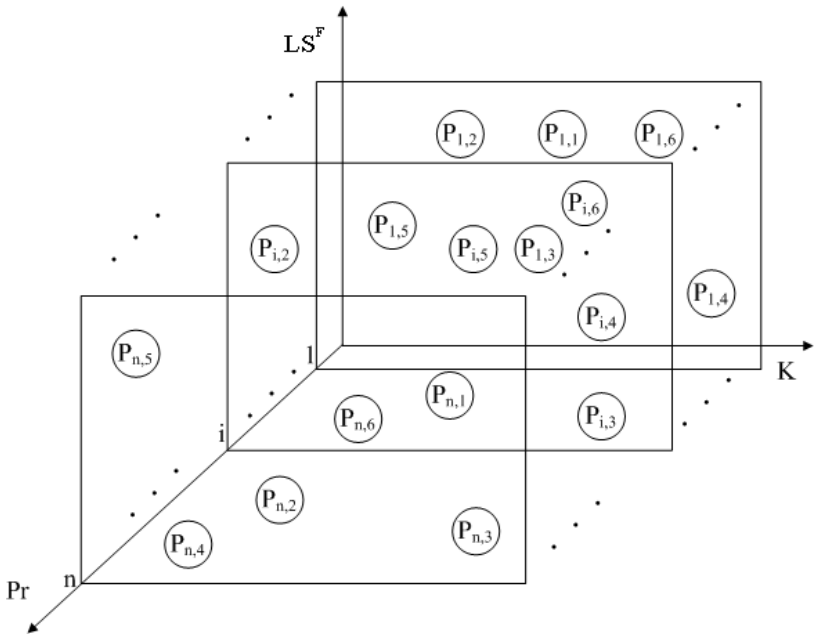

Fig. 2. A stratified representation of resource management processes in a multi-project environment

An analysis of the projections of the stratified representation of human resource management processes in a multi-project environment allows us to determine the direction of development of the processes, as well as identify the processes that need improvement (Table 1).

Table 1. The results of the analysis of the projections of human resource management processes in a multi-project environment

Projection	Description
Portfolio project process $Pr_{i,j}$ – level of resource management processes in a project $LS_{i,j}$	Allows you to analyze the level of indicators of the processes of human resources management projects in the portfolio
Level of resource management processes in a project $LS_{i,j}$ – criticality $K_{i,j}$	Allows you to assess the processes of human resource management in the bases of the level of indicators and criticality of processes
Portfolio project process $Pr_{i,j}$ – criticality $K_{i,j}$	Allows you to assess the process of human resource management in terms of their impact on critical success factors

Based on the result of the analysis of projections, a change vector is formed, which can be used in the reengineering of human resource management processes.

4.3 Method of stakeholder-based human resource management of projects in a multi-project environment

Accounting for the relationship of resource management processes with the processes of management of stakeholders in project management in a multi-project environment can improve management efficiency by reducing the risks associated with the human factor [24-25].

Stakeholders of resource management processes in a multi-project environment can be company executives, human resources director (ensures availability and availability of qualified human resources for managing a portfolio and its components), individual project managers, investors, customers, etc.

When managing a project portfolio, the stakeholders are [15]:

- supreme management body of the company, making strategic decisions on the development of the company's portfolio;
- portfolio management team;
- director of the portfolio;
- portfolio board;
- managers of programs;
- project managers;
- program / project office;
- program / project teams;
- customers;
- suppliers and partners.

The director of the portfolio, along with the analysis of financial indicators, performs an analysis of the availability of resources necessary for the implementation of the portfolio components.

The proposed method of stakeholder-based human resource management projects in a multi-project environment.

The main stages of the method:

Stage 1. Identification of stakeholders in the human resource management process:

- identification of stakeholders for each project;
- determining the projection of stakeholder interest on project management processes;
- identifying the stakeholders of the project's human resource management process and determining their interest;
- determining loyalty of interested parties;
- formation of stakeholders' expectations from the process of human resource management.

Stage 2. Formation of generalized requirements for project resources in a multi-project environment:

- formation of requirements for project resources;
- consistency check;
- formation of requirements for project portfolio resources;
- defining critical competencies;
- formation of a pool of critical competencies;
- checking resource availability.

