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BUSINESS PROCESS MODELS FOR MANAGING “GREEN” ENERGY EFFICIENCY PROJECTS

Abstract. The article analyzed research, standards, and project management methodologies that can be used to create and develop a “green” project management approach. On the other hand, it analyzed research in the field of engineering and process reengineering. It emphasized the features of process management as a system-building approach that integrates scenario, organizational, and project management. It formulated a vision of a generalized model for classifying the processes of a project-oriented organization, consisting of the following types of processes: main processes, auxiliary processes, organizational management processes, project and program and project portfolio management processes, IT processes, and stakeholder interaction processes. Two models were proposed to supplement such a classification – the “additional green processes” model and the “end-to-end greening of processes” model. Within the framework of using the first model, a list of basic “green” processes was proposed: development of top-level concepts of “green” development of a project-oriented organization – vision, mission, corporate culture; development of a strategy for the “green” development of a project-oriented organization; development of “green” projects of a project-oriented organization; development of a justification for the feasibility of implementing “green” projects; processing of “green” initiatives; implementation of “green” projects and monitoring of such implementation; management of the “time-cost-quality” triangle of “green” projects; risk management of “green” projects; management of stakeholder involvement in “green” projects; filling the knowledge base on the implementation of “green” projects; use of artificial intelligence functions in the implementation of “green” projects. The main “green” processes are characterized with the indication of the corresponding sub-processes responsible for their implementation and the measurability of the duration of such processes. One of the “green” processes (processing of green initiatives) is modeled using the BPMN 2.0 notation. A method of directed mosaic greening of process attributes of a project-oriented organization is proposed, consisting of 10 steps: 1) identification of foci of spontaneous crystallization of the basics of “green” management; 2) identification of tangential directions, formulation of clusters of development of “green” directions; 3) identification of leaders of opinions; 4) formation of a team; 5) development of a greening strategy; 6) development of a detailed plan; 7) implementation of a detailed plan; 8) parallel monitoring; 9) finalization of the project; 10) filling in the knowledge base. A SWOT analysis of the formulated approach to the models and method of engineering processes of “green” project management was conducted, its strengths and weaknesses were highlighted, as well as the opportunities and threats that may arise when using it. A conclusion was made regarding the potential effectiveness of such an approach. Areas for further research in the chosen direction were formulated. Conclusions from the conducted research were formulated.

Keywords: project and program management; project-oriented organization; “green” (sustainable) project management processes; process engineering; kaizen

Introduction

The effectiveness of project management systems is the subject of many scientific studies. The current conditions for project implementation are complicated by the war caused by Russian aggression against Ukraine,

accelerated digitalization and the ever-deeper penetration of artificial intelligence into systems and processes of both everyday and production activities, and many other factors.

Among the components of effectiveness, one can identify the qualifications of personnel and their

productivity, the adequacy of applicable tools and the correctness of their application, the consistency of the integration of such tools, etc. However, one of the essential components of the effectiveness of project management systems is management processes, their adequacy, consistency, and efficiency.

Compliance with the parameters of project management processes, finding ways to improve the values of such parameters in the right direction (one can even talk about optimization in this context) is an important management task.

The field of “green” entrepreneurship, which has begun its rapid development in recent decades, is a response to general civilizational trends regarding the littering of the planet, the critical level of use of limited resources, and the decreasing level of ecology. One of the possible responses to such challenges (although of course they require a comprehensive and systematic approach, and even an immediate one) is to increase the energy efficiency of enterprises and organizations, reduce resource use or increase the efficiency of processes and equipment.

Construction as one of the system-forming branches of the economy urgently and urgently needs the implementation of such projects. Taking into account the set of challenges facing the country and the project management industry, it is worth recognizing the high relevance of projects to ensure the energy efficiency of buildings and structures. The successful implementation of such projects will improve the degree of useful use of resources, can ensure their savings, and will have a positive impact on environmental restoration. Therefore, the development of projects to increase energy efficiency and relevant management systems are practically valuable.

From the point of view of scientific research in this area, it is worth noting their insufficiency in the context of the development of models, methods and processes for managing “green” projects, which makes it impossible to scientifically substantiate the increase in the efficiency of the processes of such projects and determines the scientific relevance of the corresponding development.

