

Development of portfolio management system in R&D: a case study

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Abstract-The relevance of the study is to consider the specific features of innovation management from the point of view of the project approach. The theoretical and methodological basis of the study was the works of Russian and foreign researchers in the field of management theory, project management, portfolio management, innovation management, project governance. The authors used analysis and generalization of domestic and foreign theory and practice, as well as the method of "Case study", in the framework of the case: strategic portfolio analysis (BCG matrix), interviewing, questioning, investment analysis as research methods. Analysis of existing approaches to the formation of a portfolio management system of R&D projects showed a low level of elaboration of the issue. The article presents the results of testing the project of development of the portfolio management system of projects and programs in the field of research and development work, taking into account the identified features on the example of a high-tech enterprise.

The expediency of implementation of project management methodology and formation of R&D project portfolio management system as a tool to improve the efficiency of investment activities, the implementation of strategic goals and improvement of the competitiveness of the modern company are confirmed.

Keywords: *project management system, R&D, innovation projects portfolio.*

I. INTRODUCTION

The need for transition to a new concept of technological development, which is increasingly declared by developed countries, due to the development of technologies of the fourth industrial revolution or Industry 4.0, exacerbates the issues of innovative development of Russian enterprises of traditional industries.

Innovative development is becoming an important factor in maintaining the competitiveness of individual enterprises and industries at the global level. Under these conditions, effective implementation of high-tech projects is a key task of the management.

In many companies, innovation takes the form of project rather than process activities. For such organizations, it becomes necessary to create a corporate project management system necessary to ensure an integrated approach to project implementation, timely management decision-making, streamline project management processes and reduce risks arising in the course of their implementation.

Since the corporate project management system requires "fine-tuning", taking into account the peculiarities of a particular company, it seems appropriate to consider such experience, on the basis of which universal recommendations can be identified.

II. COMPOSITION OF ANALYSIS PROCESS

This study consists of two stages: on the first one, based on the review of the literature, the features of the portfolio management system of R&D projects were identified.

Since the formation of such a system is a complex task, the review of studies prior to this one includes several aspects: a description of the features of project management in innovation; a review of the components of the project management system; a review of project governance studies to answer the question about the role of senior management in the formation of the R&D project portfolio.

The features of the formation of the project management system in the field of R & D are illustrated in the elements of the case.

III. LITERATURE SURVEY

3.1. Management objects in the management system of R&D projects

The main characteristics of an innovative project, determining the features of its management, include complexity, novelty of the product, knowledge and resource intensity [1].

Innovative projects are often implemented within the framework of separate divisions of the company with limited resources, which suggests that the main object of the management system will be a portfolio consisting of R&D projects and their combinations aimed at achieving a common

goal (programs), which actualizes the issues of the management of the portfolio of projects and programs in the context of innovation.

Among the advantages of the portfolio approach to innovation management are the following [2]:

- identification of strengths and weaknesses of each project;
- ability to prioritize the allocation of capital investments and resources;
- identification of the dynamics of implementation of projects;
- systematic analysis of ongoing components and portfolio review.

The main interest of researchers is directed to the process of forming a portfolio of innovative projects, which could be called optimal by various criteria [3, 4]. Among the criteria in various models, as a rule, the compliance of the strategy evaluated with the help of BSC [5], as well as the indicators of conversion of the projects' performance into certain values are singled out [4].

3.2. Project activity management system

Conceptually, the project management system is a set of interrelated methodological, technical, organizational, informational and other solutions that allow under the condition of competent formation to manage projects, programs and project portfolio effectively [6, 7].

However, there are different perspectives on the composition of the organization's project management system components. So, according to Polkovnikov A. V. Dubovik M. F. there are three main components: legal and regulatory and methodological support; technical and information support; organizational and staffing [7, p. 452]. Bogdanov V. V. identifies the following components: the concept of "project" and "project management"; project management methodology and project portfolio; project management office; automated system of project management and the system of motivation of the project team [8, p. 15].

In accordance with the national Russian standard adopted in 2018 [9], the project management system includes three main components, four supporting components, which are reflected in the regulatory and methodological support (figure 1).

Methodological support of project activities, including regulatory and methodological, is a formal description of the project management system.

Evaluation of the effectiveness of the project management system is usually carried out on the basis of criteria for the successful implementation of projects [10, 11].

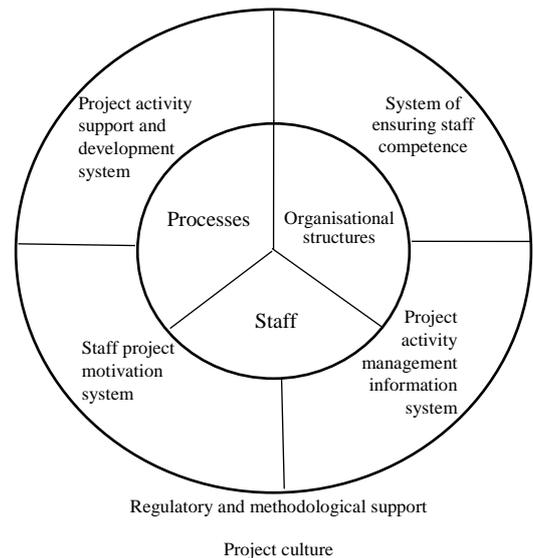


Fig. 1. Model of project activity management system [9, p.5]

Studies of the effectiveness of the project management methodology (PMM) in relation to the effectiveness of projects show that the use of only individual and standardized models in the formation of the project management system does not have such a positive effect as the adaptation of standardized models for a specific organization [12, 13].

