

Modeling a Set of Management Approaches for the Effective Operation of the Environmental Management System at the Business Entities

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ABSTRACT

The paper presented the results of research on the choice of management approaches to ensure the effective functioning of the environmental management system of business entities. New challenges contribute to the formation of a new system of approaches to decision-making. Implementation of environmental management systems is conducted in accordance with the requirements of the international standard ISO 14001: 2015. Effective EMS is based on a balanced choice of management approaches, the main objective of which is to ensure environmental performance at each stage of the EMS implementation. The clear control of indicators of environmental-organizational changes and environmental performance criteria of environmental management system requires the formation of a set of complementary management approaches that promote productive decision-making to reduce risks and prevent criticality of the environment. The result of the study is the development of an algorithm of the procedure for selecting effective management approaches. The formation of structural model of approaches in the process of implementation and functioning of the environmental management system has helped to identify the organizational activities that ensure the environmental safety of business entities. A thorough analysis of each stage of the development, implementation and operation of environmental management system enabled identifying a set of management approaches, forming a vector of environmental and organizational changes in the activities of business entities. Taking into account the developed algorithm of the procedure of selecting managerial approaches and the conceptual model of assessing managerial approaches to the effective functioning of the environmental management system, a structural model of applying managerial approaches at each stage of implementation and functioning of the EMS to improve the environmental safety of business entities was built. The study pertaining to the stages of structural model and application of QFD-methodology (Quality Function Deployment) allowed building a matrix diagram, which defines a vector of orientation of approaches, taking into account their complexity and materiality.

Keywords: structural modeling, environmental management system, operational efficiency, environmental safety, management approaches, environmental and organizational changes in the activity

INTRODUCTION

Problem statement and purpose of the study

The dynamism of events in the economic, environmental and socio-political spheres creates new challenges to the activities of business entities. This, in turn forms a new system of approaches in decision-making on the need to implement environmental management systems in accordance with the requirements of the international standard ISO 14001: 2015. An environmental management system is a part of a management system which is used for managing environmental aspects, to meet the mandatory compliance requirements, and address the issues related to risks and opportunities [DSTU ISO 14001: 2015, 2016]. In order to make EMS effective, a prudent choice of management approaches which would be applied and be effective at each stage of EMS implementation, is required. The most important result of the system implementation of the is the continuous improvement of all indicators related to significant environmental aspects of entity's activities, products and services.

The application of a management approaches combination will allow adjusting and improving technical, economic, environmental, social, psychological, managerial and other aspects, significantly affecting the stages of development and effectiveness of the implemented environmental management system at business entities. These approaches characterize and determine the state of three subsystems: «Environment», «Internal environment», «External stakeholders», which are a part of the «Business Entity» system. It was established that strengthening the human factor role in the «Business Entity» system requires the application of behavioral (motivational) approach. Incentives help to carry out the necessary ecological and organizational changes in the activities of business entities faster and better.

The main task of the implemented EMS is its effective functioning, which consists in the fulfillment of mandatory compliance requirements and commitments made by the business entity management. Continuous improvement of the ecological and organizational changes indicators and ecological activity criteria of the ecological management system determined by the EMS working group will help to implement the system for making decisions on risk reduction and prevent the critical condition of the environment.

Therefore, the purpose of this work was to develop a procedure for selecting and developing a structural and functional model of management approaches in the implementation and operation of the EMS to improve the environmental safety at business entities.

Actual scientific researches and issues analysis

A number of studies were devoted to the development, implementation and effective functioning of environmental management systems in enterprises, the transition of environmental management from tactical to strategic level through the introduction of technical and organizational mechanisms for environmental management, which reduces the negative impact on the environment.