Analysis of latest research

The issue of sustainability in project management and entrepreneurship has been considered by many researchers. It has been proven that such an issue is relevant and urgent, and therefore requires the development of new approaches [1]. The complexity of ensuring sustainability, its connection with social and state issues, as well as environmental protection issues, has been emphasized [2]. It has been noted that the development of an approach to ensuring sustainability (as well as relevant models and methods) can occur through the implementation of projects that will be aimed at sustainability. This, in particular, proves the importance of goal-setting models in such projects [3]. Most

researchers agree that ensuring the sustainability of production and management systems is directly related to ensuring the environmental friendliness of processes and products, which some authors suggest considering in the context of a new direction – “green” entrepreneurship [4]. The development of this direction in scientific research [5] led to its institutionalization [6], in particular, one that developed into a reflection in the standards of the International Organization for Standardization ISO [7] and individual applied studies [8].

It is also worth noting that the implementation of “green” entrepreneurship in the field of project management requires taking into account the appropriate methodological environment. Let's analyze the industry standards and approaches in terms of their readiness to implement a new approach. The PMBOK standard added a full-fledged value dimension to the new edition [9], expanding the knowledge area to the value delivery system. Additionally, the “tailoring” knowledge area was added, which describes approaches to adapting methodological innovations to the specifics of the project management system in the organization. The new edition of the P2M standard was supplemented with a knowledge dimension [10], in addition, this standard itself declared value-oriented management from its inception, within which the basis for potentially good integration of the “green” project management approach was created. The new edition of the PRINCE 2 standard generally provides a new dimension in project management, which correlates with “green” entrepreneurship – namely, the principle of “Sustainability” [11], a value dimension congruent with the concept of “green” project management, also added to the ISO project management standard [12]. The Agile flexible project management methodology contains many friendly concepts that will facilitate the implementation of new approaches (including “green” management), namely, flexible backlog, retrospective, retrospective of retrospectives, etc. [13] Hybridization of methodologies as an approach in general, and individual methodological hybrids in particular [14] provide space for the implementation of sustainable, ecological, “green” management even when creating and implementing methodological hybrids into the management system of project-oriented organizations.

On the other hand, developments in the field of business process description and engineering/reengineering create a scientific basis for the formalization of green project management processes. In particular, the reengineering approach is proposed as a new way to improve the efficiency of enterprises, which can be successfully used by project-oriented enterprises [15]. Based on classical approaches to reengineering [16], as well as the evolution of the development of the relevant direction [17], a modern approach to building business process models [18] can be distinguished, which

can be used to create models of green project management processes. Among the classes of such models, it is worth highlighting one of the most used and demanded in practice notation BPMN in the second edition – BPMN2.0 [19], which is proposed to be used in this study.

Certain issues regarding models and methods of “green” project management were considered in the authors’ studies [20]. At the same time, it is worth noting that the issue of modeling business processes of “green project management” is not sufficiently researched in the scientific literature. Therefore, we can conclude that the topic of this article, which is devoted to the description (engineering) of processes for managing “green” energy efficiency projects, can be considered relevant.

Purpose of the article

The purpose of the article is to develop process models and a process engineering method for green projects, based on an analysis of the approach to sustainable entrepreneurship and green project management, and to identify future research directions in this context.

The main material of the article

Process management is one of the areas of management in an organization. Other areas are scenario management, project management, organizational management, etc. However, process management itself can be considered system-forming. Indeed, process management can create synergy due to the following features:

- process management describes project processes, in particular project management processes;
 - scenario models of scenario management can be described in the form of processes;
 - organizational management (not covered by project activities), in particular in the field of organizational structure development, can be described and optimized through descriptions of such management processes.
- In the context of expanding the system of classification of processes and business processes of a project-oriented organization, we will formulate a vision of a generalized model of such classification and indicate the direction of each of their types [16]:
- core processes (aimed at creating value);
 - supporting processes (aimed at providing support in creating value), among which financial processes, marketing processes, etc. are separately distinguished;
 - organizational management processes (aimed at supporting and developing the organizational basis for creating value);
 - project, program and project portfolio management processes (aimed at creating additional value through project activities);

- IT processes (aimed at creating, supporting and developing the IT component of the organization's activities to ensure better value creation by the organization);

- stakeholder engagement processes (aimed at improving the ways in which the organization's stakeholders obtain value, achieving balanced value by interested parties).

