ZN WSH Zarządzanie 2018 (4), s. 79-92

Oryginalny artykuł naukowy
Original Article

*Data wpływu/Received:*10.09.2018
Data recenzji/Accepted: 13.09.2018/19.09.2018
Data publikacji/Published: 31.12.2018

Źródła finansowania publikacji: środki własne

DOI: 10.5604/01.3001.0013.1646

Authors' Contribution:
(A) Study Design (projekt badania)
(B) Data Collection (zbieranie danych)
(C) Statistical Analysis (analiza statystyczna)
(D) Data Interpretation (interpretacja danych)
(E) Manuscript Preparation (redagowanie opracowania)
(F) Literature Search (badania literaturowe)

dr Yurij Kharytonov *A D E*
Admiral Makarov National University of Shipbuilding in Mykolaiv, Ukraine

Postgraduate student, Oksana Savina *A B D E F*
Admiral Makarov National University of Shipbuilding, in Mykolaiv, Ukraine

VALUE-ORIENTED ANTI-RISK FUNCTIONAL MODELING OF PORTFOLIO MANAGEMENT PROCESSES FOR SCIENCE-BASED PROJECTS OF ENTERPRISES

ZORIENTOWANE NA WARTOŚĆ, ANTYRYZYKOWO-FUNKCJONALNE MODELOWANIE PROCESÓW ZARZĄDZANIA PORTFELEM DLA PROJEKTÓW PRZEDSIĘBIORSTW OPARTYCH NA BADANIACH NAUKOWYCH

Abstract: Effective management of project portfolios at science-based enterprises, which are now challenged by a dynamic turbulent environment, requires a continuous integrating activity. The goal of the latter is to maximize the return on implementation of the entire set of projects, bearing uncertainties and losses in mind. Thus, the article covers latest research in and approaches to project portfolio management. The methods and mechanisms of project portfolio management are analyzed, the weaknesses of project portfolios are detected; major issues and factors influencing their management are identified as well. The functional model of the value-oriented anti-risk science-based project portfolio management using the functional modeling methodology of IDEF0 are constructed. It takes into account the basic value indicators of the projects and portfolios that meet specified requirements, minimizes losses and uncertainties, and provides the maximum integrated value of project portfolios.

Keywords: project portfolio; formation of a project portfolio; value-oriented portfolio management; science-based enterprise.

Streszczenie: Efektywne zarządzanie portfelami projektów w przedsiębiorstwach opartych na nauce, które są obecnie zagrożone przez dynamiczne, turbulentne środowisko, wymaga ciągłej integracji. Celem tego jest maksymalizacja zwrotu z realizacji całego zestawu projektów, przy wliczeniu niepewności i strat. Artykuł zawiera najnowsze badania i podejścia do zarządzania portfelem projektów. Analizowane są metody i mechanizmy zarządzania portfelem projektów oraz wykrywane są uchybienia w portfelach projektów. Zostały również zidentyfikowane główne problemy i czynniki wpływające na zarządzanie nimi. Wykorzystując metodologię modelowania funkcjonalnego (IDEF0), opracowano model funkcjonalny zorientowanego na wartość zarządzania portfelem projektów przedsiębiorstw opartym na nauce. Uwzględnia podstawowe wskaźniki wartości projektów i portfeli, które spełniają określone wymagania, minimalizuje straty i niejasności oraz zapewnia maksymalną zintegrowaną wartość portfeli projektów.

Słowa kluczowe: portfolio projektów, tworzenie portfela projektów, zorientowane na wartość zarządzanie portfelem, przedsiębiorstwa oparte na nauce

Introduction

Changes in the global economy call for brand new methodological approaches to the analysis and management of the development of science-based high-technology industries, which guarantee the country's competitiveness and stability. Modern portfolio management focuses on forming a project portfolios (PPs) based on values[1]. The basic concept of the value-based approach is the formation of a PP with the maximum added value that integrates a variety of values and transforms them into a system of goals, which in turn lead to the creation of a new value. The latter is endowed with uniqueness, distinctive features and innovations, which satisfies all

[1] *A guide to project management body of knowledge (PMBOK): 5th edition*, "Project Management Institute", USA 2013.

the participants of the PP. This approach involves ensuring that projects and programs included in the science-based project portfolio (SBPP) are reviewed in order to set priorities according to strategic values and taking into account the uncertainties of the turbulent environment.

1. Overview of related publications

As shown by the analysis of scientific publications, the problem of the formation of an optimal PP, which allows achieving the strategic goals of an organization, is covered in a number of studies[2]. Each of them considers particular features of portfolio management and proposes appropriate methods and models of the PP formation. It can be noted that application of a certain approach is determined by the volume and quality of the input data and the conditions under which a management decision on the portfolio formation is made.

