



Sustainability Performance Indicators for Industrial Enterprise Management

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Sustainable development is increasingly considered to be a driving strategy for development. Despite the fact that sustainability performance evaluation receives broad attention from international organizations, industrial enterprises and researchers, a lot of unanswered questions remain in this area. It is commonly agreed that the use of performance indicators is a most effective way to evaluate sustainability performance, but design/ selection of sustainability performance indicators and their application wait to be explored at both national and enterprise levels until the consensus concerning the most effective performance indicator systems and methodologies for their application is achieved.

This article (i) provides an overview of different sustainability performance evaluation systems with identification of their strengths and weaknesses in respect of improved management effectiveness at an enterprise level; (ii) presents recommendations for development/ selection of sustainability performance indicators that would make it possible to increase effectiveness of decision-making and to promote application of preventive measures, and (iii) provides recommendations how the process of sustainability performance evaluation could be carried out by industrial enterprises in practice.

Keywords: *Sustainable development, sustainable industrial development, sustainability performance evaluation, performance indicators.*

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1. Introduction

After introduction of the sustainable development concept by the Brundland Commission, sustainability is embraced by a growing number of industrial companies along with other stakeholders. Sustainable development at an organizational level is described using a triple bottom line that divides performance into economic, environmental and social dimensions (Topfer K., 2000). The concept has inspired many enterprises, national and international organizations, academic institutions to search for the ways to use the tools for measuring and evaluating sustainability progress. In this context, sustainable industrial development could be interpreted as a process of continuous improvement of environmental, economic and social performance of enterprises and sustainability performance is interpreted as a result of

management of sustainability aspects in enterprises (Staniškis J., Arbačiauskas V., 2004).

The most straightforward and popular tool for sustainability performance evaluation is the use of performance indicators. In principle, indicators enable systematic performance evaluation and they present information in a form suitable for decision-making purposes.

Pressure from stakeholders to publish sustainability performance information is often perceived as a main driving force for sustainability performance evaluation in industrial enterprises. It could also be related to establishment of "socially responsible" investment funds and investment rating systems (e.g. "Dow Jones Sustainability Index") (Ballou B., Heitger, D.L., Landes, C.E., 2006).

However, modern enterprises use sustainability performance evaluation for both external and internal reasons, because the use of performance indicators can improve effectiveness of the enterprise management. Performance indicators can help identify the opportunities for operation optimization, reveal the inefficiencies that could be removed by preventive measures, improve the internal and external communication. But, these benefits will be achieved when performance indicators are properly selected.

The main objective of this article is to give an overview of different sustainability performance evaluation systems; to develop recommendations for selection of performance indicators that would make it possible to increase effectiveness of decision-making and to promote application of preventive measures; and to provide recommendations how the process of sustainability performance evaluation could be carried out in practice.

2. Overview of sustainability performance evaluation initiatives and tools

The Global Reporting Initiative (GRI) probably is the most well known initiative that develops and disseminates the globally applicable sustainability reporting of the guidelines that establish the core economic, social and environmental indicators of corporate activity which are used for preparing reports on environmental, social and economic impact of corporate activities. It is a voluntary initiative intended to be a valuable tool for decision-making at a level of the senior management, at an operational level and at a level of internal and external stakeholders.

The GRI guidelines consist of principles and recommendations and of a standard reporting format. The indicators are divided into the following groups: economic, environmental, human rights, employee and workplace related, product related and social indicators. In total, 70 key indicators are recommended, and these indicators are presented in detail in the indicator protocols (GRI, Global Reporting Initiative, 2006). Protocols also provide explanations, methodology, scope of indicator use and other technical references.

One of the main strengths of the GRI initiative is possibility to use benchmarking, because a standard format is used for reporting sustainability performance. The GRI guidelines are also attractive to industrial enterprises because of strong worldwide acknowledgement of this initiative. Nonetheless, enterprises have to allocate significant resources for presentation of information and this is frequently done at a cost of performance evaluation that could lead to the limited accuracy of evaluation. To meet the needs of any type of organization, the GRI guidelines provide a great number of indicators and the process of indicator selection in some enterprises could become too challenging. The biggest shortcoming of

the GRI guidelines is that indicators are basically developed for external reporting and their impact on practical management of sustainability performance and decision-making process is limited. In addition, due to a general nature of indicators, sustainability reports developed in the framework of the GRI initiative could have a limited value to some of stakeholders of a reporting enterprise (Veleva V., Ellenbecker M., (2000). Finally, among a large number of indicators there are practically no indicators relating to the performance in terms of quality such as process cost, service quality, product quality, despite the fact that these indicators are important for assessing the internal losses and costs of poor quality (Isaksson R., (2006).