Thus, the works of Khoroshavin [2014], Salim et al. [2018] and Cosmina L.Voinea et al. [2020] presented a study of new environmental policy instruments, which was focused on identifying the procedures needed for more dynamic and effective improvement of environmental performance. Boiral et al. [2018] and Kassinis and Vafeas [2006] noted that the EMS introduction by businesses is a tool to improve the perception of environmental activities at the enterprise by stakeholders, rather than its environmental performance. Many studies consider the data on the dynamics for EMS implementation and certification in accordance with the requirements of ISO 14001 by large multinational companies [Nawrocka and Parker, 2009, Van Kranenburg and Voinea, 2017, Phan and Baird, 2015], and assess the relationship between the EMS implementation by environmental and economic performance indices of the enterprises [Feng and Wang, 2016, Moneva and Ortasm 2010, Tourais and Videira, 2016]. Trumpp et al. [2015], Barabash and Weigang [2020], Voinea et al. [2019] studied the multidimensional construction of corporate environmental indicators and their mathematical modeling. A variety of ways to implement environmental management systems based on ISO 14001, EMAS and alternative models were considered by Díaz de Junguitu and Allur [2019], and Lukianova et al. [2020].

The works considering the organizational changes in enterprises during the EMS implementation are of particular interest [Chiarini, 2012, Nadel et al., 2016, Qi et al., 2012].

However, there is no experience in developing the procedure for creating and applying management approaches at each stage of EMS development, implementation and operation using functional modeling to predict the level of environmental and organizational changes aimed at effective EMS operation to improve environmental safety.

Features of the environmental and organizational changes strategy in the activities of business entities during the environmental management systems implementation

On the basis of the environmental management concept, the EMS implementation by business entities should be accompanied by a number of environmental and organizational changes, which are based on a long-term strategy to manage significant environmental aspects identified during the preliminary analysis of the enterprise. In order to lead the EMS strategy to the full-scale environmental and organizational changes in the activities implementation of business entities and to follow an optimistic scenario based on the management of environmental aspects identified during the preliminary analysis significantly affecting the environment, it will be appropriate to develop and apply the procedures for selecting management approaches for each stage of EMS implementation, which will allow selecting a set of management approaches aimed at controlling and improving the environmental management system.

The international standard ISO 14001 proposes to use only the classical process approach in the EMS development, implementation and operation, which should ensure the processes integration and improvement in the enterprise, transparency, cost reduction through resource management and implementation of environmental measures, as well as give a clearer understanding of responsibility by employees. In practice, the application of the only process approach during innovative changes in the activities of business entities indicates a misunderstanding by management for the standard essence and leitmotif and confirms the use of traditional authoritarian management style unacceptable for environmental and organizational changes.

The modern basis for effective management at the enterprises has a wide range of

management approaches applying both classic and new Agile methods. Today's challenges are shifting the emphasis to determining the efficiency of resource use and capacity of enterprises. This contributes to the development of environmental and organizational changes strategy in the activities of business entities, which takes into account the requirements of the time, and its implementation is based on a symbiosis of classical and innovative management approaches.

The need to apply several classical approaches to management, the shortcomings off which are removed by complementing one approach to another and combining several approaches simultaneously will allow for environmental and organizational changes as well as constantly monitoring and improving the operating environmental management system.

As for the process approach, it will be quite effective during those stages of EMS development and implementation, which require clear implementation of tasks and actions according to the established template, in particular, it is advisable to use a process approach for preliminary analysis of the entity and development of primary EMS documentation. Therefore, the long-term management strategy aimed at continuous improvement of the environmental management system should ensure the balance of socio-ecological and economic development of subsystems in the «Business Entity» system through environmental and organizational changes based on the choice of management approaches for each stage of EMS development, implementation and operation.

Therefore, in order to carry out environmental and organizational changes during the EMS implementation, it is first necessary to develop a procedure for selecting management approaches based on a careful analysis for each stage of EMS development, implementation and operation.

RESULTS AND DISCUSSION

The procedure for choosing a management approach during the EMS development and implementation

The modeling of the procedure for selecting management approaches during the EMS implementation was based on the analysis

of the operating parameters in the «Environment», «Internal stakeholders», and «External environment» subsystems, which are part of the «Business Entity» system. In order to implement the quality parameters of the management approach and determine its effectiveness, the input parameters of the system were analyzed (Fig. 1).