According to the authors of[3], the value-based approach is the major concept of the PP formation. It involves maximizing the growth of organizational values. It is this circumstance that necessitates the development of a new value-oriented project management methodology based on the integrity of the managed object and the uncertainty of changes in the environment[4].

The SBPP management is aimed at providing project analysis with the purpose of identifying value priorities, as well as consistency and compliance between the portfolio management and the organization's strategy[5].

By their specificity, science-based enterprises (SE) implement a lot of various projects, organizing them into portfolios. The main task of the executives and managers is to form an optimal portfolio from a wide range of project alternatives[6]. A functional model of the value-oriented anti-risk SBPP management is partially discussed in[7].

---

[2] A. Matveev, D. Novikov, A. Tsvetkov, *Project portfolio management models and methods*, PMSOFT, Moscow 2005; R. Archibald, *High-technology program and project management*, DMK Press, Moscow 2004; C. Benko, F. McFarlan, *Connecting the dots: aligning projects with objectives in unpredictable times*, I.D. Williams Publ., Moscow 2007; V. Burkov, O. Kvon, L. Tsitovich, *Multi-project management models and methods*, IPU RAN, Moscow 1998.

[3] S. Rudenko, S. Glovatska, *A model for the formation of project portfolios on the international activity of a university*, "Visnyk NTU (HPI)" 2013, No. 2 (1174), p. 36; S. Bushuev, N. Bushueva, *Mechanisms of the formation of value in the activity of design-managed organizations*, "Eastern-European Journal of Enterprise Technologies" 2010, No. 2 (43), p.4 .

[4] V. Molokanova, *Portfolio management of the development of an organization based on the value-oriented approach*, "Management of Complex Systems" 2012, No. 12, p. 67.

[5] *A guide to project management body of knowledge (PMBOK): 5th edition*, "Project Management Institute", USA 2013; O. Savina, *Features of portfolio projects of science-based enterprises and peculiarities of their management*, "Management of Development of Complex Systems" 2017, No. 30, p. 62.

[6] O. Savina, *Conceptual model of value-oriented management of project portfolios of science-based enterprises*, "Collection of Scientific Publications of NUOS" 2017, No. 4, p. 80.

[7] O. Savina, *Mathematical model of value-oriented portfolio management of high-tech enterprise projects*, "Natural and Technical Sciences" 2017, No. 2, p. 36.

2. Functional model of the process of the value-oriented anti-risk science-based project portfolio management

Proceeding from the method of value-oriented anti-risk SBPP management rendered in[8], solution of the task under consideration and achievement of the strategic goals of an enterprise can be aided though constructing a functional model of the value-oriented anti-risk SBPP management using the functional modeling methodology of IDEF0 (Fig. 1).

The IDEF0 methodology applied in this study for value-oriented anti-risk functional modeling of SBPP management processes has both advantages and disadvantages. The advantages are as follows: completeness of the business process description (management, information and material flows, feedback); complexity in decomposition (migration and tunneling of arrows); possibility of aggregation and further elaboration of the data and information flows (splitting and merging of arrows); strict requirements for the methodology that help obtaining process models of the standard form; simplicity of process documentation; compliance of the IDEF0 approaches to the process description with ISO 9000: 2000[9].

The disadvantages of this methodology include the complexity for perception (too many arrows), large number of decomposition levels, and difficulties in coordinating several processes given in different models of the same enterprise.

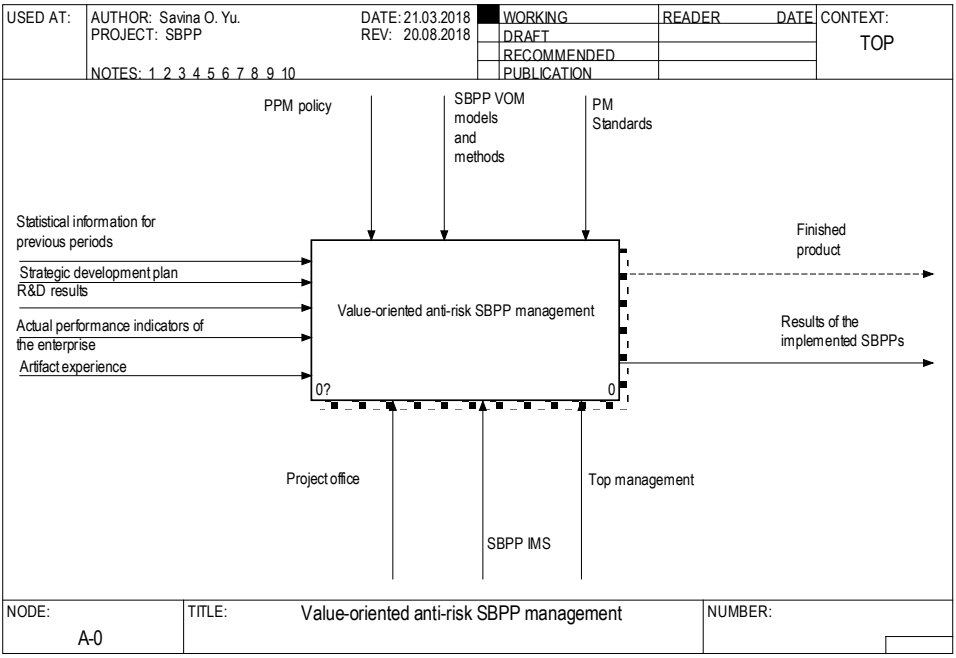
The input data for this model is the statistical information for previous periods, the strategic plan of the enterprise development, the results of research and development works (R&D), and the actual performance indicators of the enterprise, and the artifact experience. The system's operation is regulated by the PP management (PPM) policies, the models and methods of value-oriented SBPP management (SBPP VOM), and the PM standards provisions[10]. The management mechanisms include the project office, the information system for the SBPP management (SBPP IMS), and the top managers of the enterprise. The value-oriented SBPP management leads to obtaining the results of the implemented SBPPs and the reporting documentation at the output of the model.

