

PAPER • OPEN ACCESS

Indicators of Estimation of Environmental Effectiveness Activities of the Enterprise

To cite this article: Boris Khrustalev *et al* 2019 *IOP Conf. Ser.: Mater. Sci. Eng.* **471** 092005

View the [article online](#) for updates and enhancements.



IOP | ebooks™

Bringing you innovative digital publishing with leading voices to create your essential collection of books in STEM research.

Start exploring the [collection](#) - download the first chapter of every title for free.

Indicators of Estimation of Environmental Effectiveness Activities of the Enterprise

Boris Khrustalev¹, Natalia Smolich², Alexey Malakhov²

¹ Penza State University of Architecture and Construction, Penza, Russia

² Penza, Street Volodarsky, 6, Russia, 440026

Hrustalev_bb@mail.ru

Abstract. In the article the authors consider the evaluation of the environmental performance of enterprises on the basis of different indicators, using different models of organizational development in complex environmental situations, taking into account disturbance factors of risk and uncertainty in order to improve the selection and justification of managerial decisions.

1. Introduction

Analysis of complex ecological situation dictates the necessity of evaluating the performance of enterprises based on the calculation of relevant indicators that take into account the specificity and nature of their operation and development through the use of different models in order to increase the efficiency of select and justify management decisions.

2. The results of research

Provide sufficient detail to allow the work to be reproduced. Methods already published should be indicated by a reference: only relevant modifications should be described. This section also may include theory, background, calculations which represent practical development from a theoretical basis. Etc.

Currently, there are many definitions of the category "environmental management". From our point of view we can consider this phenomenon from two points of view. In a broader sense, environmental management should be understood a system of management of socio-economic system (enterprise, region, etc.), which focuses on the preservation of the natural environment and takes into account the limitations of the environment on the development of this system. That is, in this approach, the whole control system is aimed to harmonize the interaction between the organization and the natural environment. In a narrow sense, environmental management can be understood only one of the subsystems of management of the organization, ensuring the achievement of its own environmental goals, projects, and programs developed on the basis of the principles of eco-efficiency and eco-pragmatist [1].

Environmental management system (EMS) is one of the forms of implementation methods of environmental management in the system of administrative management of the organization.

Requirements for EMS is regulated by international and national standard GOST R ISO 14001-2016, which acts as a criterion in conducting certification audit.

Mandatory procedure in the functioning of the EMS is the environmental performance evaluation.

The concept of eco-efficiency and the tools for its implementation was developed for the developed and prosperous countries of the West, achieved a great success in solving economic and social



problems that have resources to address issues of environmental protection. In these countries, effective environmental legislation, there are high taxes on environmental pollution, high price of imported raw materials, which generally creates good preconditions for the development of programs aimed at improving environmental performance.

In developing countries and countries with economies in transition, environmental costs of polluting enterprises even if the high levels of pollution are usually small, and the sizes of ecological payments inadequate caused environmental damage.

There is a view that in these countries, which include Russia, the principles and mechanisms of eco-efficiency do not work. This is because to the prevention of pollution of the environment will require large costs and a fundamental change in the procedures of environmental regulation. And with constant shortage of funds and a lack of real support from the state, the environmental efficiency is not solved.

Speaking about today, it is worth noting that the implementation of programs to improve eco-efficiency requires not only investment, but also, first and foremost, make competent decisions. Even a company with high environmental costs is not necessarily eco-efficient. For example, its efforts can be concentrated solely on the technology to clean the emissions at the end of the pipe. The more informed decision-making supported by the availability of objective information obtained through such management tools as environmental performance evaluation.

Analysis of methodological approaches to assessing eco-efficiency shows that for the period from 1980 until today there have been fundamental changes in the methodology and models for estimating environmental efficiency.

The first model – economic [2]. Regulatory-methodological basis of the model was adopted in 1983 "Temporary typical methodology for the implementation of environmental measures and assessment of the economic damage to the national economy by environmental pollution". Nature conservation actions have carried all types of economic activity aimed at reducing and eliminating negative human impact on the natural environment, the conservation, improvement and rational use natural resource potential.

Among these events was the construction and operation of wastewater treatment and neutralizing facilities and devices, development of low-waste and non-waste technological processes and production, accommodation of enterprises and systems of transport streams taking into account ecological requirements. The model evaluation result of environmental measures included the calculation of total (absolute) economic efficiency (EA) and the coefficient of efficiency of capital investments in the construction of EC.