Two models can be proposed for further development of this classification.

The first model “Additional Green Processes” consists in highlighting a separate type of process in addition to the existing ones – “green” processes.

The second model “End-to-end greening of processes” involves “greening” all types of processes, i.e. adding a “green” dimension to each of them. The essence of “greening” is the use of green tools, techniques, models and methods and “green” teams in all artifacts of all processes.

We propose a list of the main “green” processes within the framework of using the first of the proposed models:

- development of top-level concept of “green” development of a project-oriented organization in accordance with the concept of “green” entrepreneurship – vision, mission, corporate culture;
- development of a strategy for “green” development of a project-oriented organization in accordance with the concept of “green” entrepreneurship;
- development of “green” projects of a project-oriented organization in accordance with the concept of “green” development;
- development of a justification for the feasibility of implementing “green” projects;
- processing green initiatives;
- implementation of “green” projects and monitoring of such implementation;
- management of the “time-cost-quality” triangle of “green” projects;
- risk management of “green” projects;
- management of stakeholder involvement in “green” projects;
- filling the knowledge base on the implementation of “green” projects;
- using artificial intelligence functions in the implementation of “green” projects.

The characteristics of some of the main processes, indicating the corresponding sub-processes responsible for their implementation and the measurability of the duration of such processes, are given in Table.

Responsibility for organizing the description of processes should be defined. One of the attractive models for this is the initiation of a project for the description (engineering) of the processes of “green” project management.

Table 1 – Characteristics of the main processes of “green” project management

№	Green processes	Sub processes	Responsible	Units of time
1	Development of high-level concepts of “green” development	– Development of a mission for “green” development; – Development of a vision for “green” development; – Development of a corporate “green” culture.	CEO	Years
2	Development of a green development strategy	– Development of the basic part of the strategy; – Development of scenario models of the strategy.	Development Director	Months
3	Development of “green” projects	– Development of energy efficiency improvement projects; – Development of greening management system projects.	PM	Months
4	Managing stakeholder engagement in “green” projects	– Managing external stakeholder engagement; – Managing internal stakeholder engagement.	PM	Weeks
5	Filling the knowledge base on the implementation of “green” projects	– Knowledge base structure development; – Knowledge base filling; – Identification of patterns and recommendations.	IT manager	Weeks

Within the framework of the use of the first model “Additional green processes”, the engineering project should cover all types of processes (main, auxiliary, organization management, project management, IT processes, interaction with stakeholders). In the case of implementing the description of the full list of processes, such description can occur using different scenarios.

Scenario 1. Step-by-step description of the full list of processes. Within such a scenario, a sequence of processes that need to be described can be formulated. Usually, the main processes are described first in this case. Although, depending on its own priorities, a project-oriented organization can establish its own sequence and adhere to it. This scenario uses the waterfall life cycle model and processes are described one after the other so that one process is described in one period of time. The longest scenario, however, the quality of each process description is predictably high.

Scenario 2. Iterative description of several processes simultaneously. The first iteration may, for example, include several main processes, the second – several main and several auxiliaries, etc. This approach provides faster consideration of errors in cross-description of processes, and guarantees faster completion of the project. However, this may require more resources. At the same time, the complexity of the project becomes higher.

Scenario 3. Simultaneous description of all processes. This scenario requires more resources compared to the previous scenarios. However, it is the fastest. Among the disadvantages of this scenario, it is also worth noting the high probability of errors due to the inability to take them into account based on the results of previous project stages.

The choice of a scenario for implementing “green” process engineering in a project is within the competence of the project team of a project-oriented organization.

The second scenario seems to be the best in terms of time-quality ratio, however, each specific case of scenario selection is subject to a more in-depth analysis, taking into account the specifics of the project-oriented organization and the situation in which it is located.