[8] S. Chernov, O. Savina, *Method of formation of value-oriented portfolio management of high-tech enterprise projects*, "Management of Development of Complex Systems" 2018, No. 34, p. 275.

[9] O. Danchenko, *Practical aspects of business process reengineering*, Kyiv 2013.

[10] *Management of innovative projects and programs. R2M. Volume 1, Version 1.2.*, "Naukovyi svit Publ.", Kyiv 2009; *A guide to project management body of knowledge (PMBOK): 5th edition*, "Project Management Institute", USA 2013.

Figure 1. Functional model of the process of the value-oriented anti-risk SBPP management
Rysunek 1. Funkcjonalny model procesu zorientowanego na wartość zarządzania ryzykiem SBPP



Source: own elaboration.

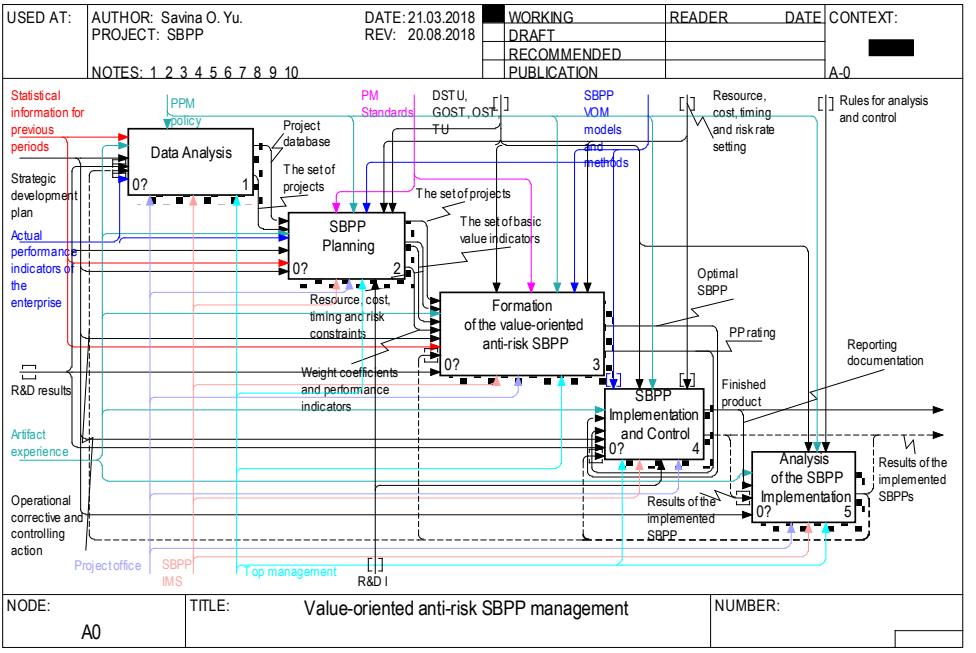
With the help of the graphical language IDEF0, the model under development appears as a set of interrelated functions. Such modeling is typically the first stage in the study of any system[11].

The first level of the functional model of the process of the value-oriented anti--risk SBPP management consists of five blocks; the details are presented in Fig. 2.

At the second level, the first subprocess is "Data Analysis" with the following inputs: the strategic plan of the enterprise development, actual performance indicators for the time being, statistical information for previous periods, and the R&D results. The control action at this stage is the PP management policy, while the management mechanisms are the project office, which employs the SBPP IMS, and the top managers.

[11] O. Danchenko, *Practical aspects of business process reengineering*, Kyiv 2013.