The total (absolute) economic efficiency EA is defined as the ratio of the annual economic effect from environmental protection activities caused to their costs. This figure was used during the justification of the structure and volume of environmental measures. The coefficient of effectiveness of capital investments in the construction of EC was used to determine the structure and volumes of capital investments and environmental protection.

Components of the assessment of the effect of environmental measures were: prevented environmental damage from pollution to the environment; increase a profitable part of the enterprise by saving of natural resources; increase a profitable part of the enterprise by sale of products produced from the waste resulting from production activities. The components of costs were the operating and capital costs of environmental character. The undisputed advantage of this model is its novelty, for the first time attempts have been made to the evaluation of the results from the environmental component of activities of organizations.

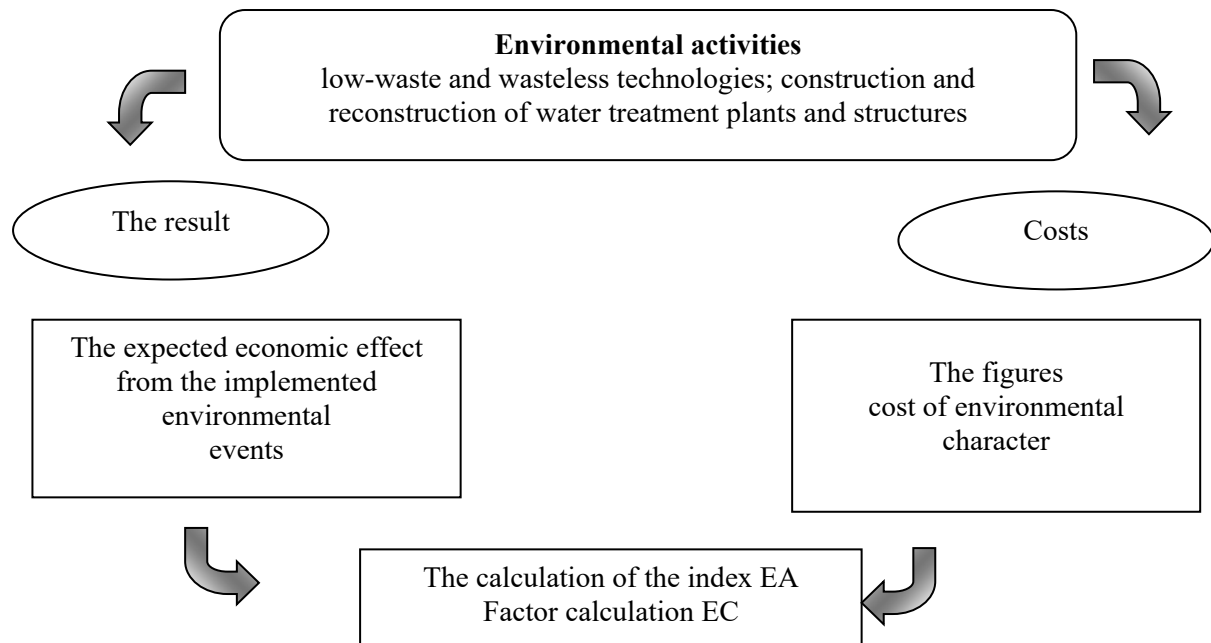


Figure 1. Economic model evaluation of environmental events

A significant drawback of this model should be considered artificial selection of environmental measures and the delegation of responsibility for the result of their execution only to environmental services, powers which did not meet neither the status, nor the functions required to implement environmental measures.

The model of ecological-social-economic (Figure 2) included a comprehensive evaluation of the results of the implementation of environmental protection measures, namely:

The ecological result was to reduce the negative impact on the environment and improving its state and manifested in the reduction of volume entering the environment, pollution or reducing pollution of the environment as a whole (concentrations of harmful substances in the environment, noise levels, radiation, etc.), to increase the number and improve the quality of usable land, forest, water resources, etc.

Socio-economic result was to raise the standard of living of population, efficiency of social production, increase of national wealth. However, the results were expressed in improvement of physical development of the population and in reducing morbidity, increasing life expectancy and the period of intense activity, improve working conditions and recreation, maintaining ecological balance (including the preservation of the genetic Fund), maintaining the aesthetic values of natural and anthropogenic landscapes, monuments of nature, protected areas and other protected areas, creation of favourable conditions for the growth of creative potential of personality and cultural development, to improve the moral consciousness of man. Social results have received partially reflected in the economic results of environmental activities.