An example of a description of one of the “green” processes, namely the “processing green initiatives” process, is shown in Figure. The BPMN 2.0 notation is used for the description. The given model uses four roles – the initiator of the “green” initiative (who can belong to both the project team and the staff of the project-oriented organization that does not participate in the project and represents stakeholders), the project manager, the technical lead and the project team. The specified process describes only the consideration of the “green” initiative, the analysis of its feasibility and, in the case of a positive conclusion on this, the selection of adequate green tools, as well as the development of a detailed plan for the implementation of the project for its implementation. The implementation of the “green” initiative, as well as the monitoring of such implementation, should be described by other processes.

Within the framework of using the second of the models proposed above (the “End-to-End Process Greening” model), we propose the method of Directed Mosaic “Greening” (DMG) of process attributes of a project-oriented organization.

1. Identification of centers of spontaneous crystallization of the basics of “green” management in a project-oriented organization.

2. Identification of tangential directions to the centers of spontaneous implementation of the basics of “green” management, formulation of clusters of development of “green” directions.

3. Identification of “leaders” of opinions regarding the development of “green” entrepreneurship in the organization.

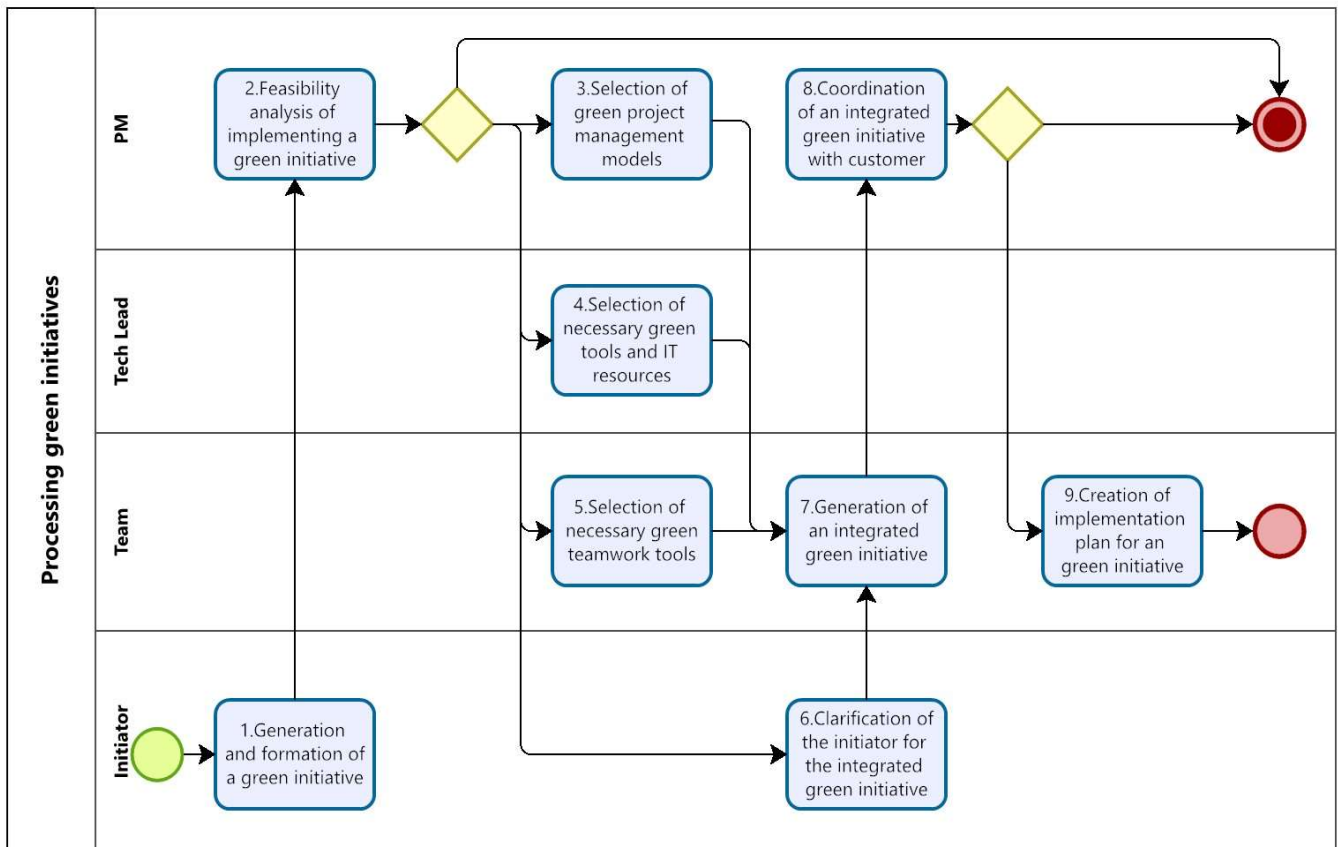


Figure – Process model of processing green initiatives in BPMN 2.0 notation

4. Formation of a team for the implementation of directed mosaic “greening” with the involvement of opinion leaders in the team.

5. Development of a greening strategy and its coordination with the organizational strategy.

6. Development of a detailed plan for directed mosaic “greening” and scenario variation models of possible ramifications in its implementation – based on the centers of spontaneous crystallization of the foundations of “green” management and clusters built on their basis.

7. Implementation of a detailed plan for directed mosaic “greening” using the Agile methodology using the Scrumban hybrid approach.

8. Parallel monitoring of the implementation of the detailed plan using kaizen models and Scrum artifacts - daily meetings, retrospectives, retrospectives of retrospectives, etc.

9. Finalization of the project, description and formalization of its results.

10. Filling the knowledge base based on the project results, applying statistical methods and artificial intelligence to identify patterns in implementation and to draw lessons for use in subsequent projects.

We will conduct a study of the obtained results in the form of a SWOT analysis with the determination of