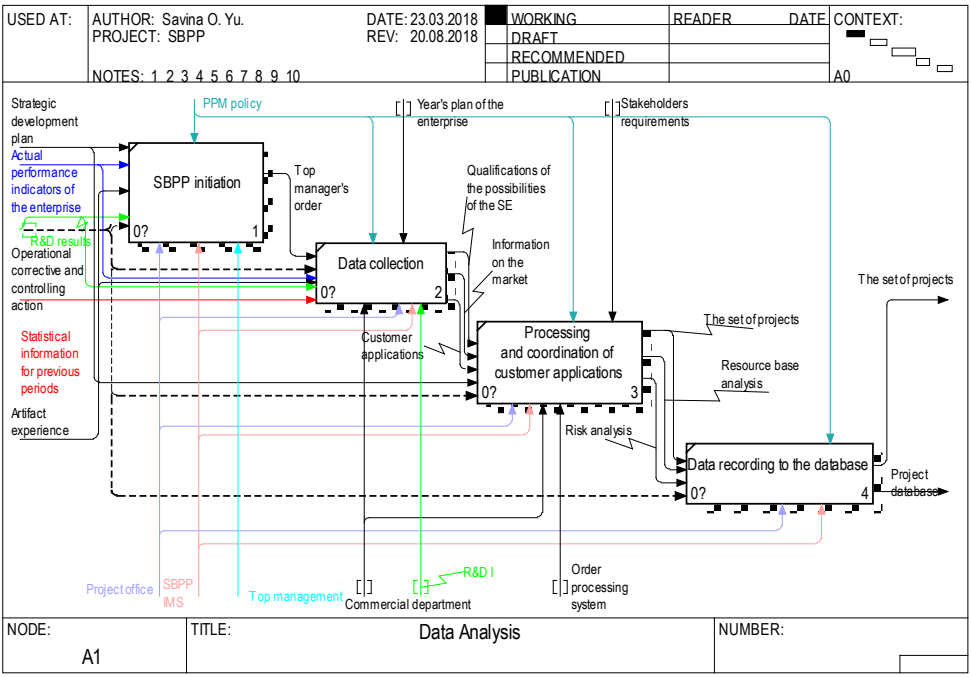
Figure 2. Decomposition of the first level of the process of the value-oriented anti-risk SBPP management
Rysunek 2. Dekompozycja pierwszego poziomu procesu zorientowanego na wartość zarządzania ryzykiem SBPP



Source: own elaboration.

Further, there are four third-level subprocesses (Fig. 3). Within the first one, "SBPP initiation", the top manager issues an order for the SBPP creation, which is guided by the PP management policy and the initiative of the project office, which uses the SBPP IMS thereat. Afterwards, there begins "Data collection", as the commercial department and R&D institutes become engaged in the activity. This stage is governed by the year's plan of the enterprise. The function output is the information on the market, qualifications of the possibilities of the SE, and available customer applications. "Processing and coordination of customer applications" is regulated by the stakeholders requests and is performed with the use of the order processing system of the SE. The output of the subprocess is a set of projects and the results of analysis of the resource base and the risks inherent in these projects. Further on, "Data recording to the database" is required. The output of the first "Data Analysis" block is a set of projects and a database on these projects. Feedback is provided through the operational corrective and controlling action at each stage of the process of the value-oriented SBPP management.

Figure 3. Decomposition of the first stage of the value-oriented anti-risk SBPP management
Rysunek 3. Dekompozycja pierwszego etapu zorientowanego na wartość zarządzania ryzykiem SBPP



Source: own elaboration.

The second subprocess, "SBPP Planning", consists of five third-level subprocesses described below (see Fig. 4).

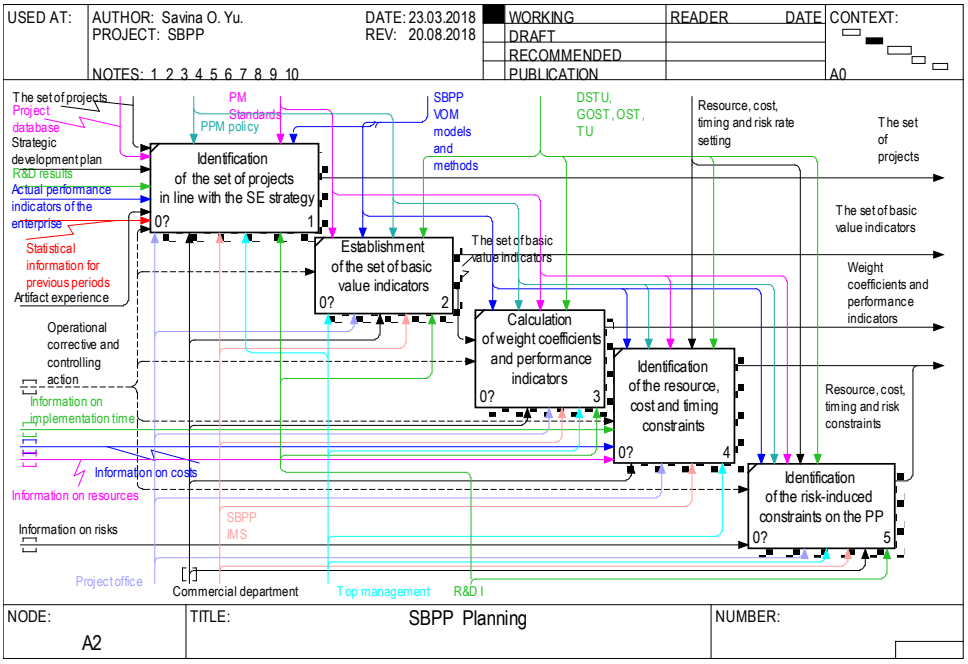
"Identification of the set of projects in line with the SE strategy". Using the statistical and expert method, project office managers together with the participation of the commercial department establish the set of projects that correspond to the strategy of the SE. They take into account the strategic plan of the enterprise development, statistical data for the past years, actual performance indicators of the enterprise, and R&D results, as well as the P2M standard provisions.