This allowed finding out how well the defined parameters meet the requirements for the effective EMS operation. Applying a systematic analysis of the parameters to enter into the «Business Entity» system and the parameters to enter into its subsystem, the results were obtained, which helped to determine how much the process efficiency will improve when the proposed approach will be applied at the stage of environmental and organizational change. If the management approach is appropriate for its application at a certain stage of EMS implementation and its application will affect the development of the «Entity» system and its subsystem, it is applied. If the approach is not effective for environmental and organizational changes, as well as for subsystems and their elements, then another approach with the necessary characteristics, which will be effective in the EMS development and implementation, is searched for.

Conceptual model for determining management approaches to the effective operation of environmental management systems

The effective functioning of the environmental management system at the business entities should take into account such management theory aspects as target and functional. These aspects are based on a number of socio-ecological and economic development indicators and quality implementation basic managerial functions. The existing general approaches to determining the management effectiveness (target, functional, compositional, multiple, behavioral) cannot fully meet the modern requirements for the formation of environmental safety of enterprises activities. Therefore, the most common solution is combining approaches and consideration triads factors: resource management activities – costs – result. The balance between the optimal use of resources and costs, which will increase the management efficiency in the environmental management system, is significant for this model [Tanchuk, 2016].

The general characteristics of efficiency models allow identifying a complex, the components which are targets and the external environment, organizational activities and structure, management technologies as well as efficiency evaluating methods.

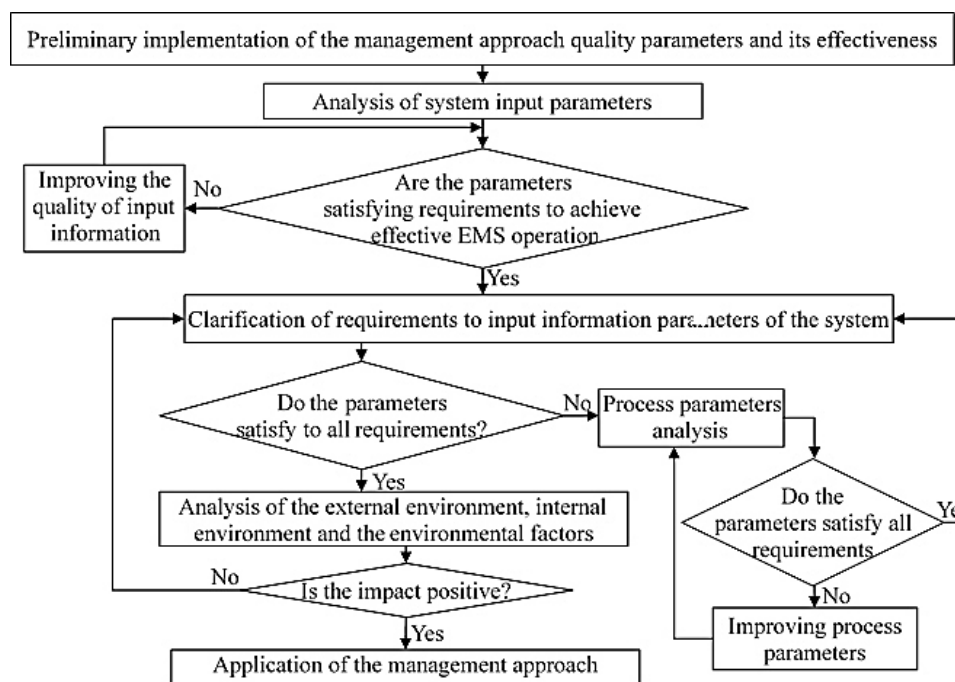


Figure 1. The procedure for choosing a management approach during the EMS development and implementation

The formation of a conceptual model for determining management approaches to the effective operation of the environmental management system is aimed at reducing the risks of negative environmental impact and requires analysis of the causes for increasing pollution and resources depletion in the business entities activity. The tools for solving this problem optimizing the integration of enterprises into the environment are management approaches and innovative methods of technical improvement. A reformatting of the organizational and production units' activities of business entities in the process of reengineering.