Stage 3. Formation of adaptive commands:

- formation of adaptive teams with given resource requirements and constraints (reservation, prohibition on combination, prohibition on participation in projects, preferences of stakeholders, cost, etc.);
- consideration of adaptation;
- optimization by specified criteria;
- selection of command options.

Stage 4. Team activity analysis:

- changes analysis;
- requirements update;
- team adaptation.

Stage 5. Correction:

- resource pool correction;
- correction of the pool of critical competencies;
- correction of the register of stakeholders.

Stage 6. Stakeholder satisfaction analysis.

Depending on the chosen strategy of human resource management, there is a choice of criteria by which candidates are selected and a project team is formed.

To minimize the impact of resource constraints, it is proposed to use redundancy (as an alternative to the resource buffer). The formation of adaptive project teams with functional redundancy was considered in [11]. Under the functional reservation understand the ability of several performers to perform a specific function. The redundancy factors determine the minimum required number of performers capable of performing this function to ensure the implementation of the project.

The use of functional redundancy in the project will lead to the fact that a specific executor will be assigned to perform a specific function. The reserve for this function will be allocated to the execution of other functions, so that, if necessary, it can be reassigned to the performance of the function. Depending on the existing restrictions allocate "cold" and "hot" backup. In case of "cold reservation", the reserve is entered only if necessary and some time should be taken into account for the redistribution of the project team. The use of a "hot reserve" minimizes the time to put in a reserve, but

it leads to an increase in the staff of the project, an increase in the budget of the project.

The model of the process of building a functional-redundant team is shown in Fig. 3

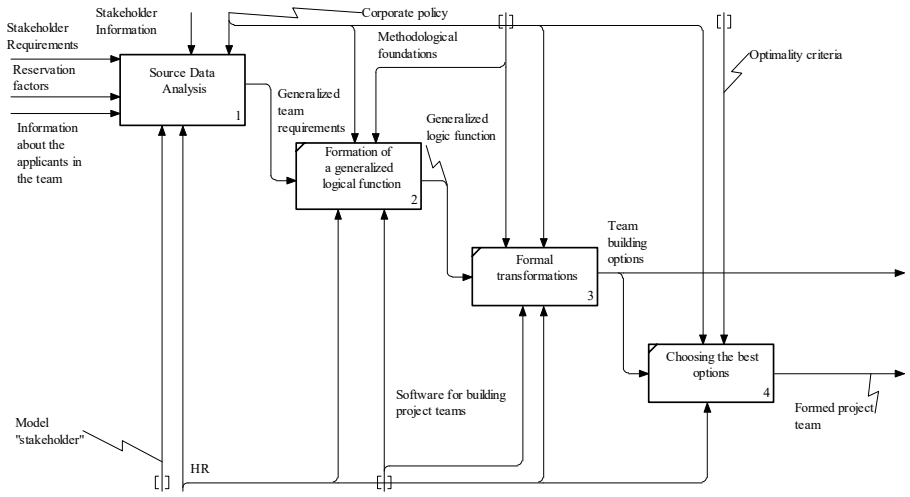

Fig. 3. Model of the process of building a functional redundant adaptive team

Resolving the task of redistributing resources is based on the use of the donor-acceptor approach. Donor-acceptor resource interaction in a multi-project environment is due to the presence of a single pool of organization resources, within which there is a redistribution of resources between the work of donor projects and acceptor projects [27].

5 Conclusions and prospects for further development

The article discusses and analyzes the features of human resource management in a multi-project environment.

A model of project-oriented resource management in a multi-project environment has been developed. A set of methods for determining human resource management strategies in a multi-project environment is proposed. It is proposed to use a stratified representation of resource management processes in a multi-project environment, which will allow an analysis of human resource management processes. Developed a method of stakeholder-based human resource management projects in a multi-project environment. A model of the process of constructing a functional-backup team has been developed.

The proposed models and methods of project-oriented resource management of the formation of adaptive teams in a multi-project environment will improve the efficiency of using human resources in the formation of multi-project teams and programs.

A promising direction is the development of a software package based on the proposed methods, which will automate the formation of adaptive commands and reduce the influence of the subjective factor on human resource management processes.

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