Another worldwide known methodology for performance evaluation is eco-efficiency assessment that was developed by the World Business Council for Sustainable Development (WBCSD) in 2000. The WBCSD methodology divides indicators into general indicators suitable for all activities and activity-specific indicators. WBCSD also makes clear recommendations how to accomplish the entire eco-efficiency assessment process up to the development of an eco-efficiency report (World Business Council for Sustainable Development, 2000) A key feature of this methodology is integration of two sustainability dimensions: environmental and economic. Social aspects are not covered by this methodology, but this could be solved by adding socio-economic indicators as suggested by Schaltegger et al (Schaltegger S., et al, 2002).

The main strength of the WBCSD methodology is that eco-efficiency information collected by the enterprise helps to identify the key problems and promotes application of preventive measures. General indicators could be used by eco-efficiency benchmarking between enterprises, but this is often undermined by the fact that enterprises decide not to report the data related to some of indicators (only a limited number of indicators is compulsory). Another limiting factor of this methodology is that only the process indicators are used. In contrast, international standard ISO 14031 described below in addition to process indicators also covers management performance indicators and environmental conditions indicators.

The first comprehensive list of environmental performance indicators was developed and recommended by the German Environment Ministry (BMU) and Federal Environmental Agency (UBA) (BMU and UBA, 1997). Soon after that, in 1999, international standard ISO 14031 for environmental performance evaluation was developed by the International Standard Organization. ISO 14031 gives recommendations to enterprises how to develop indicators for improvement of environmental performance and how to use them in practice (International Organization for Standardization, 1999). In the standard, indicators are divided into three categories: environmental (process) indicators, management performance indicators and

environmental conditions indicators. The idea behind this division is that an impact of enterprise operations on the environment results in certain changes of the environment, therefore adequate measures (management performance indicators) are needed to reduce this effect. It is an “impact – state – response” model. Its practical application could lead to positive changes in the management and performance of an enterprise. The fact that the ISO 14031 standard presents clear methodology and allows enterprises flexibility in indicator selection could also be considered as a positive feature of the standard, particularly when internal decision-making towards improvement of environmental performance is concerned.

There are also sector-specific initiatives, for example, a sustainability performance evaluation initiative of the Britain's Institution of Chemical Engineers (IChemE) (Fiksel J., 2002), Global Mining Initiative (Institution of Chemical Engineers, 2003). In principle, these sustainability performance evaluation initiatives are compatible with the GRI, but are adjusted to the needs of particular industries. The performance evaluation consists of environmental, economic and social indicators. In these initiatives relative indicators are basically used, indicator systems are simple and a life cycle approach is used. All these are positive features of the initiatives that should be used in development of sustainability performance indicators in any enterprise that is determined to achieve measurable performance improvements.

An increasing number of enterprises use the internationally acknowledged performance evaluation systems, mentioned above, but many enterprises use their own sets of performance indicators or performance evaluation methodologies. In general, these systems do not differ much from the performance evaluation systems analyzed above, especially when the absolute and relative indicators are used. Moreover, there are examples of methodologies based on the aggregate/ indexed indicators developed by large companies. For example, the Niagara Mohawk Power Corporation (NMPC), an energy supply corporation in the USA developed a methodology for calculation of an environmental index to assess overall sustainability of the corporation. The essence of index calculation is aggregation of different performance indicators into one general denominator (Bennett, M., P. James P., 1999). As a result, a single number is calculated that demonstrates the level of environmental performance, but this methodology is complicated and subjective. Efficiency of such evaluation system for improvement of management effectiveness of enterprises could also be questioned.