Conceptual model for evaluating the definition of management approaches to the effective functioning of the environmental management system (EMS_{efun}) is based on many of monitoring results and production and organizational audits (POA), socio-economic (SEA) environmental (EA) activities of business entities:

$$\begin{aligned} EMS_{efun} &\triangleq [OPA \leftrightarrow SEA \leftrightarrow EA]; \\ OPA \subseteq EMS_{efun} \wedge SEA \subseteq EMS_{efun} \wedge EA \subseteq EMS_{efun}. \end{aligned} \quad (1)$$

These sets of enterprises activities results are a set of parameters and criteria enabling to assess the impact of management approaches on the direction of change in the level of BE environmental safety and to determine the EMS_{efun} function:

$$\begin{aligned} EMS_{efun} &= f(OPA, SOA, EA); \\ \{x|OPA(x)\} &:\exists x, OPA(x); \\ \{y|SEA(y)\} &:\exists x, SEA(y); \\ \{x|EA(y)\} &:\exists x, EA(z); \\ \Rightarrow \forall xyz, &EMS_{efun}(x, y, z). \end{aligned} \quad (2)$$

Thus, the conceptual model for determining management approaches to the effective functioning of the BE environmental management system covers all structures and elements of business operation, which will determine the importance and effectiveness of implemented management approaches and assess their impact on minimizing environmental risks in uncertainty.

Structural model of management approaches implementation during the EMS development and implementation

The effective operation of the environmental management system is due to the application of management approaches at each stage of its development and implementation. The choice and application of a combination consisting of several classical approaches will allow creating such environmental management system, the foundation of which includes long-term activities aimed at monitoring, evaluation, continuous improvement and management of environmental aspects aimed at preventing the environmental pollution. The structural model of management approaches application during EMS development, introduction and operation is presented in Figure 2.

The EMS development and implementation was divided into five stages, the passage of which by the company or entity will allow focusing on each of the subsystems elements of the «Business Entity» system.

For each stage, a combination of management approaches is proposed, which will allow controlling and improving the implementation of environmental and organizational changes for each of the subsystems.

At the first stage of EMS development, the main task for the management and the working group is to understand and realize the need for changes in the activities of an enterprise or a company. Applying a combination of process-system and quantitative approaches at this stage, the EMS working group will easily carry out a preliminary analysis of the entity's activities, carefully analyze the strengths and weaknesses of the «Environment», «Internal Environment», «External Stakeholders» subsystems and black box of «Business Entity» system.

The identification of the context for the «Business Entity» system carried out at this stage, reveals three subsystems in its composition, which is the reason for seeing the business entity as a socio-ecological-economic system in the form of a «white box» with multifaceted subject-object relationships. The application of the process-system approach at this stage allows forming a program of development in the field of personnel and organizational policy in the subsystem «Internal Environment» and establishing the features of the of external stakeholders' influence, which are an integral part of the «External Stakeholders» subsystem.

