UDC 519.865 **doi: 10.32620/reks.2022.4.14**

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INFORMATION TECHNOLOGY FOR CHOOSING THE PROJECT PORTFOLIO MANAGEMENT APPROACH AND THE OPTIMAL LEVEL OF MATURITY OF AN ORGANIZATION

The choice of a project portfolio management approach has a significant impact on the effectiveness of the organization. However, each organization that carries out project activities must not only choose a project portfolio management approach, but also the degree to which its capabilities are used. This degree determines an organization's level of maturity in project portfolio management. There are many models of maturity known. The use of such models often involves a long study and costs organizations a lot of money. The paper is aimed at creating an information technology for choosing a project portfolio management approach and the optimal level of maturity of the organization in the field of project portfolio management. This information technology is created and presented in the form of IDEF0 diagram. Using information about the organization and the environment, experts can investigate the application of different alternative project portfolio management approaches. When performing this analysis, they use the Project Portfolio Management Approach Selection Method and the Organizational Maturity Level Selection Method for Portfolio Management. Using the first of these methods, experts can select the most appropriate approach based on two criteria: the risks from non-performance or imperfect performance of the processes of the generalized portfolio management process table and the cost of performing the approach processes. The second method is used to assess an organization's level of maturity in portfolio management and select the optimal level of maturity. Information technology is based on two developed applications. The first solution is designed to select the project portfolio management approach. The second application solves the problem of choosing the level of maturity of the organization in the field of portfolio management Projects. The applications have an intuitive interface. Both applications have been tested and are ready for use. Information technology is intended for use by project portfolio managers.

Keywords: *approach; project portfolio management; maturity; choice; optimal level; information technology; application.*

1. Introduction

The choice of an approach for project portfolio management is a responsible task that top managers of any organization carrying out project activities must solve. As a rule, this task is solved very subjectively and often without proper professionalism.

Several researchers have shown that the choice of approach to project portfolio management has a significant impact on the organization's efficiency [1, 2]. Under the approach to project portfolio management, we mean a specific and documented system of principles, rules, processes, practices, life cycle, organizational structure, prescribed roles, methods, tools, document templates that provides project portfolio management in an organization.

Summing up what was stated in [1, 2], it can be argued that the principles, processes, life cycle, organizational structure, methods, tools, templates of project portfolio management contribute to increasing the likelihood of project success and the profitability of organizations' efforts. According to [3], portfolio management can give positive results only if it is accompanied by external and internal factors. The internal factor included human factors, organizational structure, and processes. The positive experience of creation and application of the information system for a project management approach selection and formation "PMGuide" is known [4].

But choosing a management approach is only the first step in what needs to be done. The second step is to choose the extent to which the possibilities of this approach are used. These tasks are comparable to the behavior of a novice manager who was offered to start managing an enterprise. First, he went to the store and chose a book on management, which seemed to him the most useful, and the recommendations of which he decided to apply in the enterprise. That is, he chose the

ISSN 1814-4225 (print)
ISSN 2663-2012 (online)

approach to management. At the next stage, the manager will begin to master the approach to management and implement it, applying certain organizational structures, roles and responsibilities of personnel, management processes, software products, templates, etc. Depending on the use of the possibilities of this approach, he will spend different funds and get different results.

The degree of use of the possibilities of the approach to management determines the level of maturity of the organization in management [5].

Researchers have identified a strong positive correlation coefficient between the maturity level of project portfolio management and project success [6]. It has been shown [7] that effective project portfolio management positively impacted the capital growth of commercial organizations in Nigeria and the market share they occupy.

A survey [8] of 2428 project management practitioners representing organizations from many regions of the world showed that 21% of the surveyed organizations always use project portfolio management, 33% often use it, and 25% use it occasionally. Only 9% of organizations surveyed never use project portfolio management.

At the same time, assessing the maturity of portfolio management in their organizations, only 16% of respondents answered that the maturity of portfolio management is high, 40% rated it as average, and 44% rated the maturity of portfolio management as low. Of those surveyed, 47% indicated that their organizations have a formal process to improve existing project/portfolio management practices.

A survey conducted in 2020 [9], which already included 3,060 project management professionals from around the world, revealed some progress in the field of project portfolio management. The interviewed experts indicated that project portfolio management in their organizations is applied in 75% of cases. In 2020, 9% of professionals rated portfolio management maturity in their organizations as very high, 23% rated it as fairly high, 31% as average, 19% as fairly low, and 18% as very low. Compared to the 2016 survey, some progress can be seen in this area. Although it should be borne in mind that the number of gradations in the 2020 survey has become larger, this could affect the respondents' answers.

Quite a lot of work has been devoted to the issues of assessing the level of maturity of organizations in the field of project management. Among them are [10-14]. The best known is the CMMI® V2.0 maturity model [10]. CMMI defines areas of practice, for each of which a scale of organizational maturity levels is proposed. A total of 5 maturity levels are considered. Assessing the maturity of an organization by CMMI is a rather complicated and costly process.

The OPM3 maturity model [11] for project portfolio management offers 130 best practices. When evaluating the level of maturity, it is necessary to evaluate the implementation of these practices in the organization. To apply this maturity model, training is required.

The standard [12] considers 18 competencies, including portfolio management. The standard describes what an organization must do to successfully manage a portfolio. Assessing the competence of an organization involves answering 7 questions. The IPMA Delta approach can be used to assess the competence of an organization. Competency classes are like the five levels of maturity adopted in CMMI.

The model [13] is designed to assess the level of maturity of an organization in the field of managing projects, programs, and project portfolios. For each of the five levels of maturity adopted in the model, its process areas are considered. The process area corresponding to maturity level 3 is dedicated to project portfolio management.

The PMMM project management maturity model [14] also has five levels of maturity. Project portfolio management is considered only when describing the features of the fifth level of maturity.

The Portfolio Management Maturity Assessment Model [15] assesses portfolio management concepts, processes, and documents.

The Internet provides resources that can be used to assess the maturity of an organization's project portfolio management [16, 17]. As a result of answering questions on the website [16], an organization can receive an assessment of its readiness percentage, how adequate the organization's capabilities are, and how good the internal conditions are. Based on the results of the assessment, the site issues recommendations for each organization.

The PPM maturity assessment calculator [17] allows you to obtain an integral numerical assessment of the organization's maturity in the field of project portfolio management. Maturity assessment is carried out by evaluating the performance of certain portfolio management functions.

For those involved in the construction of maturity models, the experience of creating such a model, described in detail in [18], is useful.

An analysis of the literature showed that the choice of approach to managing a portfolio of projects significantly affects the effectiveness of the organization. In particular, the influence of principles, processes, life cycle, organizational structure, methods, tools, and templates of project portfolio management on increasing the likelihood of project success and the profitability of organizations' efforts are noted. However, in the sources known to us, there is no description of the tools for choosing a project portfolio management approach.

The researchers revealed a significant influence of the level of maturity of the organization's project portfolio management on the success of projects and the growth of the capital of commercial organizations. There are many maturity models in the field of project management. Only a few of them pay sufficient attention to project portfolio management. However, they are difficult to use and require significant costs. The Internet provides tools for assessing the maturity of organizations in the field of portfolio management. However, they do not solve the problem of choosing the optimal level of organizational maturity.