the strengths of the proposed approach (which includes the proposed models and method), its weaknesses, as well as the threats that are inherent in its implementation, and the opportunities that may open up due to its implementation.

Strengths.

- compliance with the “green” vector of development, the concept of “green” entrepreneurship and the corresponding concept of “green” project management;

- complementarity, systematicity and detail of the elements of the approach;

- flexibility of the approach due to the use of the Agile methodology and the Kaizen concept.

Weaknesses.

- contradictions between the goals of profitability and environmental friendliness within the framework of the “green” approach;

- insufficient practical testing of the approach;

- complication of the management system due to the use of models and methods of “green” project management.

Opportunities.

- the possibility of further development of “green” project management and “green”

entrepreneurship due to the application of the proposed models and method;

- the possibility of increasing the number of projects in a project-oriented organization due to improved reputation due to the use of the “green” approach;

- the possibility of ensuring the sustainability of the management system due to additional flexibility.

Threats.

- war and war risks can reduce the relevance of “green” project management;

- failure of competitors to use the “green” approach in combination with its ineffective use by the organization can lead to a loss of competitive positions;

- the threat of staff turnover due to non-adoption of the approach.

Based on the results of the SWOT analysis, we conclude that the potential strengths of the “green” project management processes can overcome its weaknesses, and the use of opportunities can overcome threats. Let us formulate the prospects for further research in the chosen direction based on the results of the conducted research:

1. Development of formalized models of "green project" management processes.

2. Development of models of executed business processes in the context of automating theoretical developments.

3. Testing of research results in energy efficiency projects.

4. Formalization of conclusions and adjustments to models and methods of managing processes of “green” projects based on the results of testing.

5. Training neural networks (or other artificial intelligence models) based on the conclusions obtained in order to use artificial intelligence in future projects to improve energy efficiency.

Conclusion

The problems of increasing energy efficiency do not lose their relevance even in times of war caused by the aggression of the Russian Federation. In this context, the relevant direction of “green” entrepreneurship is developing and a related direction of achieving it through projects – the direction of “green” project management, which is investigated in this article from the point of view of developing relevant processes.