The economic results were to save and prevent loss of natural resources, living and materialized labour in production and non-production spheres, and also in the sphere of personal consumption, achieved through the implementation of environmental protection measures.

With the economic justification of environmental measures have been complied with an integrated approach, which meant:

- more complete coverage of all socio-economic consequences of different conservation measures in different sectors, both immediate and in the longer term;

- more complete coverage of all costs associated with the implementation of the options under consideration environmental protection measures;
- the account of the temporary factor in the assessment of costs and environmental protection measures;
- a comprehensive analysis of the justification of environmental protection measures taking into account the need of cost savings to improve environmental.

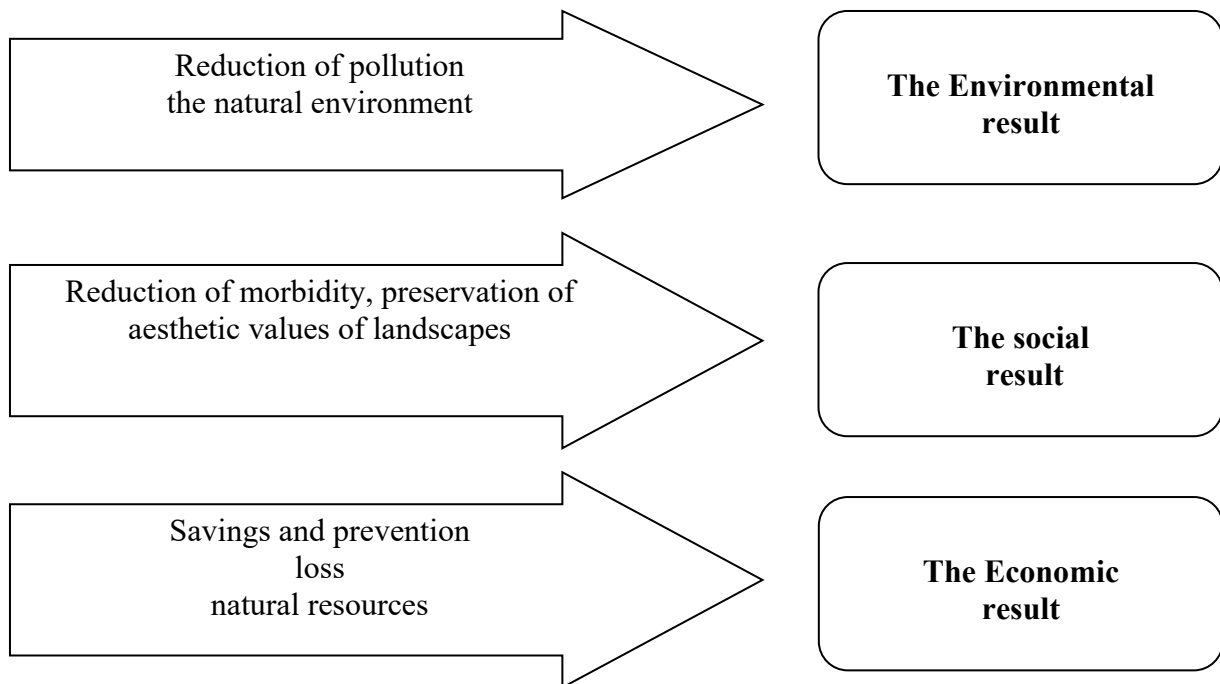


Figure 2. Ecological and socio-economic model evaluation environmental measures

The advantage of this model can be considered is its complexity, the extension of the object framework for the assessment of the effectiveness of environmental protection measures. The drawback is the lack of methodological approaches and common indicators for assessing the socio-economic and economic performance, blurring the boundaries of responsibility for the assessment of environmental performance. Modern model – environmental performance evaluation (Figure3) is formed taking into account the evaluation methods of efficiency of nature protection actions of previous models, and also the requirements of GOST R ISO 14031. Most important it is the prevention of environmental pollution as a result of influence on the processes that caused it as the root cause of negative impacts.

Prevention of pollution of the environment is achieved by:

- change of approaches to management and organization of production;
- rational use of raw materials and energy resources;
- replacement of raw materials;
- replacing technology for more environmentally friendly or resource efficient;
- formulation of other products (more environmentally friendly or resource efficient).

