

Application of ERP-Systems in Environmental Management – Case Study and Survey for IT-Support

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Abstract

To improve the environmental performance of the enterprise, environmentally relevant information has to be provided to different decision-makers in enterprises. Therefore, functionalities and information systems are necessary in order to prepare information in a user-oriented way. In this regard, information on material and energy flows, costs as well as material properties are important for producing companies. They can be provided to the users with so-called Environmental Accounting Instruments. In practise, restraints arise from non-available functionalities in software systems or missing integration of relevant systems that constrain information acquisition and integration in business processes.

Within the research project “intebis – *Integration of environmental information in Business Information System*”² a transferable generic IT-concept is developed to integrate environmental data in Enterprise Resource Planning-systems (ERP-system) such as SAP R/3 and to support business process in terms of material flow management. The objective is an integrated view on environmental relevant information and their user specific analysis and reporting for management, controlling, environmental and other operating departments.

The IT-concept is currently exemplarily implemented and evaluated by the cardboard manufacturer Kappa BADENKARTON, a medium-size enterprise in the state Baden-Württemberg, Germany. In this paper, the current state of the implementation is shown. Preceding this, results from a survey among producing enterprises in the state Baden-Württemberg, Germany are presented. In this survey, the identification of the current state of the application of information instruments for environmental management and their IT-support was addressed.

1. Introduction

The analysis of material and energy flows in a company is the starting point for an improvement of the environmental performance of a company and for cost reduction through efficient material and energy use. This can be done by closing material loops, optimisation of processes and substitution of hazardous materials. Necessary for this are a holistic analysis of corporate activities that requires detailed knowledge on processes parameters, costs of respective material and energy flows and material consumption. Environmental Accounting Instruments can provide such information to decision-makers, e. g. in the form of Environmental Performance Indicators. In practice, however, the relevant data needed for such indicators are

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spread in a heterogeneous IT landscape, in part redundant and with different reference systems. Data have to be consolidated from different organizational units and from different information systems with high effort. The high amount and complexity of the data makes an evaluation and information supply for users difficult. Thus, the data has to be structured. An approach to solve this is the integration of such environmental information into the corporate information technology systems.

2. Environmental Accounting Instruments and their Software Support in the Industry – Results from a Survey

In producing companies, environmental improvement measures have to be identified, analysed, managed and controlled. Within a management cycle, new targets have to be set regularly in order to achieve a continuous improvement. This means that information have to be gathered and consolidated from different organizational units in a company. Such environmental information has to be made available for a variety of company functions as a basis for decision-making.

To ensure this, the relevant information has to be made available with appropriate instruments. Environmental Accounting Instruments (EA Instruments) are designed to supply information on the environmental performance with the focus on material and energy flows. Many different instruments of environmental accounting have been developed in the last 25 years³. One of the most popular EA instruments are Environmental Performance Indicators (EPI)⁴. Their implementation is described in many different guidelines (BMU/ UBA 1997, LFU 1999, WBCSD 2000) and in the ISO standard ISO 14031. EPIs are absolute or relative measurements with environmental focus to describe amount, mass, concentration, costs or other environmentally relevant figures within the company. With EPI, actual performance can be compared with targets to make sure that targets and objectives are reached (e.g. Kottmann et al. 1999). EPIs are also used for external environmental communications in environmental or sustainability reports. EA Instruments should be supported by an efficient Business Information System to facilitate the consolidation and aggregation of indicators.

In spring 2004, questionnaires were sent out to 1594 producing enterprises, mainly in the State of Baden-Württemberg in southwest Germany. The survey's main topic was to get an overview over the current state of the application of information instruments for environmental management (Environmental Accounting Instruments), the users of such information as well as the IT support used in practice. 160 enterprises answered, which is equal to a return rate of about 10%. Most of these companies have a systematic environmental management system such as ISO 14000 or EMAS.

2.1 Use Intensity of Environmental Accounting Instruments

Companies were asked which Environmental Accounting Instruments they use and how often they use them. A list of instruments was given with a focus on producing companies and the terms used in industry. (e.g. Hazardous Substances Management is more than an Environmental Accounting Instrument, but the term is widely known in industry). The use intensity of the different instruments varies greatly as can be seen in Fig. 1.