Thus, the creation of information technology that will allow you to choose an approach and find the optimal level of maturity of the organization for project portfolio management is an urgent task, the solution of which will increase the success of projects and the efficiency of organizations.

The purpose of the paper is to create an information technology for choosing the project portfolio management approach and the optimal level of maturity of an organization in the field of managing a portfolio of projects.

2. Description of information technology

The task of creating information technology has been successfully solved. This information technology is intended for use by project portfolio management experts. The IDEFO notation is used to describe it. The top-level context diagram is shown in Figure 1**.**

Using information about the organization and the environment, experts can explore the application of various alternative approaches to project portfolio management. When performing this analysis, they use the method of choosing the project portfolio management approach [19] and the method of choosing the organization's level of maturity in project portfolio management [5]. Using the first of these methods, experts can choose the most appropriate approach according to two criteria: the risks from non-fulfillment or imperfect execution of the processes of the generalized table of project portfolio management processes and the cost of implementing the processes of the approach. The second method is used to assess the degree of use of principles, functions, life cycle, specialized organizational structure, assigned roles and responsibilities for their implementation, the consequences of risk events, and the costs of implementating the approach. This information is used to assess the level of maturity of the organization in the field of portfolio management and select the optimal level of maturity.

A top-level contextual chart is decomposed into six child blocks on a child chart. The child diagram is shown in Figure 2. A glossary has been created for contextual and child diagrams.

3. Glossary

The best project portfolio management approach - in this case, we mean the best project portfolio management approach among those considered by the criteria of risk and cost.

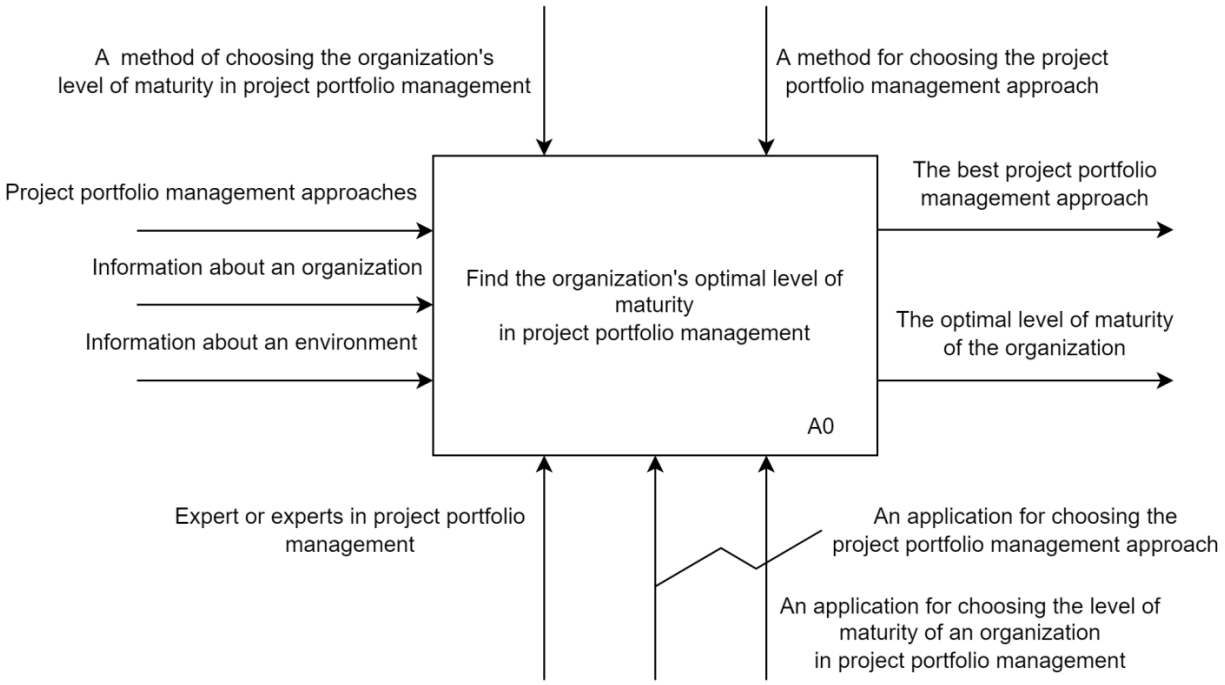


Fig. 1. Context diagram of the process "Find the organization's optimal level of maturity in project portfolio management"

ISSN 1814-4225 (print)
ISSN 2663-2012 (online)