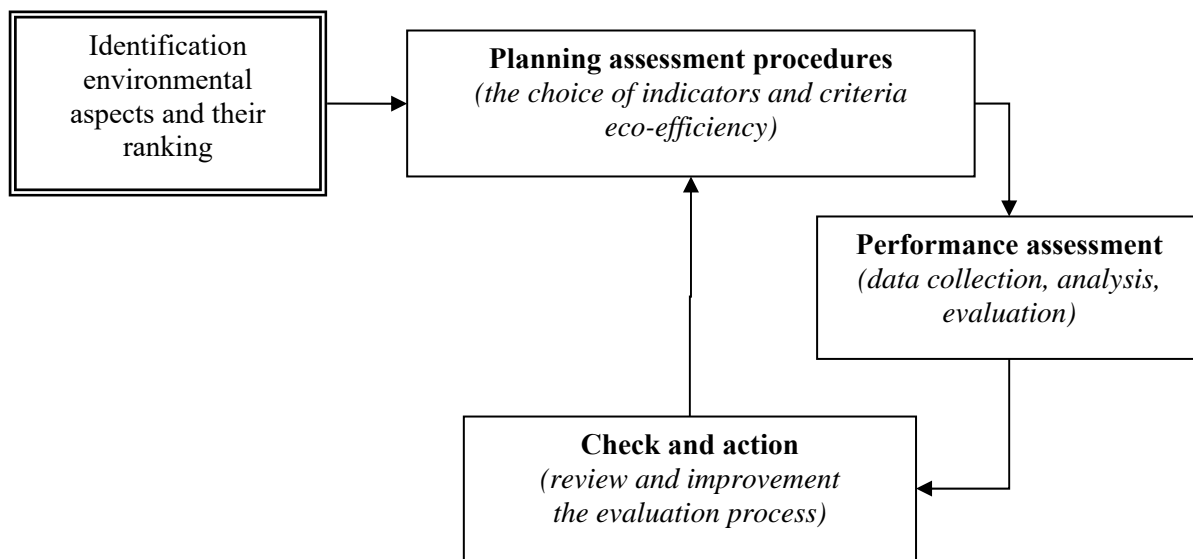


Figure 3. Model of eco-efficiency assessment

Regulatory-methodological basis of this model is the international and national standard GOST R ISO 14031. Standard apart from clear definitions of key terms, results model evaluation and classification of eco-efficiency indicators, and recommendations for the selection of these indicators depending on the purposes of assessment.

3. Results and discussions

Environmental performance — measurable results of environmental management related to the organization's control of its environmental aspects, based on its environmental policy, and environmental goals and objectives.

Evaluation of environmental performance process that promotes the adoption of managerial decisions concerning the methods of selection of indicators, collection and analysis of data, evaluation of the environmental performance criteria, reporting and information dissemination, periodic revision and improvement of this process.

Regulated two categories of indices for evaluating the environmental performance and indicators of environmental condition. The index of environmental efficiency — a specific form providing information on the environmental performance of the organization. Indicator of the state of the environment indicator state of the environment in local, regional, national or global scale.

Eco-efficiency indicators, in turn, subdivided:

- indicators of management efficiency of the organization, providing information on the efforts taken by the leadership to influence on environmental effectiveness;
- indicators of efficiency of functioning of organizations that provide information about environmental performance.

The criterion of environmental efficiency — the target or the planned environmental or other indicator provided for level of environmental effectiveness, given the direction of the organization and used for purposes of evaluation. Central to the model is to determine priority of ecological aspects of activity of the enterprise. This stage is the starting point for the initiation of the process environmental performance.

The advantage of this model is the presence of a methodological framework that allows:

- manage priority environmental aspects;

- to involve in the evaluation process eco-efficiency not only environmental services but also other functions that participate in achieving the selected eco-efficiency indicators and various levels of management;
- clearly define the environmental performance for various services and purposes of assessment.

The disadvantage of this model is its complexity in identifying priority environmental aspects of the company. One of the key positions in the environmental performance evaluation is the calculation of the benefits and costs of environmental management and conservation activities [3].

The benefits of environmental management and conservation activities can be represented by:

- the form of savings by reducing the number of used resources, prevent pollution or waste recycling.
- the form of income from sales of new products with the regulatory requirements to ensure environmental safety (calculated for each product separately);
- the form of income received from organizations engaged in waste collection, in the case of increasing the volume captured (collected) and handed over to specialized organizations waste or change their quality.
- the form of savings from the reduction or complete absence of penalties for non-compliance with Federal environmental laws and regulations in terms of environmental protection

Costs for environmental protection include current and capital expenditure. Ongoing costs include the cost of production or financial results of the period in which it was implemented. Such costs that bears periodic nature include:

- salary deductions of staff employed directly in conservation activities;
- material costs for the maintenance of environmental protection facilities and equipment (fuel, electricity, supplies, etc.);
- costs of services of other organizations that have a current character (garbage, recycling, etc.).
- the cost of maintenance of the environmental management system and its certification.