"Establishment of the set of basic indicators of SBPP values". According to the P2M standard, this subprocess employs the balanced scorecard "5E+2A". It is proposed to supplement the scorecard with the innovation indicator "I", as this value is essential for science-based enterprises and their development[12]. The resulting project value scorecard "5E+2A+I" is used in the mathematical model of the value-oriented SBPP formation and presented in[13]. Within the functional model under study,

[12] O. Savina, *Conceptual model of value-oriented management of project portfolios of science-based enterprises*, "Collection of Scientific Publications of NUOS" 2017, No. 4, p. 80.
[13] O. Savina, *Mathematical model of value-oriented portfolio management of high-tech enterprise projects*, "Natural and Technical Sciences" 2017, No. 2, p. 36.

the employees of the project management office and commercial department are to verify that the obtained value indicators comply with the requirements of relevant DSTU, GOST, OST and TU.

Figure 4. Decomposition of the second stage of the value-oriented anti-risk SBPP management
Rysunek 4. Dekompozycja drugiego etapu zorientowanego na wartość zarządzania ryzykiem SBPP



Source: own elaboration.

"Calculation of weight coefficients". Using the expert assessment method, managers and financial experts take into account the basic value indicators to calculate the performance indicators and weight coefficients to be achieved within the strategic goals of each project.

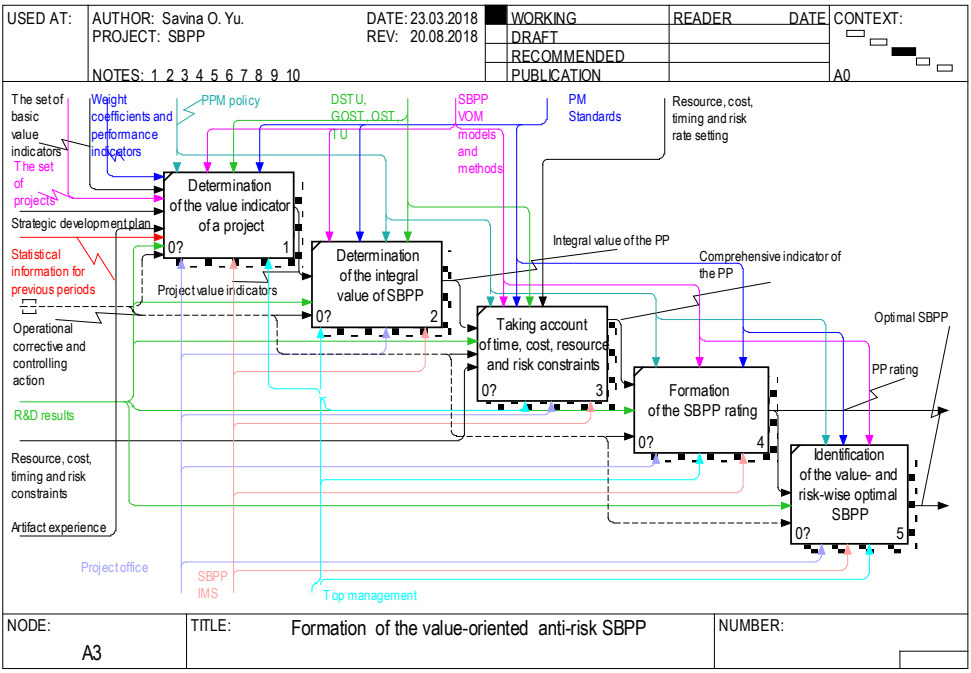
"Identification of the resource, cost and timing constraints of PP implementation". Relevant regulatory documents and input data serve to determine the constraints on the resources, costs, and implementation time. The statistical and expert methods introduced by the managers are also used for this purpose.