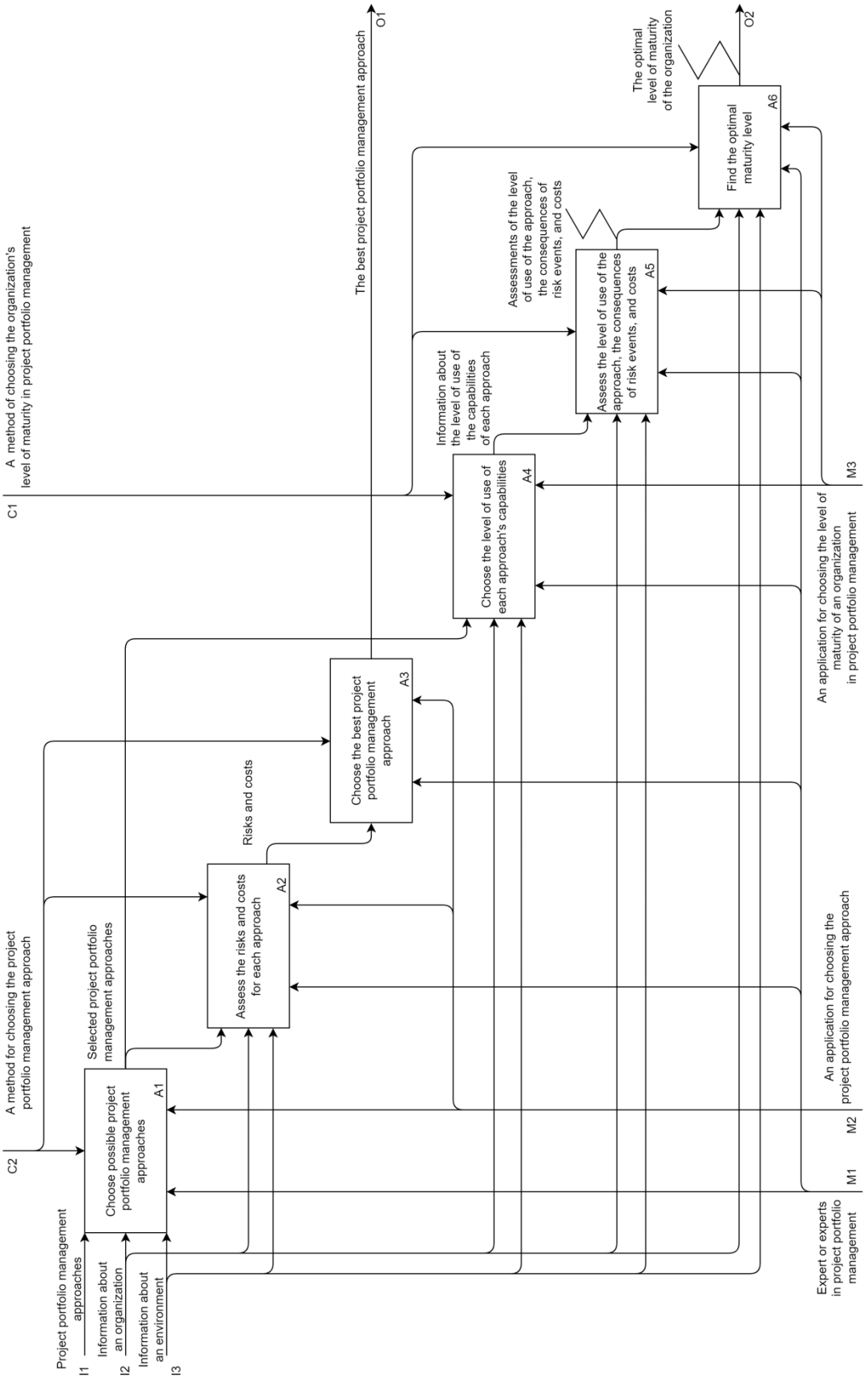


Fig. 2. Child diagram of the process "Find the organization's optimal level of maturity in project portfolio management"

The optimal level of maturity of the organization is the optimal level of maturity of the organization in the field of project portfolio management. This level of maturity is selected according to two criteria: the level of maturity of the organization in project portfolio management and the average annual costs of implementing and applying the methodology at a given degree of its implementation.

Risks and costs are risks from non-fulfillment or imperfect implementation of project portfolio management processes and costs of applying the approach.

Choose the best project portfolio management approach means choose the best project portfolio management approach among those considered by risk and cost criteria.

Assess the level of use of the approach, the consequences of risk events, and costs - means to assess the level of use of principles, functions, life cycle, specialized organizational structure, prescribed roles and responsibilities for their implementation in managing a portfolio of projects, assess the consequences of risk events, and assess the costs of implementing the approach.

Assessments of the level of use of the approach, the consequences of risk events, and costs - estimates in points of the level of application of principles, functions, life cycle, specialized organizational structure, prescribed roles and responsibilities for their implementation in project portfolio management, assessment in points of the consequences of risk events, and assessment of the costs of implementation of each approach.

Find the optimal maturity level – find the optimal project portfolio management approach and the degree of its application, that is, the optimal level of maturity. The optimal level of maturity of the organization in project portfolio management is selected according to two criteria: the level of maturity of the organization in project portfolio management and the average annual costs of implementing and applying the methodology at a given degree of its implementation.

4. An application for choosing the project portfolio management approach

The project portfolio management approach selection method [19] is used as a control when performing the processes of 1) selecting possible approaches to project portfolio management; 2) evaluating risks and costs for each approach; 3) selecting the best approach to project portfolio management. The project portfolio management approach selection application implements this method and is used as a mechanism.

Functional and non-functional requirements for the application for choosing the approach to project portfolio management have been determined. The application is a web page that can be used by experts to collect and quickly obtain information about the risks and costs of various approaches to managing the project portfolio in the organization, as well as choosing the best approach.

The web application for choosing the project portfolio management approach has the following functionality: the ability to view a generalized table of project portfolio management processes, the ability to enter data on the risks associated with the fact that a certain process is not performed or is performed imperfectly, as well as on systemic risk, the ability to enter data on the cost of implementing processes, as well as additional costs when implementing and using the approach, the ability to obtain the results of calculating the risks and costs for the approach under consideration, the ability to compare several approaches to project portfolio management, and the ability to upload a file or download a file with the results.

When visiting a web page, the user can open a tab that presents the generalized table of project portfolio management processes (Figure 3).

By analyzing this table and the processes of the project portfolio management approach under consideration, the user can get an idea of whether a particular process is being performed in the evaluated approach and, if so, how perfect its implementation is. As a result of this analysis, the user can begin to fill in the risk tables. For this, the application has a “Risks“ tab (Figure 4). Each process in the generalized project portfolio management process tables corresponds to two cells of the table in Figure 4, which are at the intersection of the process group under consideration and the area of knowledge. In one cell of the table corresponding to the process under consideration, the consequence of the risk event that occurs when the process is not performed or is imperfectly performed is entered. In the other cell of the table, an assessment of the probability of occurrence of a risk event is documented. In addition to the risks associated with the non-implementation or poor implementation of individual processes, it is possible to add an assessment of the synergistic effect of the totality of risks characteristic of this approach. This tab has a tooltip that appears when you hover over the text "what is this table?". It contains a description of the current tab. There are also buttons for resetting the table fields to their original state.

ISSN 1814-4225 (print)
ISSN 2663-2012 (online)

Risks | Cost | Results | Project portfolio management processes

Knowledge Areas	Process Groups			
	Determination of Goals and Criteria, Management Principles, Methods for Achieving Goals, Resources, and Appointment of a Portfolio Manager	**Preliminary Selection of Components**	**Balancing (Optimization) of a Portfolio**	**Authorization of Components**
Portfolio Strategic Management	Development and approval of the charter of the portfolio	Preliminary selection, evaluation and categorization of potential components	Portfolio optimization within the categories and the whole portfolio	Component authorization
	Development of a portfolio management plan			
Portfolio Performance Management	Development of a portfolio performance management plan	Evaluation of the effectiveness of potential components		
Portfolio Communication Management	Development of a plan for interaction with stakeholders	Exchange of information with stakeholders on the results of the preliminary selection of components	Exchange of information with stakeholders in the process of portfolio optimization	
Portfolio Risk Management	Developing a risk management plan	Risk assessment of potential components		

Knowledge Areas	Process Groups				
	Monitoring and Control				**Closing of Components**
	Accounting and forecasting	**Control**	**Analysis**	**Decision making**	
Portfolio Strategic Management	Portfolio performance accounting and forecasting	Portfolio monitoring	Analysis of portfolio performance	Decision making	Component closure
Portfolio Performance Management	Monitoring and managing portfolio performance				
Portfolio Communication Management	Exchange of information with stakeholders on the results of accounting and forecasting portfolio performance	Exchange of information with stakeholders on the results of monitoring portfolio performance	Exchange of information with stakeholders on the results of portfolio performance analysis	Exchange of information with stakeholders on the decisions taken	
Portfolio Risk Management	Portfolio risk monitoring and management				