1.1. Project governance

In recent years, researchers have significantly increased their interest in project governance and its impact on the success of individual projects [14-16]. The interest is due to the fact that, despite significant efforts at the level of professional and scientific community to develop the methodology, large-scale studies show that most of the projects do not achieve their goals [17, 18] and do not meet the organizational strategy [19].

In this regard, the role of the top management of the company, which forms the project governance system, in the formation of the project management system, is of great interest.

At the same time, there is a great variety in the understanding and definition of the term "project governance" [20].

As an example, we can give the definition, describing project governance from the conceptual side as "the framework within which project decisions are made" [21, p. 10], as the action "the use of systems, structures of authority, and processes to allocate resources and coordinate or control activity in a project" [22, p.383] or system – the value system, responses, processes and policies that allow projects to achieve organizational objects and foster implementation that is in the best interest of all stakeholders, internal and external, and the corporation itself" [23, p. 23]. 4].

Previously mentioned Russian national standard defines the main activities of project governance as follows: "strategic management of the project activities on a long-term and medium-term periods, as well as the establishment of a system of management of the project activities and determining directions of its development" [9].

Summarizing the different definitions of project governance, we can conclude that this system provides the rules of operation and targets of the project management system.

Studies confirm the positive impact of project governance on the success of the project, by building a methodology of project management [24].

In the project portfolio management system, the company's top management assumes the additional role of the portfolio Committee, which forms and reviews the project portfolio.

IV. ANALYSIS

4.1 Description of organization – the research object

The object of research in this work is the enterprise of machine-building industry, producing high-tech equipment. The company is a part of the holding, so the best management practices can be centrally replicated.

Production of the enterprise is presented in several markets-construction, power, geology. The company is the owner of a number of unique technical solutions protected by patents, it has its own Engineering center, whose specialists carry out work on the development, modernization and improvement of high-tech equipment.

The company's project portfolio includes 15 large and medium-sized R&D projects for the development of new equipment and improvement of products.

All projects of the enterprise are managed by the chief engineer of the enterprise alone.

The composition of the project teams to combine with operational activities include both employees of the Engineering center and employees of other departments of the organization.

4.2. Prerequisites for the development of R&D projects management system

The management of the organization was concerned about the low efficiency of investment activities and the lack of effectiveness of innovative projects in the company's portfolio. Some of the ongoing projects do not produce results by the time the diagnosis starts. In 2016, the organization lost about 17% of investments in the implementation of inefficient projects. Of the 15 R&D projects at the time of the study, 8 had no real application and did not provide for the expansion (replacement) of the product line.

4.3. Road map of project activity management system formation

The sequence of stages of development of the project activity management system is presented in table 1.

TABLE I. ROAD MAP OF PROJECT ACTIVITY MANAGEMENT SYSTEM FORMATION

Stage	The characteristic of stage	Duration
Step 1 - Diagnosis of the existing	1.1 Analysis of the company's product portfolio and setting strategic development priorities	0,5 month

management system of project activities	1.2 Interviewing key participants in the project activity	1 month
	1.3 Analysis of existing projects in the company's portfolio	1 month
	1.4 Analysis of existing elements of project management system: terminology, processes, roles and information systems	2 months
	1.5 Analysis of personnel potential of the company	2 months
Step 2 - System requirements identification	2.1 Identification of requirements to the main elements of the project management system at the level of top management of the company	2 months
	2.2 Formulation of performance indicators of the project management system	0,5 month
	2.3 Determination of the target type of projects, which will be primarily focused on by the system of project activities.	
Stage 3- Formation of the main stages of the project activity management system	3.1 Definition of the list and characteristics of elements of the project management system	0,5 month
	3.2 Description. methodological support of key processes of project portfolio management.	1 month
	3.3 Formation and ensuring of functioning of organizational structures: project management office, role structure of project activities, portfolio Committee at the level of top management.	2 months
	3.4 Formation of requirements for personnel competencies in the project management system.	0,5 month
	3.5 Organization and implementation of training aimed at improving the competence of project management.	0,5 month

Source: compiled by the authors

The total duration of the improvement project was 9 months.

The first stage was aimed at identifying problems, weaknesses and growth points of portfolio management systems. Taking into account the imposition of stages, the total duration of the stage is 3 months.

Since the success of the R&D portfolio management system directly depends on the actions of the management, the composition of the actions of the second stage was defined. The elements of project governance were formed in this stage. Its total duration was 2 months. At the third stage, elements of the system were developed and implemented, the duration of the stage was 4 months.