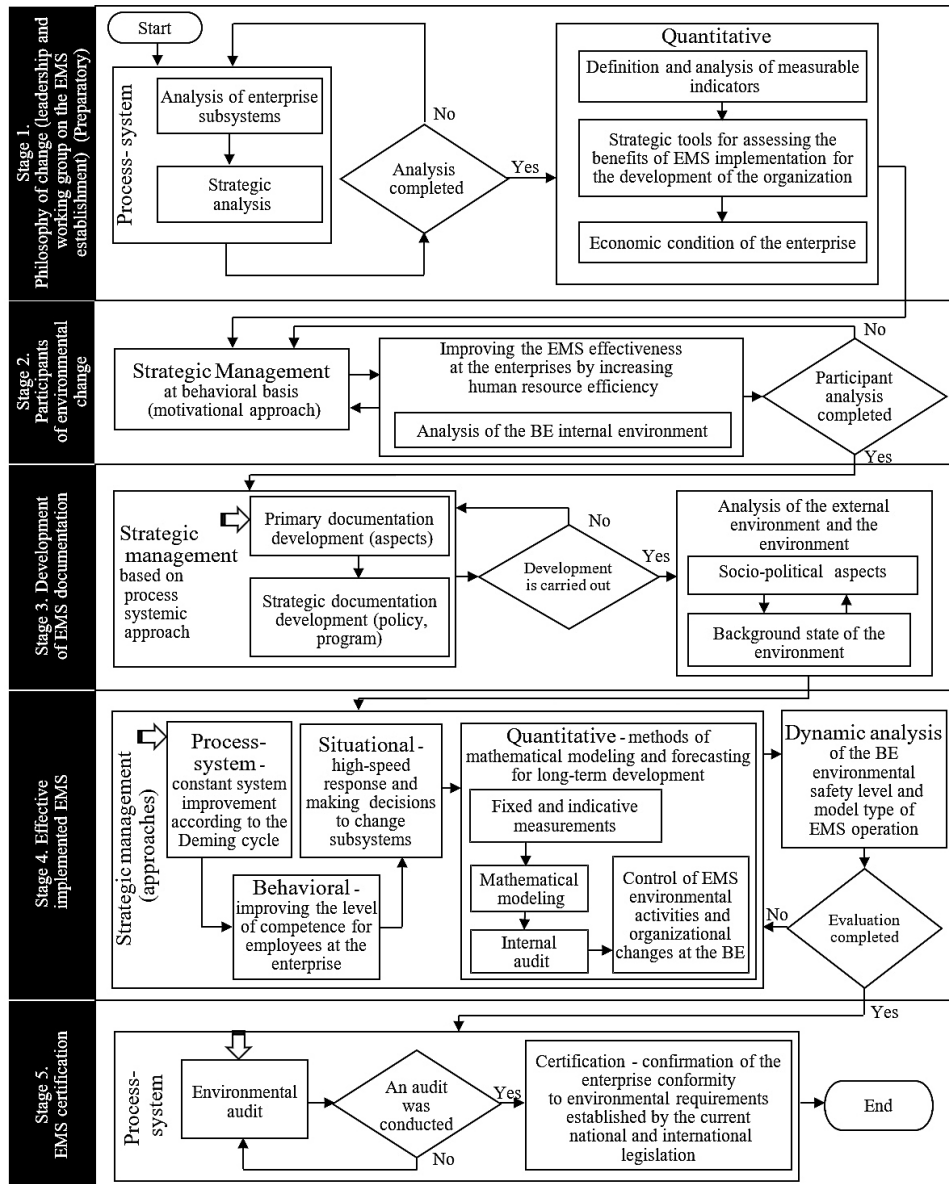


Figure 2. Structural model of management approaches application at each stage of EMS implementation and operation for increasing of environmental safety level at business entities

The risks associated with the EMS implementation can be identified using quantitative approach and the material balance of the enterprise for the time before the EMS implementation can be checked using mathematical and statistical methods. The quantitative approach should be used to assess the state of the enterprise’s assets and the benefits of the EMS implementation, which affect the entity’s overall economic profitability. The data obtained as a result of process-system and quantitative approaches to management application, will determine the environmental safety level of the entity before the EMS implementation, which will be the stimulus for

environmental and organizational changes in the entity by involving employees of all departments.

At the second stage, the management and the working group should consider the relationship between the participants of environmental and organizational changes of the «Internal Environment» subsystem. Awareness, development and opportunities for employees to implement personal ideas, stimulate them to implement innovations in the enterprise is the basis for the management applying behavioral (motivational) approach. Defining social relationships, revealing the features of the psychological climate within the team, identifying leaders in formal and informal

groups of employees will allow management and the EMS working group to identify the problem areas in the «Internal Environment» subsystem, while the application of basic concepts of behavioral sciences as well as aspects of social and psychological team will lead to appropriate changes in the relationship between groups of employees and the establishment of communication between them. Such transformations are possible if at the first stage the context in the «Internal environment» subsystem was studied, in particular group and interpersonal relations both in the staff and between the head and subordinates. The activities to improve the management of industrial and social conflicts and stresses will overcome the resistance of employees in the informal group to environmental and organizational change. Eliminating the resistance of employees to environmental and organizational changes, communication, motivational measures is a prerequisite for effective functioning of the implemented environmental management system, although hypertrophied care and diagnosis and problem solving can reduce the quality of decisions and distract participants from the necessary stages of EMS implementation.