Fig. 3. The "Project portfolio management processes" tab

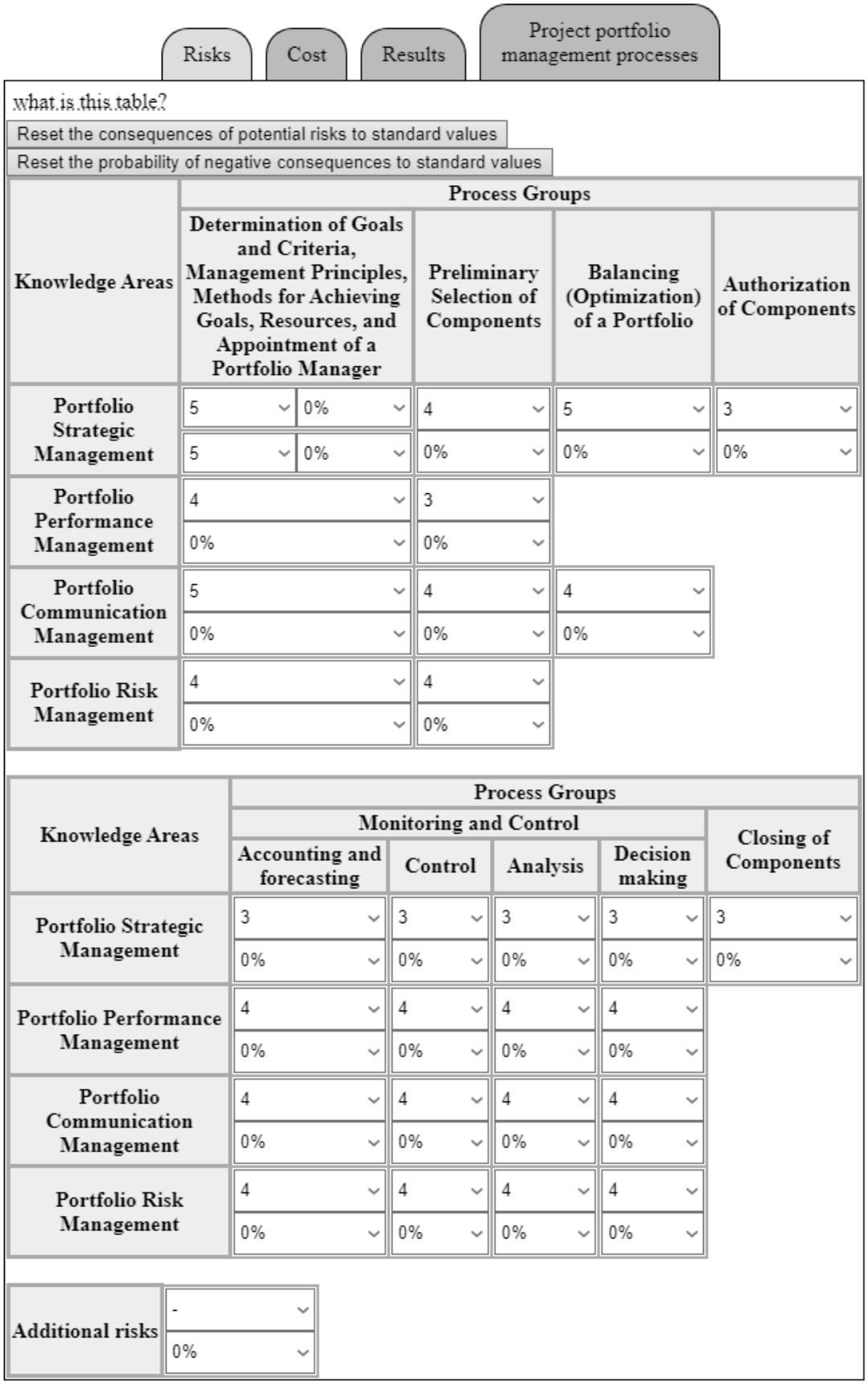


Fig. 4. The “Risks” tab

ISSN 1814-4225 (print)
ISSN 2663-2012 (online)

Next, the user can proceed to estimate the cost of performing the processes under consideration. Estimates of the cost of performing processes are displayed in the cells of the table on the "Cost" tab. Each process from the generalized tables of project portfolio management processes has its own cost cell (Figure 5). In addition to the cost of running processes, additional costs that are not directly related to the management processes may be placed at the bottom of the table. This tab also has a tooltip that appears when you hover over the text "what is this table?". It contains a description of the current tab. The tab has a button to reset the table fields to their original state.

Fig. 5. The "Cost" tab

After filling in the tables, or if the user already has a previously prepared file with the results, you can go to the "Results" tab. The on-screen form is shown in Figure 6. On this tab, you can view the risk and cost assessment results for your current approach to project portfolio management, save them to a page, view saved results, download saved results as a file, or upload a file containing results to a page. By comparing the results of risk assessment and the cost of multiple approaches, the user can choose the best one.

The developed web application successfully passed unit and integration testing.

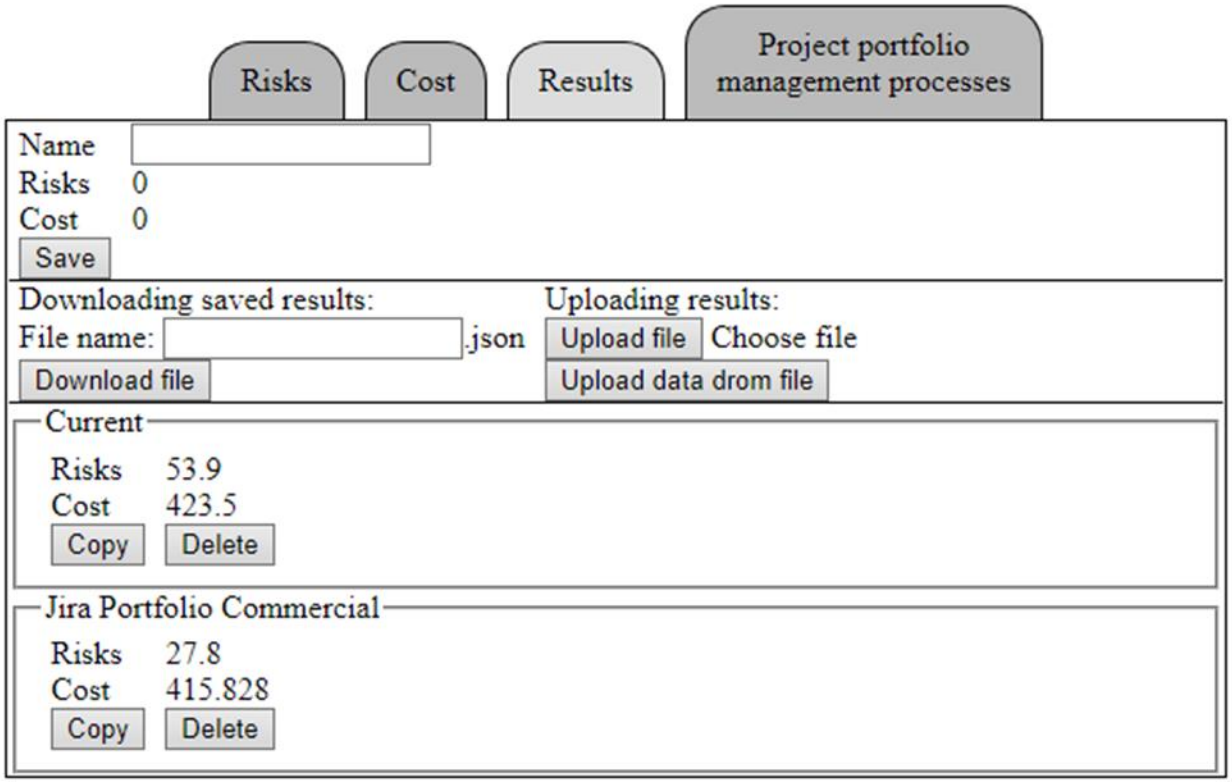


Fig. 6. The “Results” Tab

5. An application for choosing the level of maturity of an organization in project portfolio management

When performing processes, 4) choose the level of use of each approach's capabilities, 5) assess the level of use of the approach, the consequences of risk events, and costs, 6) find the optimal maturity level, the method of choosing the organization's level of maturity in project portfolio management is used [5]. As a mechanism, an application is used to choose an organization's maturity level in project portfolio management. This application implements the method of choosing the organization's level of maturity in project portfolio management.