³ for an overview see e.g. Schaltegger and Burrit (2000), BMU, UBA (2001) Bennet and James (2000), also see Bennet, Rikhardsson, Schaltegger (2003)

⁴ Loew and Hjalmsdottir describe the broad use of EPI based on an empirical analysis(1996). The popularity of EPIs is also reflected by their use in environmental reports or sustainability reports, and EMAS statements

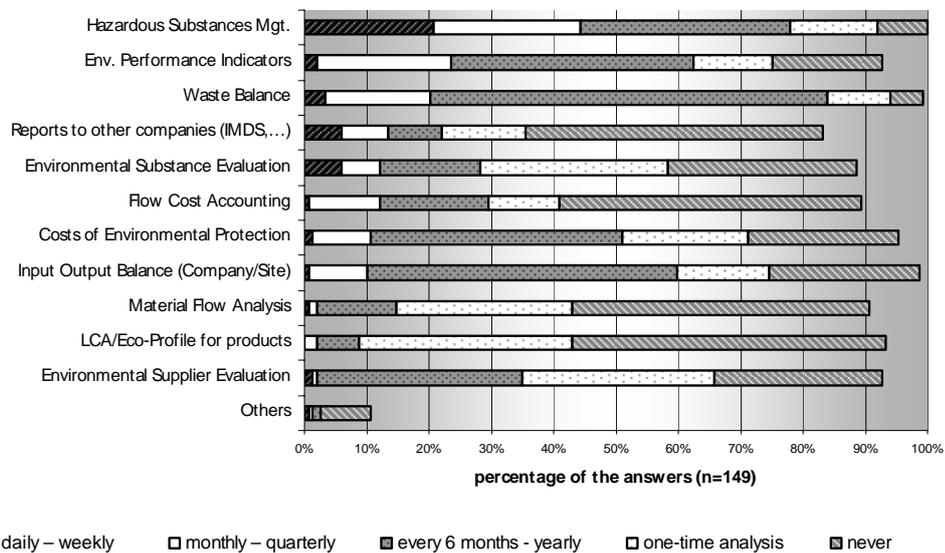


Fig. 1: Use of Environmental Accounting Instruments with Use Intensity

The instruments used most are Hazardous Substances Management, Environmental Performance Indicators and Waste Balance, probably caused by pressure from legal obligations in Germany. Environmental Performance Indicators are used by a lot of companies, but with a low level of detail as is shown in Fig. 2. Most companies apply them only at a company or site level and not for cost centers or processes. Thus, they cannot be used as controlling instruments.

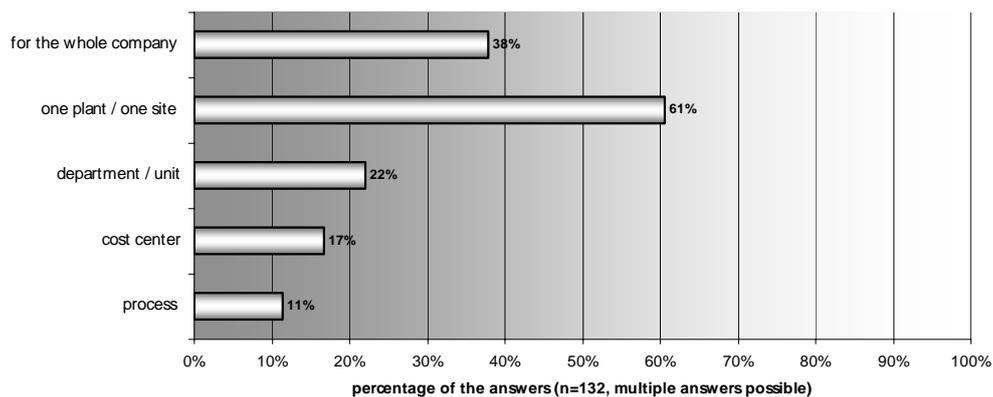


Fig. 2: Level of Detail of EPI in the Enterprise

An environmental balance (input-output balance) is used by many companies. It can be the basis for external communication or to support the environmental management system in order to display the environmental impact of the company as a whole or one of its sites. Product or process related instruments (such as eco-profiles, LCA or material flow analysis) are used with a lower intensities or only for one-time analyses. This can be caused by a low internal or external demand or by the high effort to use these instruments and to supply the required data.

2.2 Users and Reasons to Use Environmental Accounting Instruments

The companies addressed were asked which enterprise functions use Environmental Accounting Instruments (EA Instruments) and thus require environmental information. The evaluation of the returned questionnaires showed that such instruments are mostly used by environmental management, production, controlling and quality management.

The companies were also asked for their reasons to use Environmental Accounting Instruments. Many different possible reasons were given to choose from. Most answers were given in the area of controlling and communication. Over 60% of the companies stated that they use EA Instruments for internal communication (67%), to inform employees (67%), to fulfil the requirements of the environmental management system (63%) or to inform public authorities (61%). Still more than half of the companies use EA instruments to identify the relevant environmental aspects (54%) and to analyse trends and support the continuous improvement process (both 52%).

