Implementation of technical and information systems in environmental management

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Abstract

The paper will address the topic of technical and information systems, which constitute a very important element of supporting environmental management in an enterprise in a turbulent environment. There is a range of variants of their implementation fulfilling a number of different functions, which examined in terms of the effects of implementing systems informing about the environment in an enterprise, usually focus on typical areas of their use in environmental management, with particular reference to the evaluation of their practical importance.

Implementation of the objectives related with instruments for environmental management in the aspect of improving the effectiveness of environmental protection in an enterprise enables the achievement of a specific goal implied by ecological controlling. However, these instruments are characterised by specific attributes, as most of them, having a nature of satellites, are implemented as a complement to conventional instruments. A wide range of applications of systems informing about the environment allow enterprises to systematically implement such instruments without significant financial outlay. Despite numerous unfavourable economic and ecological conditions, it should be stressed that the effects illustrating the implementation of such systems are very reliable and so evocative that integration of environmental information systems with the structures existing in an enterprise determines high quality of the final data. In the relationship between environmental management and instruments, it is very important for effective environmental protection implemented within an enterprise that the instruments are compatible and can be combined with one another, which will have a significant impact in the future on the paradigm of constantly increasing interest of enterprises in systems for environmental management through the perspective of ecological indicators and balances.

Keywords: Technical and information systems; Environmental management; Ecological controlling.

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Introduction

Environmental indicators and systems of environmental indicators are specialist tools designed to support environmental protection solutions in enterprises (Herva et al., 2011). They represent an instrument for implementing various tasks in the area of environmental protection, controlling this process, searching for optimal potentials as well as for internal and external communication.

From the methodological perspective, they are characterised by relatively low costs, simple use and possibility of evaluation.

We often talk about trade-off between attempts to achieve certain parameters on the one hand, and profitability and transparency of indicators on the other hand (Armon & Osmo, 2015). We also cannot ignore the issue of lack of information caused by parameter aggregation – both from the perspective of a single indicator and the whole system of environmental indicators. It also should be mentioned that one of the weaknesses is the fact that the impact of a system of environmental indicators depends on the choice of an indicator and parameter. It is not the number of selected indicators that matters, but specification of indicators that are geared towards a specific goal. As far as the dependence on a parameter is concerned, it is reasonable to say that the value of an environmental parameter is as accurate as its underlying output parameters. If they are roughly estimated, then the environmental parameters are also only relatively accurate. However, the implementation of indicators has its limits, if the information relevant to the environmental protection is only qualitative, not quantitative in nature (Kuik & Verbruggen, 2012). Apart from that, environmental indicators, due to their orientation towards the past, do not make it possible to reverse identified imperfections, which could reduce similar problems in the future or allow them to be avoided. Environmental indicators cannot be used to conduct a detailed analysis and assessment of single measures (Kuik & Verbruggen, 2012). This is because typical sources of errors in the application of indicators refer to research and measurement errors, as well as calculation errors and those resulting from an incorrect assessment (Hřebíček et al., 2014). Difficulties in the assessment of indicators can be connected with the interpretation of results and their further use, e.g. to compare enterprises. Often, proper comparative values are not available because of the protection of data and various production structures participating in the examination of enterprises, and due to dissimilar methods for examining indicators.

Despite the above-mentioned weaknesses, environmental indicators and systems of environmental indicators, due to their characteristics and the fact that the indicators are already widely used in the classical model of controlling, constitute a widespread and open instrument in enterprises committed to environmental protection (Efroymson & Dale, 2015). They are employed by large enterprises actively involved in environmental protection to assess the effectiveness of such activity in the aspect of controlling the effectiveness of the environmental management system and to communicate their environmental activity. In their practice, enterprises most often develop indicators of the effects of their activity in the area of environmental protection, for which environmental management indicators are selected, but environmental state indicators are not popularised in any way (O'Riordan, 2014).

1. Compatibility of environmental management instruments

Environmental management instruments are used for environmental management in an enterprise to identify the enterprise's impacts and effects on the environment and indicate the possibilities to minimise them. In accordance with established goals and adaptation of environmental management, both offensive and defensive (Urbaniak, 2012), as well as operational and strategic one, only diversified instruments are significant. For instance, strategic environmental management uses SBCS, while operational environmental management more often uses indicators. Comprehensive environmental management, which takes place at all levels, has to choose such a set of instruments that can be used in all areas. Figure 1 shows the usefulness and significance of the different instruments of environmental protection in different phases of the implementation of an environmental protection system. While some instruments are typical of only one phase e.g. environment-orientated guidelines on procurement), other instruments may be used in a number of phases (e.g. environmental indicators).