In general, the biggest shortcoming of existing sustainability performance evaluation systems is their focus on external reporting and underestimation of the internal information needs for decision-making, increased management effectiveness and actual performance improvement. Furthermore, a concern is

sometimes expressed that sustainability reports published by enterprises are only “greenwash” which are intended to improve a company's public image. For example, one review of business sustainability indicator frameworks has shown that they present simple lists of indicators with little or no guidance as to how to apply them over time to become more sustainable (Veleva, V. Ellenbecker, M., 2001).

Therefore, a fundamental challenge is to select appropriate performance indicators to support operational decision-making in enterprises. External reporting should not be an objective in itself.

3. Selection of sustainability performance indicators

As presented in a previous chapter, several performance evaluation standards/ systems exist, but they preferably should be used as reference materials and an enterprise should go through the development of indicators “from the first principles” (Keeble J., Topiol S. Berkeley S., 2003). This will help the organization develop a sense of ownership over the results and, more importantly, to develop a system that fully reflects the values and needs of the enterprise (Searcy C., Karapetrovic S., McCartney D., 2005).

Before selecting sustainability performance indicators, the objectives of the performance evaluation system should be defined. Frequently, there exists a need for different accountability - for everyday operations of the company and external reporting (Accountability and WBCSD, 2004). In general, the selected performance indicators should enable enterprises in the following:

- to identify the areas where performance improvement options are most feasible (preferably using preventive measures);
- to assess whether the objectives and targets have been achieved;
- to assess legal compliance;
- to assess effectiveness of implemented measures, i.e. to assess the progress from particular projects;
- to enable development of the sustainability report that meets the requirements of key stakeholders.

Generally speaking, an indicator gives useful information about the system that can be used to describe its state, to detect changes and to show the cause and effect relationships (Miller G., 2001). Indicators can be quantifiable (quantitative) and non-quantifiable (qualitative). The best approach is the combination of both methods (Diakaki C., Grigoroudis E., Stabouli M., 2006). In terms of an expression, there are four types of quantifiable indicators: absolute indicators, relative indicators, aggregate indicators and indexed indicators. Aggregate and indexed indicators integrate data either in particular categories or in one number presenting the level of performance. Such indicators could be

useful in the overall assessment of enterprise's performance, but they lack a detailed information and this fact limits their practical use in terms of opportunity identification for performance optimization. In this respect, the use of absolute and relative indicators is recommended. Relative indicators are particularly useful in decision-making as they allow to observe the changes of particular values (e.g. pollution) in relation to a common denominator (e.g. raw material or production unit). Absolute and relative indicators can be expressed in natural units (tons, litres) and monetary units.

Taking into account the nature of decision-making (e.g. strategic, operational, innovation generation), performance indicators should be defined at an enterprise, department or process level. In general, to ensure the effective decision-making, indicators of all specified levels should be used. Moreover, in addition to traditional sustainability indicators such as economic, environmental and social, communication indicators should be also considered.

Researchers at the Lowell Center for Sustainable Production (LCSP) at the University of Massachusetts developed the indicator hierarchy as a tool to organize performance indicators and to enable companies to evaluate effectiveness of their indicator systems (Veleva V., Hart M., Greiner T., Crumbley C., 2003). This hierarchy has five levels in relation to the basic principles of sustainability: (i) facility compliance/conformance (e.g. number of notices of violations); (ii) facility material use and performance (e.g. heavy metal emissions to water in tons per year); (iii) facility effects (e.g. carbon dioxide emissions from energy use in million tons); (iv) supply chain and product life-cycle (e.g. post-consumer recycled material used); and (v) sustainable systems (e.g. percent of total energy used from renewable sources harvested sustainably). Application of such hierarchy is very useful as it helps keep a clear structure of indicators and corresponds to the level of the enterprise's ambition in performance evaluation. The enterprise could start from evaluation of compliance and with gradual development of experience it could continue with more sophisticated performance evaluation.