The criterion of the efficiency of current expenditure on environmental activities is the positive difference between the total value of economic benefits and the amount of operating costs.

Costs of a capital nature is presented in the form of investments in fixed assets, necessary for the implementation of environmental activities (construction of buildings, acquisition and installation of equipment, etc.).

To assess the effectiveness of such costs must be regarded as a specific investment project with the use of common indicators to measure the effectiveness of investments, such as net present value, return on investment and payback period.

Net present value represents the difference between the discounted to the same point in time, profits and investment spending:

$$NPV = \sum_{t=1}^T B_t \times k_t - \sum_{t=1}^T P_t \times k_t \quad (1)$$

Where: NPV – net present value; B_t – the difference between the value of total economic benefits of the project and its current cost in the period t ;

k_t – the discount factor; P_t – the investment cost in period t ;

T – the length of the billing period.

BCR is a metric that is derived from the net present value (profit). It is the ratio of discounted costs to discounted investment expenses:

$$BCR = \frac{\sum_{t=1}^T B_t \times k_t}{\sum_{t=1}^T P_t \times k_t} \quad (2)$$

Dynamic payback period is the time during which income from the project (discounted profit) will cover the discounted amount of investment spending.

4. Conclusions

The criterion of efficiency of investment project environmental activities is a positive value of net present value, the value of BCR greater than one and acceptable to the organization payback period. Thus, eco-efficiency should be the indicator of assessment of environmental management systems and/or conservation activities to be measured and to serve as a reliable criterion for making management decisions.

References

- [1] Ferrara, G. C. Environmental management: textbook. guide with the stamp of UMO on specialty "Economics and management" / G. S. Ferrara. Moscow – Arkhangelsk: Jove, 2004. – 184.
- [2] Bondarenko V. V. Development of the mechanism for enhancing the level of greening of economic activity in the region / V. V. Bondarenko, L. M. Chernova, M. A. Tanin, A. E. Malakhov // Economy and society: problems and prospects of modernization in Russia. Dedicated to the 95th anniversary of Financial University under the Government of the Russian Federation / under the General editorship of V. V. Bondarenko, V. A. Dresvyannikova, O. V. Loseva. - Penza, 2013. - S. 383-398.
- [3] Senators D. V. the role of the "green economy" to achieve economic growth / D. V. Senatorov, V. A. Ryzhenkov // Solution: materials of the fourth all-Russian scientific-practical conference. – Perm: Publishing house Perm. NAT. issled. Polytechnic. University press, 2015.-387 p.
- [4] Hrustalev B. B., Hrustalev Yu. B. Basic approaches of the concept of formation and development of industrial complex of the Penza region / B. B. Khrustalyov, Khrustalyov Y. B. // Education and science in the modern world. Innovation. – 2017. – No. 1. – S. 296-305.
- [5] Hrustalev B. B. Development of enterprises construction complex of the Penza region in terms of risk / B. B. Khrustalyov // Kucеровsky]. – 2016. – T. 2. – № 2 (10). – Pp. 173-185.
- [6] EC/ISO 31010:2009. Risk management – Risk assessment techniques: International standard. Geneva, Switzerland: International Organization for Standardization (ISO)/International Electrotechnical Commission (IEC), 2009.176 p.
- [7] ISO Guide 73:2009. Risk management – Vocabulary: International standard. Geneva, Switzerland: International Organization for Standardization (ISO), 2009. 15 p.
- [8] ISO/TR 31004:2013. Risk management – Guidance for the implementation of ISO 31000: Technical report. Geneva, Switzerland: International Organization for Standardization (ISO), 2013. 38 p.
- [9] The revision of ISO 31000 on risk management has started, News by Sandrine Tranchard on 13.5.2015, http://www.iso.org/iso/home/news_index/news_archive/news.htm?refid=Ref1963
- [10] Grabovyi P.G., Avilova I.P. The empiric methodology of evaluating and managing the aggregate risk at implementing large complex building and investment projects abroad / P.G. Grabovyi, I.P. Avilova // Life science journal. – 2014. – № 12s. – т. 11. – С. 610-615.