The Web application for selecting the level of maturity of an organization in the field of project portfolio management provides the user with the ability to:

– Login to the system;

– View the components of the generalized body of knowledge on project portfolio management;

– Assess the level of use of the capabilities of the project portfolio management approach (assess the application of the principles of portfolio management in the organization, the performance of portfolio management functions, the use of the concept of "life cycle of the project portfolio", the existence of a specialized organizational structure for managing the project portfolio, prescribed roles, and responsibilities for their implementation);

– Assess the costs of implementing the approach, the level of maturity of the organization, and the ratio of the level of maturity and costs;

– Choose the optimal level of maturity of the organization in the field of project portfolio management;

– Save the entered information, and receive reports with the results of the analysis.

When entering the site, an unregistered user can immediately begin to assess the maturity level of project portfolio management. This procedure is carried out by choosing the right answer to questions regarding the application of the principles of portfolio management in

ISSN 1814-4225 (print)
ISSN 2663-2012 (online)

the organization, the application of the concept of "lifecycle of the project portfolio", the presence of a specialized organizational structure for managing the portfolio of projects, the roles assigned and responsibility for their implementation. Five answer options are given, from which the user must choose one (Figure 7).

The user can evaluate the performance of portfolio management functions in the organization. Evaluation is carried out using the generalized table of project portfolio management processes (Table 1 and Table 2 [19]). In this case, a function is understood as the execution of a process that is located at the intersection of a group of processes and the knowledge area of the generalized table of processes. A questionnaire is filled out for each cell of the table. When you click on the cell with the process, an answer selection menu appears. The user should take the most correct answer regarding the process in question (Figure 8).

Each answer in points (from 1 to 5) corresponds to a certain color in which the table cell is painted. This allows you to visually see the state of the portfolio management processes.

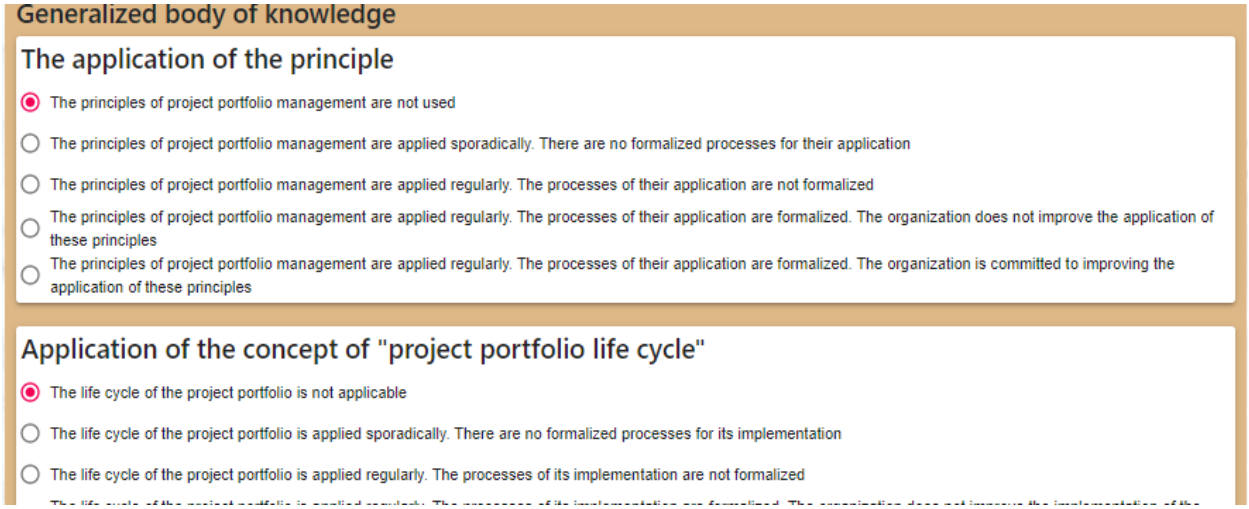


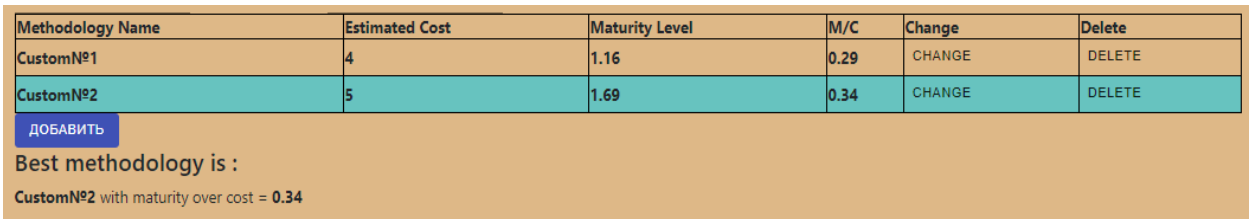
Fig. 7. Form of answers to the questionnaire questions

Fig. 8. Process table

The user can analyze different approaches with different levels of use of the capabilities of these approaches. The results of the analysis are saved and can be displayed in the form of a table shown in Figure 9. In the table, the user can see the name of the analysis case, the costs of implementing the approach, the maturity level of the organization, the value of the quotient of the maturity level divided by the costs (M/C parameter), as well as the CHANGE and DELETE columns to switch between the analysis options and delete the specific analysis option.

The best analysis option is displayed, for which the maximum M/C value is obtained.

If desired, the user can download the report with the results of the analysis in PDF format or specify the e-mail address to which it will be sent. The first page of the report provides information about the portfolio management maturity assessment method. Each of the following pages describes the results of an analysis of one variant of the portfolio management approach with the appropriate level of use of the capabilities of this approach. The user can see answers to questions regarding the application of the principles of project portfolio management in the organization, performance of project portfolio management functions in the organization, application of the concept of "lifecycle of the project portfolio", the presence of a specialized organizational structure for project portfolio management, prescribed roles, and responsibility for their implementation. It can also see the maturity level of the organization, the cost of implementing the approach, and the value of the M/C parameter. The sample report is shown in Figure 10 - 12.