A particularly important aspect for selecting sustainability performance indicators is application of a product life cycle approach. Frequently, enterprises limit performance analyses to production and to other internal processes, sales and general economic indicators. However, there are cases when a product use impact on the environment is stronger than that caused by the production phase. For example, the US National Academy of Engineering (NAE) presented information on an impact on the environment from different life cycle phases of a car: 4/5 of water is used in production of a car, but in terms of energy only a small fraction of total energy amount is used in the production phase (National Academy of Engineering, 1999). Although the product life cycle aspects could be excluded in the first round of sustainability performance evaluation, such aspects should be kept in mind, because the changes in the

area of sustainable development and consumer preferences will gradually result in greater attention to all direct and indirect aspects of a product life cycle (Pfliege J., Fischer M., Kupfer T., Eyerer P., 2005).

Finally, to develop an operational system to bring value to the enterprise, the following key requirements for sustainability performance indicators should be fulfilled (Toth G., Arbačiauskas V., 2005):

1. Comparability/measurability – indicators should help identify performance changes;
2. Meaningfulness – indicators should help identify losses, performance improvement options and increase decision-making effectiveness;
3. Integrity – indicators should cover all main aspects of sustainability;
4. Continuity – indicators should be used continuously (including the same measurement methods) to enable tracking of changes;
5. Clarity – indicators should be clear and specific to avoid misunderstandings;
6. Efficiency – indicator system should be reasonably simple to be functional and resource efficient.

Further, this article gives several examples of sustainability performance indicators based on the considerations presented above. It should be stressed that no standard set of performance indicators could be prescribed to make sustainability performance evaluation meaningful in terms of the better enterprise management, enterprises have to develop their own sets of indicators that reflect their profile and needs.

For overall assessment of sustainability performance in enterprises, qualitative performance indicators could be used (Table 1). To make the data analysis process operational and effective, it is recommended to use indicator values in points (values are assigned in respect of the enterprise's performance in a particular area).

For a more detailed analysis of sustainability performance, a set of quantitative indicators should be developed.

4. Procedure for evaluating sustainability performance in enterprise

Sustainability performance evaluation does not end with development selection of performance indicators. Bridging the gap between development of a performance measurement system and its implementation could be a key challenge (Searcy C., Karapetrovic S., McCartney D., 2008). To make a sustainability evaluation process successful, there is a need to allocate responsibilities and to develop procedures for information collection and analysis. Case study conducted by researchers at the University of Alberta in Edmonton, Canada has revealed that it is extremely important to consider the role of indicators in the overall management system from the very beginning and to use the existing management system for successful implementation of sustainability performance evaluation (Searcy C., Karapetrovic S.,

McCartney D., 2005). From the point of a management system, it could be stated that within the management systems it is necessary to develop and implement a well-structured performance evaluation methodology to ensure that management objectives

are met (Coelho J.F.G.M., Moy D., 2003). It can be concluded that management systems and performance evaluation systems are mutually supportive and should be integrated.

Table 1. *Examples of qualitative performance indicators for overall assessment of sustainability performance in enterprises*

Indicator	High sustainability performance, points	Medium sustainability performance, points	Low sustainability performance, points
Economic indicators			
Use of preventive measures/ innovations) to reduce costs	Identification and implementation of preventive measures/ innovations are accomplished systematically	Obvious preventive measures/ innovations implemented on regular basis	Preventive measures/ innovations are not used
Economic input to local infrastructure development	Enterprise on regular basis financially contributes to development of local infrastructure	Enterprise participates in a limited number of local infrastructure development projects	Enterprise is not involved in development of local infrastructure
Environmental indicators			
Reduction in energy and water consumption	Everyday search for options to reduce energy and water consumption, technical and organizational energy and water saving measures are used	Analysis of options for reduction in energy and water consumption use is carried out periodically, good housekeeping measures are used	Energy and water saving measures are not used or only obvious saving measures used
Treatment of recyclable waste	Waste is treated on the-site of enterprise	Part of generated waste is treated in enterprise	Generated waste is transferred to other companies
Improvement of product characteristics	Improvement of product characteristics is part of the enterprise's policy	Improvement of product characteristics is done in specific cases	Improvement of product characteristics is not considered
Social indicators			
Involvement of employees in decision-making	Employees are promoted to make suggestions	Employee opinions are considered	Employee opinions are not considered
Training of employees	Active search for employee training options and support	Employees have opportunities to participate in training programmes	Employee participation in training activities is not desirable
Communication indicators			
Publication of sustainability report	Annual sustainability report published	Annual environmental report published	Report not published
Information to consumers concerning an environmentally friendlier way to use products and to dispose of waste properly	Clear instructions concerning product and product waste given to consumers	Recommendations concerning proper waste disposal made to consumers	No environmental information is provided to consumers