The key results of each phase will be described below.

Stage 1. The product portfolio balance analysis was conducted on the basis of BCG matrix. As a result, it was found that 50% of the products are "cash cows", providing profitability and stability of the business. Next in terms of volume in the portfolio are the components that can be classified as "dogs" - 35%. Despite the duality of the classic options for working with this group of products - namely, leaving the market or repositioning, in this case, the only option is the removal from production, as the equipment that

falls into this category is obsolete and is used exclusively in the third world. The remaining 15% of the portfolio is "difficult children" (10%) and "stars" (5%). It can be said that the organization will soon face difficulties in developing and maintaining new and existing markets. The low share of these groups in the portfolio indicates the need to implement projects to develop new products [25].

At the time of the analysis, the work on the projects was carried out within the framework of operational activities strictly within the framework of the duties of engineering and technical workers, there was no understanding of the boundaries and main parameters of the project, project management processes were not allocated.

Below is a list of the most common problems in the field of R&D identified in the study:

- In most of the projects (60%) that are initiated and implemented in the Engineering center, the executors do not have a clear understanding of the project goals and products;
- Only 10% of participants understand the ways to achieve the goals (due to what work the goals will be achieved, in what time frame, what resources will be required);
- Team interaction is not organized, communication problems within project teams, cross-functional interaction is carried out at the senior management level.
- In 90% of projects there are no tools and technologies that ensure the reliability of the project implementation;
- In 90% of projects there is no regular and transparent control system. Control is exercised at the level of separate employees.
- In 80% of cases in the process of project implementation, employees face difficulties upon their occurrence, preventive risk analysis is not carried out.

Stage 2.

One of the strategic priorities of the company is the development and market launch of new equipment.

The main indicator of the effective implementation of the total portfolio of projects was return on investment (ROI), the current value of which was only 9%.

Critical Ratio was adopted as a single indicator of the current control components in the composition of the portfolio. Critical Ratio is the product of the indices of the schedule execution and cost, calculated using the method of earning value analysis.

Stage 3.

On the basis of the defined requirements to the main elements of the R&D project management system, a common vision of the developed system was formed. It is presented in the table.

TABLE 2 THE FINAL REQUIREMENTS FOR THE MANAGEMENT SYSTEM OF R&D PROJECTS

Requirements section	Brief characteristic
Organizational structure	Weak matrix
Stages of the management process	Initiation, planning, execution and control, completion
Process subject groups	Integration, Resources, Time, Cost, Quality, Risks
Service elements of project control	Resource pool management Project portfolio management
Coordination centre	Project management office
Organization of interaction with the top management of the company	Portfolio Committee, which includes the entire top management of the company

Role structure of project activities	Project portfolio Manager, project Manager, project administrator, chief subject specialist
Personnel motivation system	On process, timing and quality of process steps
Target effect	Standardization of processes, standardization. Optimization of operations, reduction of time and costs, compliance with strategic goals

Source: compiled by the authors

The presented project management tools are gradually introduced into the activities of the Engineering center of the company, which provides an increase in the profitability of projects. During the year of implementation of the project for the introduction of the project management system, the return on investment ROI increased by 6.8 times. The growth of the indicator is primarily due to the change in the composition of the components of the R&D project portfolio, the rejection of unpromising areas of research and development, planning and control of resources. The indicators of compliance with the terms of implementation of R&D and the budget have improved, the risks of a negative result of the project have been reduced.

It should be noted that the company still has problems in the field of project management, which can be solved by further development of the system elements in terms of the introduction of additional groups of processes; certification of project managers for compliance with recognized standards; involvement of third-party auditors to analyze the current project management system and identify growth points that contribute to the transition to the next level of development of the project portfolio management system.

VI. DISCUSSION

As a result of the study, conclusions of a universal nature were made. The project management system should be based on the characteristics of the company's project portfolio. The success of the project management system R & D largely depends on the management of project activities, because it sets the rules for the system and the project portfolio. The main characteristics of the R&d project management system are presented in table 3.

TABLE 3. KEY FEATURES OF R&D PROJECT MANAGEMENT SYSTEM

System element	Element characteristic
Target project	A unique product of the project with a well-known implementation technology
The main direction of development of the methodology	Unification of the main project implementation processes: Initiation Planning Motivation Accountability
Organizational structure	Functional, weak matrix
Automation of information system	Processes of planning and control of content, terms, cost
Staff motivation focus	On process, timing and quality of process steps

Key roles	Portfolio Committee, portfolio Manager, component Manager, project administrator
Project office	Center for standardization of approaches Methodological support of project participants The center of the ROI (the leader is responsible for the efficiency of investment)

Source: compiled by the authors

The results of research can be used in the formation of a management system for innovative projects in the field of R&D. Future research in this direction should focus on the development of recommendations for the formation of supporting elements of project activities. In addition, it is advisable to focus future efforts on building an effective project governance system.

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