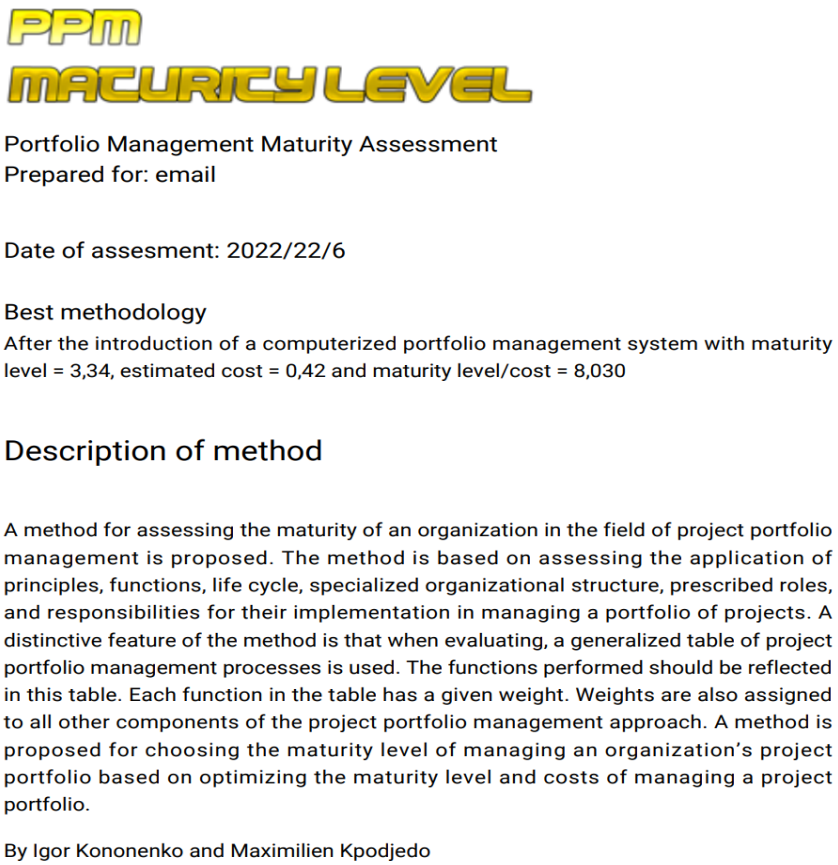
Methodology Name	Estimated Cost	Maturity Level	M/C	Change	Delete
CustomN°1	4	1.16	0.29	CHANGE	DELETE
CustomN°2	5	1.69	0.34	CHANGE	DELETE

ДОБАВИТЬ

Best methodology is :

CustomN°2 with maturity over cost = **0.34**

Fig. 9. Analysis results



PPM
MATURITY LEVEL

Portfolio Management Maturity Assessment
Prepared for: email

Date of assesment: 2022/22/6

Best methodology
After the introduction of a computerized portfolio management system with maturity level = 3,34, estimated cost = 0,42 and maturity level/cost = 8,030

Description of method

A method for assessing the maturity of an organization in the field of project portfolio management is proposed. The method is based on assessing the application of principles, functions, life cycle, specialized organizational structure, prescribed roles, and responsibilities for their implementation in managing a portfolio of projects. A distinctive feature of the method is that when evaluating, a generalized table of project portfolio management processes is used. The functions performed should be reflected in this table. Each function in the table has a given weight. Weights are also assigned to all other components of the project portfolio management approach. A method is proposed for choosing the maturity level of managing an organization's project portfolio based on optimizing the maturity level and costs of managing a project portfolio.

By Igor Kononenko and Maximilien Kpodjedo

Fig. 10. The first page of the report in PDF format

ISSN 1814-4225 (print)
ISSN 2663-2012 (online)

The application of the principle :2

The performance of the project portfolio management functions: 4

Application of the concept of "project portfolio life cycle": 4

Existing project porfolio management methodology with maturity level = 2,587, estimated cost = 0,42 and maturity level/cost = 6,110

				Monitoring and Control				
Determination of Goals and Criteria, Management Principles, Methods for Achieving Goals, Resources, and Appointment of a Portfolio Manager	Preliminary Selection of Components	Balancing (Optimization) of a Portfolio	Authorization of Components	Accounting and Forecasting	Control	Analysis	Decision Making	Closing of Components
Pportfolio Strategic Management 3,22								
Development and approval of the charter of the portfolio (3)	Development of a portfolio management plan (3)	Preliminary selection, evaluation and categorization of potential components (2)	Portfolio optimization within the categories and the whole portfolio (3)	Component authorization (4)	Portfolio performance accounting and forecasting (4)	Portfolio monitoring (4)	Analysis of portfolio performance (3)	Decision making (3)	Component closure (4)
Portfolio Performance Management 2,00								
Develoment of a portfolio performance management plan (1)	Evaluation of the effectiveness of potential components (2)			Monitoring and managing portfolio performance (3)				
Portfolio Communication Management 2,28								
Development of a plan for interaction with stakeholders (2)	Exchange of information with stakeholders on the results of the preliminary selection of components (2)	Exchange of information with stakeholders in the process of portfolio optimization (1)		Exchange of information with stakeholders on the results of accounting and forecasting portfolio performance (3)	Exchange of information with stakeholders on the results of monitoring portfolio performance (3)	Exchange of information with stakeholders on the results of portfolio performance analysis (3)	Exchange of information with stakeholders on the decisions taken (2)	
Portfolio Risk Management 1,00								
Developing a risk management plan (1)	Risk assessment of potential components (1)			Portfolio risk monitoring and management (1)				

Fig. 11. The second page of the report in PDF format

The application of the principle :4

The performance of the project portfolio management functions: 4

Application of the concept of "project portfolio life cycle": 4

After the introduction of a computerized portfolio management system with maturity level = 3,337, estimated cost = 0,42 and maturity level/cost = 8,03

				Monitoring and Control				
Determination of Goals and Criteria, Management Principles, Methods for Achieving Goals, Resources, and Appointment of a Portfolio Manager	Preliminary Selection of Components	Balancing (Optimization) of a Portfolio	Authorization of Components	Accounting and Forecasting	Control	Analysis	Decision Making	Closing of Components
Pportfolio Strategic Management 3,32								
Development and approval of the charter of the portfolio (3)	Development of a portfolio management plan (3)	Preliminary selection, evaluation and categorization of potential components (3)	Portfolio optimization within the categories and the whole portfolio (3)	Component authorization (4)	Portfolio performance accounting and forecasting (4)	Portfolio monitoring (4)	Analysis of portfolio performance (3)	Decision making (3)	Component closure (4)
Portfolio Performance Management 3,36								
Develoment of a portfolio performance management plan (3)	Evaluation of the effectiveness of potential components (3)			Monitoring and managing portfolio performance (4)				
Portfolio Communication Management 3,14								
Development of a plan for interaction with stakeholders (3)	Exchange of information with stakeholders on the results of the preliminary selection of components (3)	Exchange of information with stakeholders in the process of portfolio optimization (4)		Exchange of information with stakeholders on the results of accounting and forecasting portfolio performance (3)	Exchange of information with stakeholders on the results of monitoring portfolio performance (3)	Exchange of information with stakeholders on the results of portfolio performance analysis (3)	Exchange of information with stakeholders on the decisions taken (3)	
Portfolio Risk Management 3,00								
Developing a risk management plan (3)	Risk assessment of potential components (3)			Portfolio risk monitoring and management (3)				

Fig. 12. The third page of the report in PDF format

The user can see the processes of the standards in the application: The standard for portfolio management. 3rd ed. PMI (2013), ISO 21504: 2015. Project, program, and portfolio management - Guidance on portfolio management, 2015, and GOST P 54870 2011. Project management, 2011. These processes are presented in the

ISSN 1814-4225 (print)
ISSN 2663-2012 (online)

format of the generalized table of project portfolio management processes (Figure 13). The processes of the standards can be seen by switching the menu tabs with the names of the standards.