The choice of instruments and scope of their use in an enterprise may be further subject to modifications, in order to meet constantly changing requirements. As empirical analyses show, numerous enterprises committed to
environmental protection, currently use a set comprising three environmental management instruments on average (Rice, 2013), or four instruments for sustainable development (Baumgartner 2014).

The effectiveness, use and efficiency of ecological controlling depend on the compatibility of implemented instruments, which in turn is determined by data availability and quality. It is possible to implement many instruments at the same time, both operationally and strategically, by the subject of reference and by content (only economic or environmental and economic, or environmental, economic and social) so that they complement each other and constructively impact each other. By combining compatible instruments, a noticeable profit can be obtained in an effective way. In this context, competition may occur between instruments. In such a case, reduced profit during the implementation and use of competing instruments makes it necessary to make additional financial outlays. When combining environmental management instruments, in each case it is important that denotation cycles are selected analogically, which will ensure the use of the target profit also as part of offensive environmental management. If, for instance, environmental balances, as the starting point for the development of environmental indicators, are created only once a year, then a short-term adaptation is not possible (Kaźmierczak-Piwko, 2012).

An effective combination also refers to the time horizon. Orientation towards the past of many instruments is in contradiction with the dynamics of impacts and ecological changes, which as a result may be insufficiently taken into account by this instrument (Wysokińska-Senkus & Raczkowski, 2013; Stulginskis 2013). Prospective, or future-oriented, instruments should therefore complement widely used instruments of ex-post analysis in an enterprise.

2. Effective environmental protection using systems informing about the state of the environment existing in an enterprise

In order to introduce selected concepts and instruments for environmental protection in the aspect of sustainable development in an enterprise in an effective and targeted way, technical systems for information support were used. The best support is provided by systems informing about the state of the environment used in an enterprise (BUIS). BUIS enables targeted formulation, control, definition of values and presentation of data relevant to environmental protection in an enterprise (Arndt, 2013). Some authors regard BUIS and ecological controlling as synonyms. In this paper, BUIS is understood in a broader sense as all IT solutions as well as those in the paper form, which are used in an enterprise to compare data on its activity's impact on the environment, and thus support various and complex tasks of environmental protection and ecological controlling (Isenmann & Rautenstrauch, 2007).

BUISs are thus responsible for data and information exchange in three areas: enterprise, electronic data processing and environmental protection. Moreover, they may contribute to integration of environmental protection in certain areas of an enterprise's activity, such as procurement or production, etc. ( Möller & Schaltegger, 2012). However, the choice of BUIS is also determined by a selected supportive instrument. Apart from a quantitative
representation of the flow of materials and energy, individual BUISs offer (e.g. Audit®, Umberto®) a graphical presentation in the form of so-called images of the operation of programmes, as presented in figure 2 and enable identification of complex structures and process relationships. Based on the quantity of materials and energy, it is possible to make calculations or simulations. The result often takes the form of ecological balances. Apart from the quantities of materials and energy, also the costs associated with them can be presented in the graphical form. Figure 3 presents, using the example of Umberto® software, the distribution of material and energy costs as well as components of the other costs in the form of Sankey diagram. The width of an arrow signifies the amount of costs, whereas the colours of the arrows inform about the type of the material, or energy. Moreover, individual BUISs (e.g. UMsys® software) feature geo-information modules, which present environmental data in geo-information systems developed on the basis of maps to ensure insight into the most frequent quantities of data. This allows the user to quickly find out when, with what results and what sampling took place within the company, or where the different waste disposal plants stored waste (Solsbach, Lipnitskaya & van Vliet, 2013). Apart from that, the implementation of BUIS brings the following benefits (Junker, 2013):

- Direct effects in the form of cost reduction through increased efficiency in an enterprise: systematic data management and processing as well as support for the analysis, visualisation and presentation of extensive ecological information; increased availability, comprehensiveness and topicality of ecological information; ensuring data continuity; simplification of important tasks as well as documentation and publication of ecological information; quick access to important data; continued support for controlling and planning; improved possibilities of control and advice with respect to environmental protection in an enterprise.
- Indirect effects, i.e. indication of pro-ecological potentials for savings: decrease in risk/costs through identification of weak points in an enterprise and focus on potentials for unburdening the environment;
- Other effects: (geo)graphically supported presentation of the circulation or archiving of documents; provision of regional or global systems of ecological information with ecological data from an enterprise¹.