This article analyzes research on project management, as well as known standards and methodologies in the context of their possible use for the development of a “green” project management approach. The features of process management are emphasized, a vision of a generalized model of classification of processes of a project-oriented organization is formulated, two models of supplementing such a classification are proposed - additional green processes and end-to-end greening of processes. A list of the main “green” processes is proposed, their characteristics are given, one of the processes is modeled using the BPMN 2.0 notation. A method of directed mosaic greening of attributes of processes of a project-oriented organization is proposed. A SWOT analysis of the proposed set of models of “green” project management processes was conducted, their strengths and weaknesses were highlighted, as well as opportunities and threats that may arise when using them. A conclusion was made regarding their potential effectiveness. Areas of further research in the chosen direction were formulated.

In general, it is worth noting that the proposed approach to “green” project management processes is relevant, and its implementation can potentially bring practical value for the further development of project management models and methods, project teams, the environment in general, and the scientific direction of sustainability management.

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**МОДЕЛІ БІЗНЕС-ПРОЦЕСІВ УПРАВЛІННЯ «ЗЕЛЕНИМИ ПРОЄКТАМИ»
ПІДВИЩЕННЯ ЕНЕРГОЕФЕКТИВНОСТІ**

Анотація. У статті було проведено аналіз досліджень, стандартів і методологій проєктного менеджменту, які можна використовувати для створення та розвитку підходу «зеленого» проєктного менеджменту. З іншого боку, було проведено аналіз досліджень у галузі інжинірингу та реінжинірингу процесів. Підкреслено особливості процесного управління як систематичного підходу, що інтегрує сценарне, організаційне та проєктне управління. Сформульовано бачення узагальненої моделі класифікації процесів проєктно-орієнтованої організації у складі таких типів процесів: основні процеси, допоміжні процеси, процеси управління організацією, процеси управління проєктами та програмами й портфелями проєктів, IT-процеси, процеси взаємодії зі стейкхолдерами. Запропоновано дві моделі доповнення такої класифікації – модель «додаткові зелені процеси» та модель «наскрізне озеленення процесів». У межах використання першої моделі запропоновано перелік основних «зелених» процесів: розробка верхньорівневих концептів «зеленого» розвитку проєктно-орієнтованої організації – бачення, місії, корпоративної культури; розробка стратегії «зеленого» розвитку проєктно-орієнтованої організації; розробка «зелених» проєктів проєктно-орієнтованої організації; розробка обґрунтування доцільності реалізації «зелених» проєктів; обробка «зелених» ініціатив; впровадження «зелених» проєктів та моніторинг такого впровадження; управління трикутником «час-вартість-якість» «зелених» проєктів; управління ризиками «зелених» проєктів; управління залученням стейкхолдерів до «зелених» проєктів; наповнення бази знань щодо

реалізації «зелених» проєктів; використання функцій штучного інтелекту в реалізації «зелених» проєктів. Надано характеристику основних «зелених» процесів із зазначенням відповідних підпроцесів, відповідальних за їх здійснення, та вимірності тривалості таких процесів. Один із «зелених» процесів (обробка зелених ініціатив) змодельовано з використанням нотації BPMN 2.0. Запропоновано метод спрямованого мозаїчного озеленення атрибутів процесів проєктно-орієнтованої організації у складі 10 кроків: 1) виявлення осередків спонтанної кристалізації основ «зеленого» менеджменту; 2) виявлення дотичних напрямів, формулювання кластерів розробки «зелених» напрямів; 3) ідентифікація «лідерів» думок; 4) формування команди; 5) розробка стратегії озеленення; 6) розробка детального плану; 7) реалізація детального плану; 8) паралельний моніторинг; 9) фіналізація проєкту; 10) заповнення бази знань. Проведено SWOT-аналіз сформульованого підходу щодо моделей і методу інжинірингу процесів «зеленого» проєктного менеджменту, виділено його сильні та слабкі сторони, а також можливості й загрози, що можуть виникнути при його використанні. Зроблено висновок щодо потенційної ефективності такого підходу. Сформульовано галузі подальших досліджень у обраному напрямі. Сформульовано висновки з проведених досліджень.

Ключові слова: управління проєктами та програмами; проєктно-орієнтована організація; процеси «зеленого» (циркулярного) проєктний менеджменту; інжиніринг процесів; кайдзен

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