Table 2. Examples of quantitative sustainability performance indicators

Indicator	Calculation method	Measurement units
Economic indicators		
Investments in research and development	Investments in research and development, LTL	%
	Total sales, LTL	
Investments in preventive environmental measures	Investments in preventive measures, LTL	%
	total environmental investments, LTL	
Environmental indicators		
Costs of air emission treatment	costs of air emission treatment, LTL	%
	total production costs, LTL	
Energy consumption	total energy consumption, kWh	kWh/product unit or ton
	Production, units or tons. or tons	
Use of recycled material	use of recycled material, t	%
	total material use, t	
Hazardous waste amount reduction due to material substitution	Absolute number	t
Social indicators		
Number of working days lost due to accidents	Absolute number	units
Percentage of employees that participated in training programmes, related to sustainable development	Number of employees that participated in training programmes	%
	All employees that have to be trained	

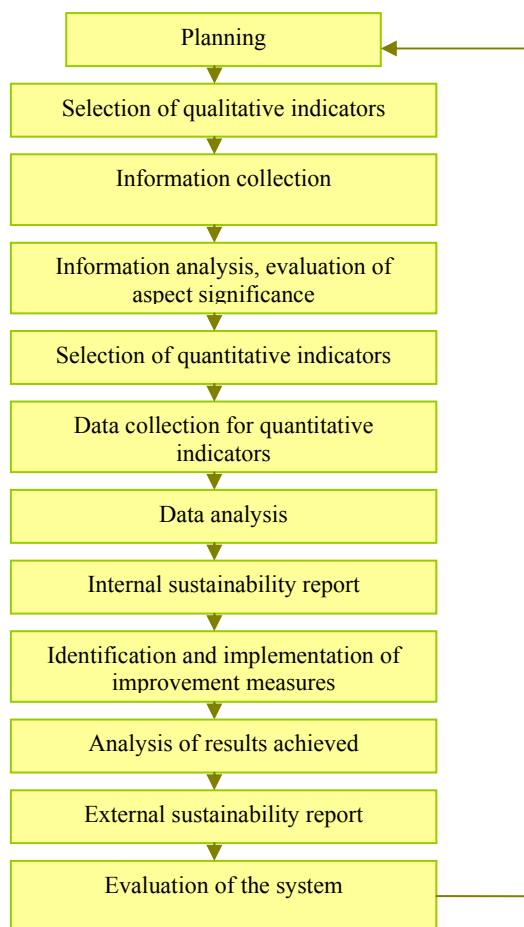


Fig. 1. Simplified structural system for sustainability performance evaluation

Comprehensive and detailed sustainability evaluation of an enterprise is a complicated process. Some recommendations are made in this chapter how to organize this process that could help avoiding waste of time and resources. A simplified structure of sustainability evaluation is presented in Figure 1.

In general, planning of sustainability performance evaluation in enterprises is the same as in the case of any other project. At this stage, a top-management decision is made, responsibilities are allocated and initial information is collected.

The next step is to select qualitative indicators for assessment of overall sustainability of the enterprise. When the information for qualitative indicators is collected and analyzed, positive and negative aspects of the enterprise sustainability performance will surface. Sustainability evaluation needs a great amount of data to be analyzed due to both multiple levels (processes, production sites, products) and multiple dimensions (energy and resource use, emissions, management) (Berkhout F., Hertin J., Azzone G., et.al, 2001). Therefore, it could be useful to perform significance evaluation of these aspects and to focus on the most significant aspects in further development of a sustainability evaluation system.

Quantitative indicators should cover identified significant sustainability aspects and other aspects of the enterprise's operations, products and services that seem to be important in terms of performance improvement. Generally speaking, indicators should inform decision-makers of what they need to know, for example, they should be informed of the quantities of factors related to the environmental impacts, and

these should be related to the environmental and operational aspects (Upham P.J., Mills J.N., 2006). Probably, the most efficient and accurate way to collect data for selected quantitative indicators is material and energy balance. Necessary data could be found in measurement records, different reports, invoices, etc. In some cases, additional measurement could be needed.