¹ For more on national and global ecological information systems or networks, see: (Thiel-Clemen, 2013)
In order to achieve the above-mentioned benefits, BUIS has to meet the following requirements (Gräuler et al., 2012):

- Completeness: as far as possible all ecological information should be taken into account, from all important periods;
- Accumulation/concentration: Accumulation of ecological information to ensure it is comprehensive and facilitates decision making;
- Control: "being up to date" with ecological information;
- Comparability: Using a uniform measure of evaluation;
- Topicality: Preparation of ecological information on a continuous basis to support prospective decisions;
- Economy: The introduction and use of BUIS is feasible from the economic perspective and may contribute to savings achieved by an enterprise.

However, these requirements are in contradiction with estimation of costs in terms of their use e.g. with reference to completeness of presentation of data, which relativize the firmness of the requirements.

3. Evaluation of the market and practical significance of BUIS

In recent years, a great many of BUISs have been developed. BUISs available on the market can be systematised in the context of environmental protection by the following criteria (Junker, 2010): areas of use - ecological databases and ecological law databases, pro-ecological organisations, material flow management, ecological balance; aspects important for the environment - waste, emission, energy, hazardous materials, infrastructure, material flow; used data - data on the origin of raw materials and materials, structural data, process data, data connected with material and energy flow, organisational data; addressees - management of an enterprise, agents responsible for ecology, specialised divisions, peripheral organisations, people outside an enterprise interested in its
activity; areas of functioning - procurement, data management, preparation, presentation, organisation; accepted boundaries of the system impact - an enterprise or its branch, process, product, inter-factory/off-site.

However, a clear assignment of the different BUISs to the above-listed categories is not always possible, because there are sometimes too many differences between them. An effective use of BUIS is determined by a wide scale integration of the flow of information about all the areas and levels of functioning and approval by the management of an enterprise (Teuteberg & Gómez, 2010). At the same time, it should be noted that the quality and success of BUIS depend to a large extent on the quality of input data, its association with ITK system/systems existing in a given case and on the organisation of integration (Tarara, 2013). The aim of a general algorithm for implementing an environmental management system in an enterprise is to find out whether the system meets the requirements of the enterprise and whether its implementation is correct in the aspect of identification of discrepancies in the areas of measurements and control, which is illustrated in the diagram.

Fig. 4. Algorithm for implementing an environmental management system in an enterprise

However, due to its diversity, BUIS can effectively support various tasks connected with ecological activity of an enterprise and environmental management in accordance with the demand (Haasis, 2008). However, an unclear BUIS - offerer - market relation makes it more difficult for users to choose appropriate software. Moreover, the different commercial versions of BUIS are so specifically constructed that they can be operated only by experts, which usually requires training courses.

Conclusions

The implementation of goals and tasks connected with environmental protection in the sense of continuing the improvement of an effective environmental protection in an enterprise enables the achievement of a specific goal.

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1 The distinction between inter-factory and off-site should be understood as follows: inter-factory cooperation is pure cooperation limited by the boundaries of an enterprise, concentrated on direct relationships between two or more enterprises. In contrast, off-site cooperation refers not only to enterprises but also to organisations that are not profit-oriented (e.g. associations, public institutions, political agencies) compare with Reichmann, T., and M. Kißler (2010).
through support from ecological controlling. It should be remembered that ecological controlling, or environmental management in a broader sense, in an enterprise uses, depending on the requirements and conditions of an enterprise, instruments that are generally available and / or ecologically specific.

However, these instruments are characterised by a certain peculiarity. Thus, most instruments for environmental management show the character of satellites, i.e. they are implemented in an enterprise in addition to conventional instruments. In the practice of enterprises, they are most often used to perform tasks at the operational level and without incurring significant costs. Despite possible different economic, ecological and other effects, the results showing the implementation of BUIS are so trustworthy and significant that a successful integration of BUIS with the existing structures can ensure high quality of final data.

Further, it is also worth noting that these instruments are often oriented towards the past, although we cannot ignore the fact that important lessons for the future can be learnt from weaknesses in the past. New concepts, such as SBSC, may support environmental management, or management of sustainable development, especially at the strategic level of environmental management. However, in the case of these instruments, especially SBSC, it is currently necessary to develop them conceptually and practically. For example, there are many assumptions about the implementation of solutions connected with environmental costing. The choice of an appropriate assumption depends on individual requirements of individual enterprises. It can be perceived as a chance in terms of the development of an environmental management system and ecological controlling specific to an enterprise, but also as a challenge. In such a specific for an enterprise choice and use of instruments in the form of the environmental management - instruments relation, of importance for an effective environmental protection implemented within an enterprise is further compatibility and possibility of combining instruments. In view of the constantly increasing interest of enterprises in environmental management systems in recent years, we should expect increased popularisation and use of especially those environmental management instruments that have been presented in detail in this paper.

References