"Identification of the risk-induced constraints on the PP". This subprocess uses the statistical and expert methods, which are regulated by respective normative documents and standards. The information on identified risks serves as input. Within this subprocess, the following techniques are applied: Ishikawa cause and effect dia-

grams[14] and decision trees for high risks, and risk reduction methods, such as insurance, risk sharing, outsourcing, limitation, diversification, and reserve formation.

The third subprocess, "Formation of the value-oriented anti-risk SBPP", consists of the following five third-level subprocesses (see Fig. 5).

Figure 5. Decomposition of the third stage of the value-oriented anti-risk SBPP management
Rysunek 5. Dekompozycja trzeciego etapu zorientowanego na wartość zarządzania SBPP przeciw ryzyku



Source: own elaboration.

"Determination of the value indicator of a project". Based on the weight coefficients for achieving the strategic objectives and performance indicators of the SE, the value indicators of each science-based project are determined so that they can be rated according to their value.

"Determination of the integral value of SBPP". The economic and mathematical model is taken as a basis for the solution of the optimization problem of linear programming via the simplex method. It results in establishing the integral value of the PP[15] and forming the sets of PP.

[14] O. Savina, V. Kharuta, *Risk management for project portfolios of science-based enterprises,* "Bulletin of the National Transport University, Series "Technical sciences" 2017, No. 1 (40), p. 285.

[15] O. Savina, *Mathematical model of value-oriented portfolio management of high-tech enterprise projects*, "Natural and Technical Sciences" 2017, No. 2, p. 36.

"Taking account of time, cost, resource and risk constraints". Knowing the integral values of SBPPs, project management office managers check their compliance with the constraints on resources, costs, timing and risks within the mathematical model of the SBPP value-oriented management. At the output, there is obtained a comprehensive indicator for each PP, which is used in "Formation of the SBPP rating".

"Identification of the value- and risk-wise optimal SBPP". By analyzing the obtained indicators and rating, the head of the project management office together with its top managers identifies the optimal SBPP, which has the value indicators and complies with the established risk constraints. This SBPP shall be implemented.

The fourth subprocess, "SBPP Implementation and Control", consists of five third-level subprocesses, see below and in Fig. 6.

"Development of a production schedule". Being guided by the decision of top managers, the project office and the planning department develop a production schedule for a particular SBPP, which is based on respective norms and standards.

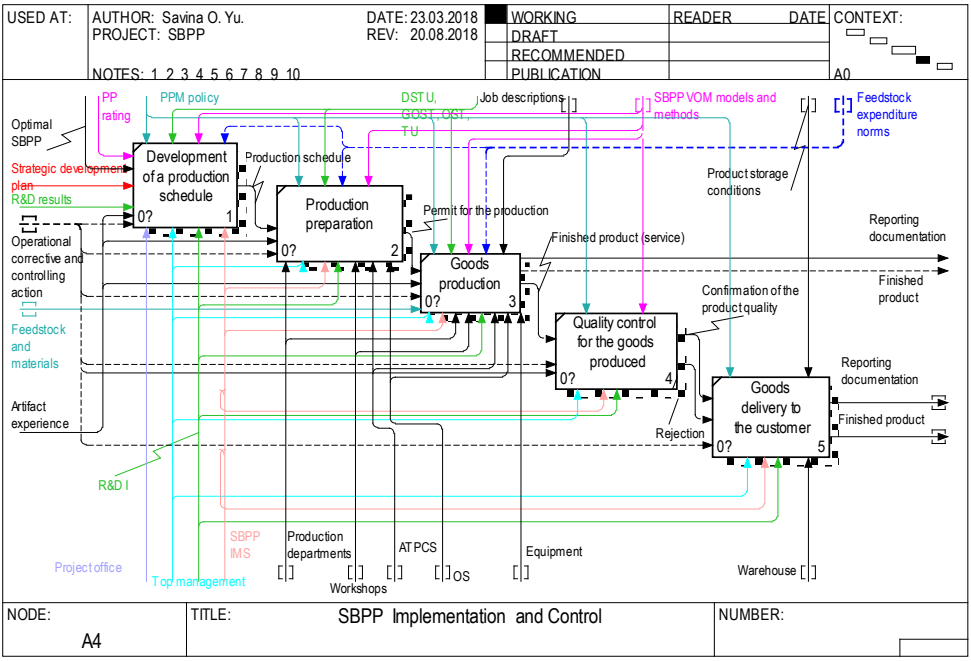
"Production preparation". Production departments and workshops prepare the capacities for production using the automated technical process control system (ATPCS) and the operating system (OS) with account for the production schedule, norms for feedstock and material expenditure, and provisions of appropriate standards and technical conditions. Checking the readiness of production is followed by a granting a permit for the production of goods.