To place a description of other tables of the generalized body of knowledge on project portfolio management (principles, life cycles, organizational structures for project portfolio management, prescribed roles, and responsibilities for their implementation), as well as to add information from scientific articles, an encyclopedia was added to the site - Wikipedia. It allows you to conveniently manipulate pages, post information, grant rights to edit this information, etc.

When choosing a standard, the user can go to the description page of this standard in Wikipedia (Figure 14). Separate pages were created for each standard, as well as for a general description of the generalized body of knowledge on project portfolio management (Figure 15).

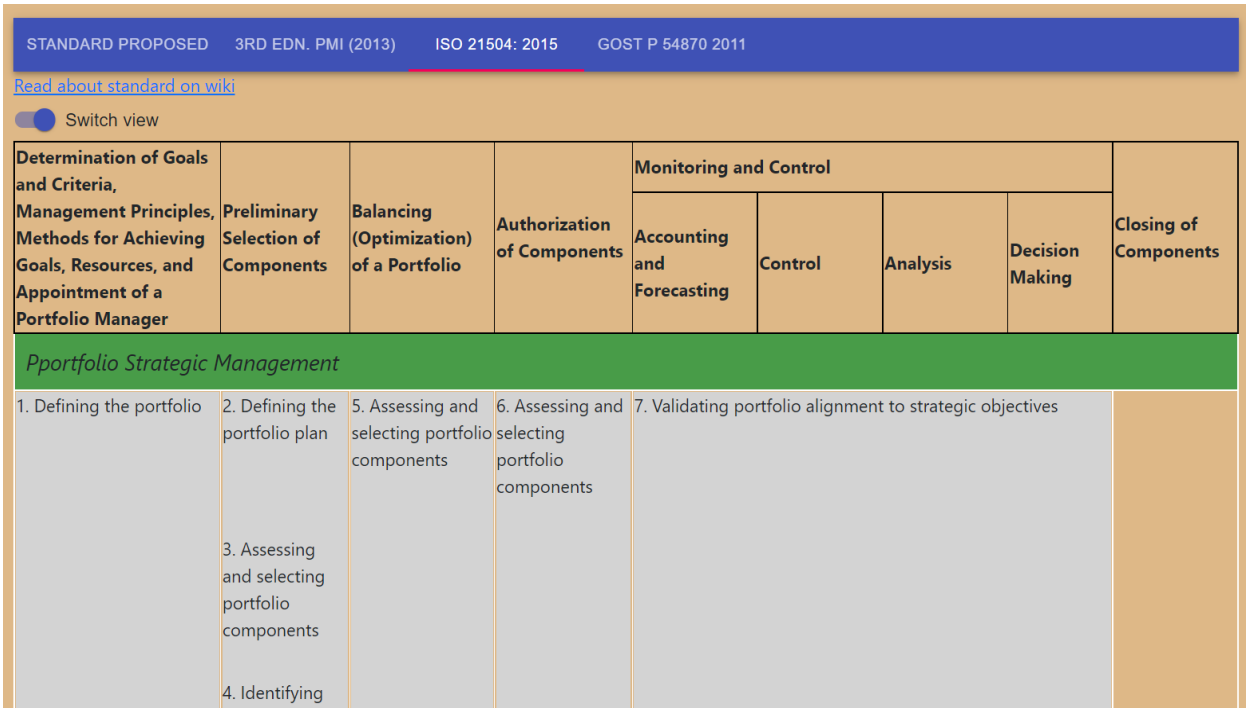


Fig. 13. Processes ISO 21504: 2015. Project, program, and portfolio management - Guidance on portfolio management, 2015 in the format of the generalized table of project portfolio management processes

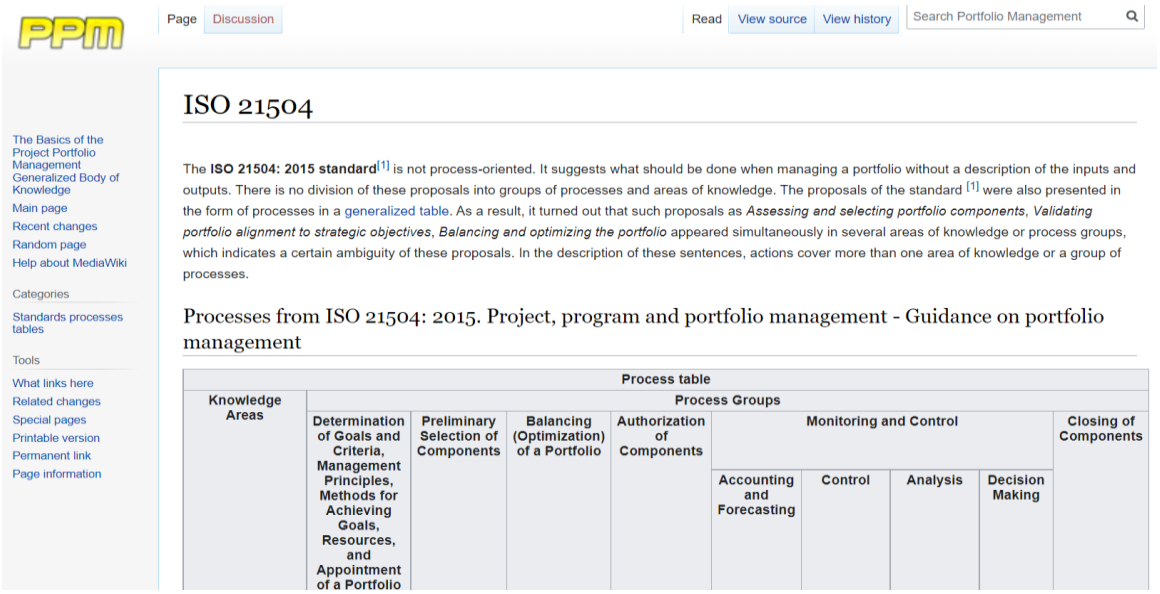


Fig. 14. Wikipedia page describing the ISO 21504: 2015. Project, program, and portfolio management - Guidance on portfolio management, 2015

such the body of knowledge have been developed. Information on five common standards and portfolio management guides are added to the body of knowledge. Considering the components of the **project portfolio management generalized body of knowledge**, approach to strategic management and project portfolio management of the organization is proposed.

Contents [hide]

The Structure of a Generalized Body of Knowledge on Project Portfolio Management [edit]

The structure of the generalized body of knowledge on project portfolio management is proposed.

It includes principles, processes, practices, life cycles, organizational structures, defined roles, from common standards, portfolio management guides, publications in this area, considering the opinions of experts [1] [2] [3] [4] [5].

The difficulty of creating the generalized body of knowledge is that well-known standards and guidelines differ significantly in the principles and structure of the presentation of materials, in the principles, processes, and practices of managing a portfolio of projects, in the proposed life cycles of management, organizational structures, prescribed roles. Most of these standards don't describe the portfolio management processes.