Therefore, quality human resource management is aimed at the elimination of internal conflicts and direct involvement of employees in the EMS development through the application of various types of teamwork («brainstorming», SWOT and PESTLE-analysis), which will increase motivation of employees and transform their thinking. Thus, effective human resource management, which is based on the application of behavioral (motivational approach) will immediately affect the course of all subsequent stages of EMS implementation, as changes in the «Internal Environment» subsystem will affect the efficiency of EMS development, implementation and operation.

The third stage of EMS development focuses on the preparation and implementation of a series of continuous interrelated actions aimed at preparing the primary and strategic EMS documentation of the entity through the application of a process-system approach. The development of primary documentation is a kind of continuation for the processing information obtained during the preliminary analysis of the enterprise and is the update for the requirements of regulations, analyzing the impact of the entity on the environment by identifying environmental aspects of its activities, products and services. On the basis

of the information obtained, the EMS working group develops registers allowing management to constantly monitor and analyze the environmental and organizational changes, in particular: 1) environmental aspects and the impact of the enterprise on the environment; 2) significant environmental aspects; 3) legislative and regulatory requirements. In order to achieve the effective EMS operation, the next step at this stage is the development of strategic documents, namely: environmental policy, goals and objectives, programs of the environmental management system. Strategic documents should ensure the EMS development in accordance with scientifically sound environmental requirements and commitments made by management. The development of procedures is not a requirement of DSTU ISO 14001: 2015, unlike the previous versions of this standard, but their development and application during environmental and organizational changes will allow controlling the processes which govern the effective functioning of EMS and the level of environmental safety.

In addition to developing strategic documents in the third stage, the EMS working group requires to study all elements of the «External Stakeholder» subsystem to increase the opportunities for effective communication with stakeholders, as well as the «Environment» subsystem, which will allow for quality monitoring, and data collection for the type, composition, cycle and migration of pollutants before the EMS introduction by the business entity. The working group should use the data of monitoring studies before and after the of the environmental management system implementation to monitor and analyze the environmental and organizational changes in the activities of the entity, which affect its environmental safety level. Thus, the previously received information for strategy development of the business entity directed on constant improvement of ecologically oriented activity is synthesized at the third stage.

The fourth stage evaluates the environmental and organizational changes affecting the development of the environmental management system and its integration into the overall management system of the entity to identify deficiencies and errors made during the EMS development and to determine the necessary corrective measures to improve the criteria, indices and indicators defined by the management and the EMS working group, based on which it can be established

how effective the ecological and organizational changes in the activity of the business entity were carried out. Therefore, the use of a set of approaches, in particular: process-system to clearly fix the condition of all subsystems elements of the «Business Entity» system (from the beginning of EMS development to its implementation), quantitative data processing which will provide the information on the ways to improve product life cycle, situational to respond immediately to potentially adverse effects on the environment and correct inconsistencies in the environmental management and behavioral system to continuously improve the psychological climate in the team, employee competencies, which affects the overall EMS development and the entity’s environmental safety level. The application of a set of such management approaches will lead to the creation of a strong team, which will be the foundation for environmental and organizational changes in all subsystems of the «Business Entity» system and ensure the effective functioning of the environmental management system.

The main function of the fifth stage is to conduct a certification audit. Applying a process-system approach to ensure a clear implementation of the procedure and certification audit program will facilitate analyzing the necessary data on: 1) environmental and organizational changes which have occurred in the subsystems of the «Business Entity» system; 2) achievement of planned results (EMS environmental program and environmental policy are analyzed); 3) monitoring results; 4) the environmental safety level of the business entity; 5) operational efficiency of the implemented ecological management system.