"Goods production". Based on the previously obtained permit, production departments and workshops produce goods using appropriate raw materials and equipment. The subprocess is regulated by job descriptions and rules, which are in turn based on the strategic values of the SE. What scientific departments produce is services, sets of documents, or patents. The subprocess output is the results of the implemented SBPP and relevant reporting documentation.

"Quality control for the goods produced (services rendered)". The finished product (service) is checked for compliance with the claimed characteristics and value indicators. The output comprises confirmation of the quality of the finished product or rejection.

"Goods delivery to the customer". The finished product is submitted to the customer or temporarily stored in a warehouse until the order for delivery is issued. in case of rejection, the product is stored at the enterprise for recycling or disposal. At the output, the relevant reporting documentation is obtained, and the finished product is immediately available.

Figure 6. Decomposition of the fourth stage of the value-oriented anti-risk SBPP management
Rysunek 6. Dekompozycja czwartego etapu zorientowanego na wartość zarządzania ryzykiem SBPP



Source: own elaboration.

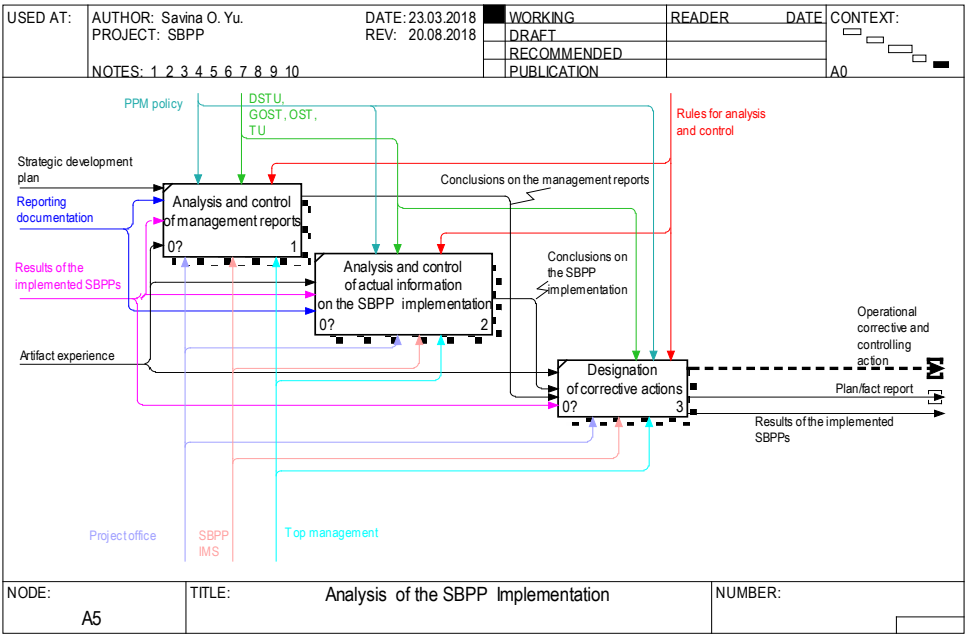
The last, fifth subprocess, "Analysis of the SBPP Implementation", consists of three third-level subprocesses (see Fig. 7). Let us discuss them below.

"Analysis and control of management reports". The head of the project management department along with top managers considers the results of the implemented SBPP and the reporting documentation and, being guided by the standards, technical specifications and regulations for analysis and control, conducts analysis and control of management reports and draws respective conclusions.

"Analysis and control of actual information on the SBPP implementation". Based on the implementation reports and actual results of the implemented SBPP, the head of the project management office and top managers conduct analysis and control of the actual information on the PP implementation and draws respective conclusions.

"Designation of corrective actions". Based on the conclusions of the analysis of management reports and SBPP implementation, the head of the project office and the top manager set the corrective actions. At the output, there is an operational corrective and controlling action, a plan/fact report, and the SBPP results.

Figure 7. Decomposition of the fifth stage of the value-oriented anti-risk SBPP management
Rysunek 7. Dekompozycja piątego etapu zorientowanego na wartość zarządzania ryzykiem SBPP



Source: own elaboration.

Conclusions

Changes in the global economy affect all the spheres of human activity. They prompt a rapid response from the world of project management, as its boundaries are expanding, and new important trends are shaping. In particular, current conditions call for brand new methodological approaches to the analysis and management of the development of science-based high-technology industries, which can be regarded as guarantors of the state's competitiveness and stability. The goal of the latter is to maximize the return on implementation of the entire set of projects, bearing uncertainties and losses in mind.

The constructed a functional model of the value-oriented anti-risk science-based project portfolio management using the functional modeling methodology of IDEF0. It takes into account the basic value indicators of the projects and portfolios that meet specified requirements, minimizes losses and uncertainties, and provides the maximum integrated value of project portfolios.