Analysis of quantitative and qualitative information will result in an internal sustainability report that could be used to inform employees about the existing situation and to involve them in identification and development of sustainability performance improvement options/ measures. The cleaner production methodology could be used for identification and development of preventive environmental options (Staniškis J., Stasiškienė Ž., Arbačiauskas V., 2001).

When sustainability performance improvement options are implemented, effectiveness of these measures and improvement of performance should be assessed. It could be stressed that a lack of good performance measurements and impossibility of quantifying improvement indicate that a driver for changes becomes weaker (Isaksson R., 2006). Analysis of the results will provide the background information for an external sustainability report. The last step is analysis of the sustainability performance evaluation system and its improvement.

5. Conclusions

1. An increasing number of industrial enterprises use the internationally acknowledged performance evaluation systems (e.g. Global Reporting Initiative, International standard ISO 14031), but many enterprises use their own sets of performance indicators or performance evaluation methodologies.
2. The biggest shortcoming of many existing sustainability performance evaluation systems is their focus on external reporting and underestimation of internal information needs for decision-making, increased management effectiveness and actual performance improvement. Therefore, a fundamental challenge is to select appropriate performance indicators to support operational decision-making in enterprises.
3. The existing performance evaluation systems preferably should be only used as reference materials. Enterprises have to develop their own sustainability performance systems using both qualitative and quantitative performance indicators. To develop an operational system that brings value to the enterprise, the following key requirements for sustainability performance indicators should be fulfilled: comparability/measurability, meaningfulness, integrity, continuity, clarity and efficiency.

4. The existing management system should be used for successful implementation of sustainability performance evaluation. From the point of a management system, it can be stated that within the management systems it is necessary to develop and implement a well-structured performance evaluation methodology to ensure that management objectives are met. Therefore, management systems and performance evaluation systems are mutually supportive and should be integrated.

References

- AccountAbility and WBCSD (2004). Strategic challenges for business in the use of corporate responsibility codes, standards, and frameworks, 2004, WBCSD.
- Ballou B., Heitger, D.L., Landes, C.E. (2006), The Future of Corporate Sustainability Reporting., *Journal of Accountancy*, 00218448, Dec2006, Vol. 202, Issue 6.
- Bennett, M., P. James P., (1999), *Sustainable Measures*, Greenleaf Publishing, Sheffield
- Berkhout F., Hertin J., Azzone G., et.all, (2001), *Measuring the Environmental Performance of Industry*, Final Report of Project MEPI, Environment and Climate Research programme, European Commission, Brussels.
- BMU (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit) und UBA (Umweltbundesamt), (1997), *A Guide to Corporate Environmental Indicators*. BMU, UBA, Bonn.
- Coelho J.F.G.M., Moy D. (2003), The new performance evaluation methodology and its integration with management systems, *The TQM Magazine*, Vol. 15 No 1, MCB UP Limited.
- Diakaki C., Grigoroudis E., Stabouli M., (2006) A risk assessment approach in selecting environmental performance indicators, *Management of Environmental Quality: An International Journal* Vol. 17, No. 2, Emerald Group Publishing Limited.
- Fiksel J. (2002), *Toward Sustainable Cement Industry. Key performance indicators.*, WBCSD.
- GRI – Global Reporting Initiative (2006), *Sustainability Reporting Guidelines*, RG 3.0.
- Institution of Chemical Engineers (2003), *The sustainability metrics. Sustainable Development Progress Metrics recommended for use in the Process Industries*. 28 P.,
- Isaksson R. (2006), *Total quality management: Process based system models*, *Business Process Management Journal*, Vol. 12 No. 5, Emerald Group Publishing Limited.
- ISO (International Organization for Standardization) (1999) *ISO 14031: Environmental Performance Evaluation - Guideline and general principles*, Geneva.
- Keeble J., Topiol S. Berkeley S. (2003), Using indicators to measure sustainability performance at a corporate and project level, *Journal of Business Ethics*, Vol. 44 Nos 2/3.
- Miller G., (2001), The development of indicators for sustainable tourism: results of a Delphi survey of tourism researchers, *Tourism Management*, Vol. 22.
- NAE(National Academy of Engineering) (1999). *Industrial Environmental Performance Metrics – Challenges and Opportunities*, Committee On Industrial Environmental Performance metrics, NAE, National Research Council, National Academy Press, Washington D.C..