The structure of the developed generalized body of knowledge is shown in Fig.1.

The structure of the project portfolio management generalized body of knowledge can be specified in the form of a set $G = \{P, Z, Q, L, O, R\}$ where P - is the set of principles of portfolio management, in this case $P = \{P^{[2]}, P^{[3]}\}$ $P^{[2]}$ - 8 principles of the standard [2][2], $P^{[3]}$ - 5 principles of the guide [3][3], Z - is the set of the project portfolio management processes, $Z = \{Z^{[1]}, Z^{[4]}, Z^{[5]}, Z^{[n]}\}$. $Z^{[1]}$ - 16 processes of the standard [1][1], $Z^{[4]}$ - 7 proposals of the standard [4][4], $Z^{[5]}$ - 9 processes of the standard [5][5], $Z^{[n]}$ - 23 processes, proposed by the authors, Q - is the set of practices, in this case, these are 12 practices described in the guide [3][3], L - is the set of life cycles, $L = \{L^{[2]}, L^{[3]}\}$, $L^{[2]}$ - life cycle in accordance with the standard [2][2], consisting of the phases of initiation, planning, execution, optimization, $L^{[3]}$ - the life cycle in accordance with the guide [3][3], including the definition cycle and the delivery cycle, O - is the set of types of organizational structures, $O = \{O^{[3]}, O^{[p]}\}$, $O^{[3]}$ - the organizational structure proposed in the guide [3][3], $O^{[p]}$ - the organizational structure used in practice, R - is the set of roles, $R = \{R^{[2]}, R^{[3]}, R^{[5]}\}$, $R^{[2]}$ - 12 roles described in the standard [2][2], $R^{[3]}$ - 5 roles proposed in the guide [3][3], $R^{[5]}$ - 3 roles provided by the standard [5][5]

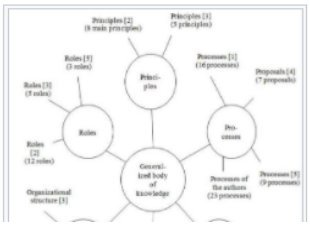


Fig. 15. Wikipedia page with a summary of knowledge on project portfolio management

6. Conclusion

The paper analyzes publications on the impact of the project portfolio management approach on the effectiveness of the organization, as well as publications on assessing the level of maturity of organizations in the field of project portfolio management. Analysis of the results of the research showed that the components of the project portfolio management approach, namely the principles, processes, life cycle, organizational structure, methods, tools, and templates contribute to increasing the probability of project success and the profitability of organizations' efforts. It is concluded that the creation of a tool for choosing an approach to managing a portfolio of projects is an urgent task.

There is a lot of work devoted to assessing the level of maturity of the organization in the field of project management. Directly managing project portfolios in most of the models considered, little attention is paid. In addition, known models are complex, require lengthy study, and involve a fairly high fee for assessing the level of maturity of the organization. There are applications for assessing organizational maturity in portfolio management, but they do not solve the problem of choosing the optimal level of maturity of the organization.

The purpose of the paper was to create an information technology for choosing the approach to project portfolio management and the optimal level of maturity of the organization in the field of project portfolio management.

This information technology has been created and presented in the form of an IDEF0 diagram. Information technology relies on two developed applications. The first application is designed to select the approach to project portfolio management. The second application solves the problem of choosing the level of maturity of the organization in the field of project portfolio management. The applications have an intuitive interface. Both applications have been tested and are ready for use. The information technology created is designed for use by project portfolio managers.

The novelty of the study is that for the first time information technology has been created for a formalized choice of approach and the search for the optimal level of maturity of the organization in managing the project portfolio, which makes it possible to increase the success of projects and the efficiency of the organization.

According to the estimates [19] application of the approach selection method for project portfolio management, which is implemented in information technology, can reduce management costs in the considered organization by 1.8% and reduce risks by 49.4%. Application of the maturity level selection method in project portfolio management allows to choose the best maturity level out of the considered ones and thus to increase the ratio of the organization's maturity level to the cost of management by 1.31 times [5].

ISSN 1814-4225 (print)
ISSN 2663-2012 (online)

Contribution of authors: analysis of existing works on the topic of research, setting the goal of the study, creating and describing the information technology for selecting the approach and finding the optimal level of maturity of the organization in project portfolio management, identifying the requirements for applications, conclusions – **Igor Kononenko**, **Maximilien Kpodjedo**, software implementation of the application for choosing the project portfolio management approach – **Andrii Morhun**, software implementation of the application for choosing the level of maturity of an organization in project portfolio management – **Maksym Oliinyk**.

All the authors have read and agreed to the published version of the manuscript.

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Надійшла до редакції 20.09.2022, розглянута на редколегії 20.11.2022

ІНФОРМАЦІЙНА ТЕХНОЛОГІЯ ВИБОРУ ПІДХОДУ ТА ОПТИМАЛЬНОГО РІВНЯ ЗРІЛОСТІ ОРГАНІЗАЦІЇ В ГАЛУЗІ УПРАВЛІННЯ ПОРТФЕЛЕМ ПРОЄКТІВ

Ігор Кононенко, Максімільєн Кподжедо, Андрій Моргун, Максим Олійник

Вибір підходу до управління портфелем проєктів суттєво впливає на ефективність організації. Однак кожна організація, яка здійснює проєктну діяльність, повинна не тільки обрати підхід до управління портфелем проєктів, а й ступінь використання його можливостей. Цей ступінь визначає рівень зрілості організації в управлінні портфелем проєктів. Відомо досить багато моделей зрілості. Використання таких моделей часто передбачає тривале вивчення і коштує організаціям чималих грошей. Мета статті - створення інформаційної технології вибору підходу до управління портфелем проєктів та оптимального рівня зрілості

ISSN 1814-4225 (print)
ISSN 2663-2012 (online)

організації в галузі управління портфелем проєктів. Зазначену інформаційну технологію створено і представлено у вигляді IDEF0 діаграми. Використовуючи інформацію про організацію та навколишнє середовище, експерти можуть досліджувати застосування різних альтернативних підходів до управління портфелем проектів. При виконанні цього аналізу вони використовують метод вибору підходу до управління портфелем проектів і метод вибору організаційного рівня зрілості для управління портфелем. Використовуючи перший із цих методів, експерти можуть вибрати найбільш підходящий підхід на основі двох критеріїв: ризики від невиконання або недосконалого виконання процесів узагальненої таблиці процесів управління портфелем і вартість виконання процесів підходу. Другий метод використовується для оцінювання рівня зрілості організації в управлінні портфелем і вибору оптимального рівня зрілості. Інформаційна технологія спирається на два розроблені додатки. Перший додаток призначений для вибору підходу до управління портфелем проектів. Другий застосунок розв'язує задачу вибору рівня зрілості організації в галузі управління портфелем проєктів. Додатки мають інтуїтивно зрозумілий інтерфейс. Обидва додатки пройшли тестування і готові для застосування. Інформаційна технологія призначена для використання фахівцями з управління портфелями проєктів.

Ключові слова: підхід; управління портфелем проєктів; зрілість; вибір; інформаційна технологія; додаток.

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