Bibliography

A guide to project management body of knowledge (PMBOK): 5th edition, "Project Management Institute", USA 2013.

Archibald R., *High-technology program and project management*, "DMK Press", Moscow 2004.

Benko C., McFarlan F., *Connecting the dots: aligning projects with objectives in unpredictable times,* I.D. Williams Publ., Moscow 2007.

Burkov V., Kvon O., Tsitovich L., *Multi-project management models and methods*, IPU RAN, Moscow 1998.

Bushuev S., Bushueva N., *Mechanisms of the formation of value in the activity of design-managed organizations*, "Eastern-European Journal of Enterprise Technologies" 2010, No 2 (43).

Chernov S., Savina O., *Method of formation of value-oriented portfolio management of high--tech enterprise projects*, "Management of Development of Complex Systems" 2018, No. 34.

Danchenko O., *Practical aspects of business process reengineering*, Kyiv 2013.

Management of innovative projects and programs. R2M. Volume 1, Version 1.2., "Naukovyi svit Publ.", Kyiv 2009.

Matveev A., Novikov D., Tsvetkov A., *Project portfolio management models and methods*, PMSOFT, Moscow 2005.

Molokanova V., *Portfolio management of the development of an organization based on the value-oriented approach*, "Management of complex systems"2012, No. 12.

Rudenko S., Glovatska S., *A model for the formation of project portfolios on the international activity of a university*, "Visnyk NTU (HPI)" 2013, No. 2 (1174).

Savina O., *Conceptual model of value-oriented management of project portfolios of science--based enterprises*, "Collection of Scientific Publications of NUOS" 2017, No. 4.

Savina O., *Features of portfolio projects of science-based enterprises and peculiarities of their management*, "Management of Development of Complex Systems" 2017, No. 30.

Savina O., *Mathematical model of value-oriented portfolio management of high-tech enterprise projects*, "Natural and Technical Sciences" 2017, No. 2.

Savina O., Kharuta V., *Risk management for project portfolios of science-based enterprises*, "Bulletin of the National Transport University, Series "Technical sciences" 2017, No. 1 (40).

Authors' resume:
Yurij Kharytonov *– Doctor of Technical Sciences in the area of management, Professor, specialized in strategic management. The author of numerous articles and essays concerning strategic management of enterprises and resources management. The scientific interest of the author focuses on topics related to the strategic management of national enterprises and their logistics. Dean of the Faculty of Marine Infrastructure, Admiral Makarov National University of Shipbuilding, Mykolaiv, Ukraine.*

Oksana Savina *– postgraduate student of the Department of Project Management, specialized: project and program management. An author of many articles in the field of project management and portfolio management for science-based projects of enterprises. Her research in-*

terests focus on the value-oriented anti-risk of portfolio management for science-based projects of enterprises. Senior Lecturer of the Department of Technological and Civil Security, Admiral Makarov National University of Shipbuilding, Mykolaiv, Ukraine

Noty o Autorach:
***Yurij Kharytonov** – doktor nauk technicznych w zakresie zarządzania, profesor, specjalizujący się w zarządzaniu strategicznym. Autor wielu artykułów i esejów dotyczących zarządzania strategicznego przedsiębiorstwami i zasobami. Zainteresowania naukowe autora koncentrują się wokół zagadnień związanych z zarządzaniem strategicznym przedsiębiorstw krajowych i ich logistyką. Dziekan Wydziału Infrastruktury Morskiej, Narodowego Uniwersytetu Budowy Okrętów imienia Admirała Makarowa, Mykołjów, Ukraina.*

***Oksana Savina** – asystent w Katedrze Zarządzania Projektami, specjalizacja: zarządzanie projektami i programami. Autorka artykułów z zakresu zarządzania projektami i zarządzania portfelem projektów naukowych przedsiębiorstw. Jej zainteresowania badawcze koncentrują się na zorientowanym na wartości ryzyku zarządzania portfelem projektów przedsiębiorstw opartych na nauce. Starszy wykładowca w Departamencie Bezpieczeństwa Technicznego i Cywilnego Narodowego Uniwersytetu Budowy Okrętów imienia Admirała Makarowa, Mykołjów, Ukraina.*

Contact /Kontakt:
dr Yurij Kharytonov
Admiral Makarov National University of Shipbuilding
Faculty of Marine Infrastructure
Avenue Central 3
54025 Mykolaiv, Ukraine
kharytonov888@gmail.com

Asystent Oksana Savina
Admiral Makarov National University of Shipbuilding
Department of Project Management
Avenue Heroes of Ukraine 9
54025 Mykolaiv, Ukraine
oksanasavina14@gmail.com

Wkład poszczególnych autorów w przygotowanie publikacji:
The contribution of particular co-authors to preparation of the paper:
Yurij Kharytonov – 40%, Oksana Savina – 60%.