Pfliche J., Fischer M., Kupfer T., Eyerer P. (2005), The Contribution of Life Cycle Assessment to Global Sustainability Reporting of Organisations. „Management of Environmental Quality: An International Journal, Vol. 16, No. 2, , Emerald Group Publishing Limited.

Searcy C., Karapetrovic S., McCartney D. (2005), Designing sustainable development indicators: analysis for a case utility, Measuring Business Excellence, Vol. 9 No. 2, Emerald Group Publishing Limited.

Searcy C., Karapetrovic S., McCartney D. (2008), Application of a systems approach to sustainable development performance measurement, International Journal of Productivity and Performance Management, Vol. 57 No 2, Emerald Group Publishing Limited.

Staniškis J., Arbačiauskas V. (2004), The Sustainable Industrial Development: Reality and Vision. In “Technological Choices for Sustainability”, Springer-Verlag.

Staniškis J., Stasiškienė Ž., Arbačiauskas V. (2001), Cleaner Production Concept and Its Implementation. Guidebook. Kaunas, Technologija, (In English and Lithuanian).

Schaltegger S., Herzig Ch., Kleiber O., Müller J. (2002), Sustainability management in business enterprises. Concepts and Instruments for Sustainable Organisation Development,

Topfer K., (2000), The triple bottom line economic, social natural capital, UN Chronicle, Vol. 36 No. 2.

Toth G., Arbačiauskas V. (2005), Environmental Performance Evaluation. Guidebook. Kaunas, Technologija, 2005 (in Lithuanian).

Upham P.J., Mills J.N., (2006), Environmental and Operational sustainability of airports: core indicators and stakeholder communication, Benchmarking: An International Journal, Vol. 12 No. 2, Emerald Group Publishing Limited.

Veleva V., Ellenbecker M. (2000), A Proposal for Measuring Business Sustainability // Greener Management International 31, 2000

Veleva V., Hart M., Greiner T., Crumpley C. (2003), Indicators for measuring environmental sustainability, a case study of the pharmaceutical industry, Benchmarking: An International Journal, Vol. 10 No. 2, MCB UP Limited.

Veleva, V. Ellenbecker, M. (2001), Indicators of sustainable production: framework and methodology, Journal of Cleaner Production, Vol. 9 No. 6.

World Business Council for Sustainable Development (WBCSD). Eco-efficiency indicators and reporting, Status Report, WBCSD EEM Working Group, March 2000, Geneva.

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Darnaus vystymosi veiksmingumo indikatorių taikymas pramonės įmonių vadyboje

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Darnus vystymasis vis dažniau vertinamas kaip pagrindinė vystymosi strategija. Nepaisant to, kad įvairios tarptautinės organizacijos, pramonės įmonės ir akademinės institucijos daug dėmesio skiria darnaus vystymosi veiksmingumui įvertinti, ši sritis vis dar iki galo neištirta. Daugelis pripažįsta, kad veiksmingumo indikatorių taikymas yra efektyviausias darnaus vystymosi veiksmingumo įvertinimo metodas, tačiau indikatorių parinkimas ir taikymas šalies ir pramonės įmonės lygmeniu turi būti tiriamas tol, kol bus bendrai sutarta dėl efektyviausių veiksmingumo indikatorių sistemų ir metodikų, kaip šias sistemas taikyti.

Šiame straipsnyje apžvelgta: a) įvairių darnaus vystymosi veiksmingumo įvertinimo sistemos nustatant jų pranašumus ir trūkumus vadybos efektyvumo didinimo požiūriu (įmonės lygmeniu); b) darnaus vystymosi veiksmingumo indikatorių parinkimo rekomendacijos, kad būtų didinamas sprendimų priėmimo efektyvumas ir skatinamas prevencinių aplinkos apsaugos priemonių taikymas; c) darnaus vystymosi veiksmingumo įvertinimo proceso pramonės įmonėje rekomendacijos.