The process of EMS environmental certification is the final stage of the first turn in the Deming cycle, which consists in the EMS implementation

and confirmation of its compliance with the requirements of DSTU ISO14001: 2015. Therefore, further actions of the business entity should be aimed at continuous EMS improvement, which consists in constant monitoring, evaluation and improvement of environmental and organizational changes to improve the environmental safety of the business entity through the implementation of an effective environmental management system.

The analysis of management approaches at each stage of EMS implementation and operation for increasing ecological safety level at business entities and minimizing the environmental impact risks allows the application of QFD-methodology (Quality Function Deployment) and building a matrix diagram [Kudryavtsev et al., 2018] to identify the closeness of the links for certain approaches and the corresponding stages (Table 1).

The analysis of this matrix diagram shows that the basic approach in the process of EMS implementation and operation is the classical process-system approach. An important addition to this approach is quantitative approach, which requires the processes management for determining computational indicators and their mathematical processing, and behavioral, which is based on taking into account the management processes of both human behavior and the behavior of technical means.

Calculating the uncertainty and instability conditions of today relies on the situational approach application. The weight of the motivational approach is insignificant compared to other approaches; however, without proper staff motivation there will be no increase in environmental safety and reduction in the risks of negative impacts, as human resources require timely support and interest (Fig. 3).

Table 1. Matrix L-shaped diagram

Stage	Approaches					
	Process and System	Behavioral	Situational	Quantitative	Motivational	Total
Stage 1	•		▽	•		19
Stage 2		•	○		•	21
Stage 3	•		▽	▽		11
Stage 4	•	•	•	•	▽	37
Stage 5	•	▽	○			13
Total	36	19	17	19	10	

Note: Types of relationships and their evaluation: weak – ▽ (1), medium – ○ (3), strong – • (9).

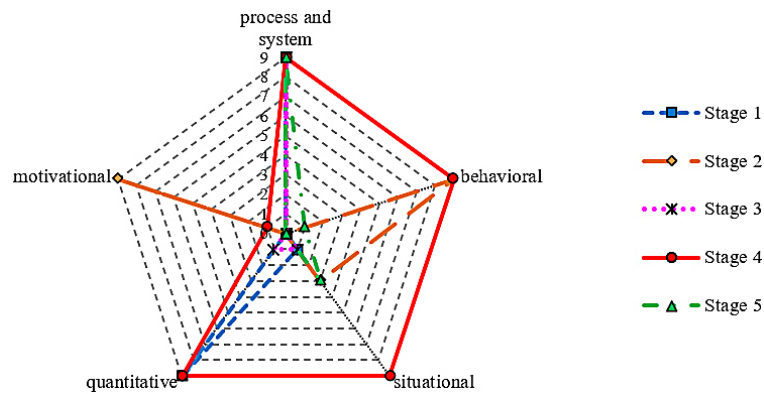


Figure 3. Vector orientation of management approaches in the process of EMS development and implementation

The analysis of the matrix diagram and the vector for the approaches orientation at each stage shows that the largest number of management approaches shall be applied at the fourth stage, which indicates its complexity and significance.

Thus, the development of a structural model for the management approaches implementation during the environmental management systems development and implementation identified those approaches affecting the system effectiveness.

CONCLUSIONS

On the basis of the strategy of continuous EMS improvement, the essence of which is to increase the environmental safety level of business entities through the implementation of an effectively functioning environmental management system, a procedure for selecting management approaches for each stage of EMS development and implementation was proposed. It was established that the effective EMS operation depends on the use of a combination of classical approaches to management, which allows controlling and assessing the state of environmental and organizational changes based on: 1) achieving goals and objectives of EMS strategic documents, 2) motivating employees; 3) preventing and eliminating demotivating elements, 4) controlling of balance sheets and reporting in all subsystems of the «Business Entity» system.

The built structural model of management approaches application at each stage of EMS implementation and functioning is the tool for effective ecological administrative decisions, forecasting of a of environmental conditions and increase of ecological safety level at business entities, cities and regions, depending on efficiency and control

of environmental and organizational activities of business entities operating in various sectors of the economy and implement environmental management systems.

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