2.3 Software Support for Environmental Accounting Instruments

The companies were asked in two questions which IT-support is used within the application of Environmental Accounting Instruments and which benefit or restraint they expect for an EPI integration in the ERP-System. The latter question refers especially to the research in the project intebis.

Office products like Microsoft Excel are the IT-systems predominantly used while an intranet is applied less. While ERP-systems like SAP R/3-systems increasingly support business processes of production and sales management, they were applied in practice by just a few enterprises to supply EA Instruments.

Some case studies presented already the benefit effects of an integration of EPIs in the ERP System (Heubach et al 2003, Biebel/ Heubach 2003). However the survey shows, that the usage of ERP Systems is mainly restricted to the calculation of environmental cost (24%), another field is the Hazardous Substance Management (15%). The generation of a corporate material balance is supported by the ERP System in some few enterprises too.

More than a half of the enterprises agreed partly or completely the theses that the integration of EPIs in the ERP-system results in a stronger integration of corporate environmental management into the enterprises. Expected benefits are mainly:

- make writing of internal or external reports more efficient,
- make it possible to attribute environmental impact to place of origin,
- lead to a more intensive use of EPIs,
- lead to a use by more persons than before.

But more than a half of the enterprises suppose that such integration would be too complicated and too much work (see Fig. 3)

Survey: An Integration of Environmental Performance Indicators into the ERP System would...

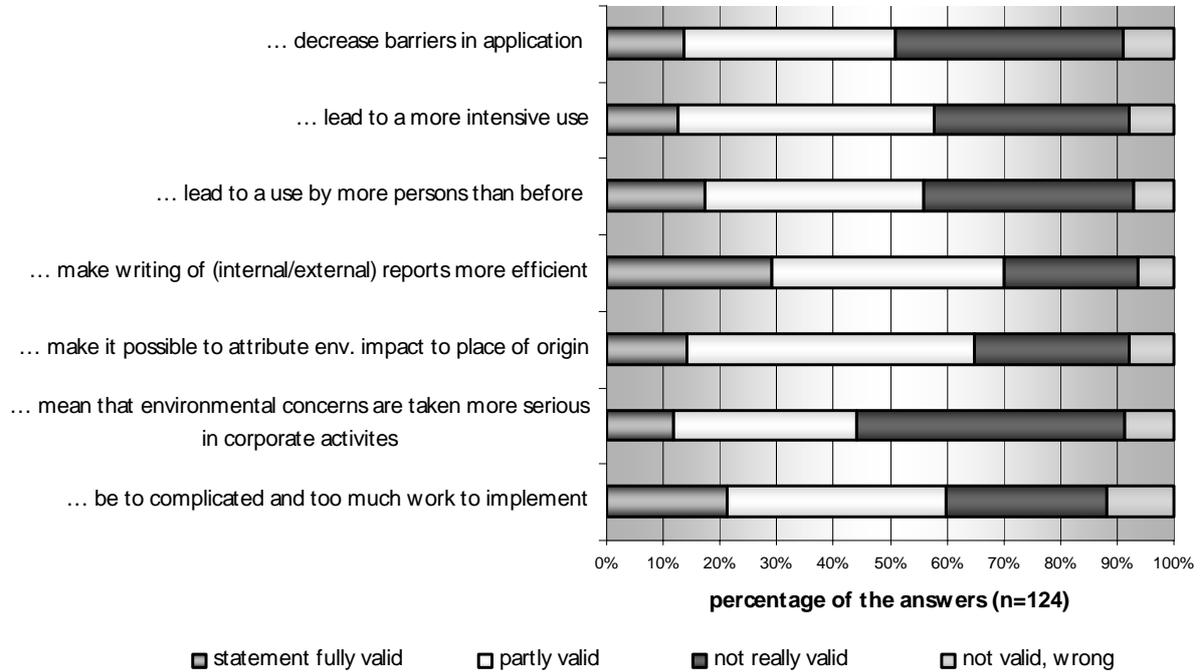


Fig. 3: Integration of Environmental Performance Indicators in ERP-system – Benefits and Restraints

3. Implementation of an Environmental Performance Indicator System in SAP R/3

3.1 Objective and Implementation

The objective is to develop a concept to integrate an Environmental Performance Indicator System (EPI System) on process level into the ERP System SAP R/3 of the small and medium-sized enterprise. This is evaluated with Kappa BADENKARTON, a cardboard manufacturer in Gernsbach, Germany. The performance indicators regard material and energy flows, efficiency aspects as well as cost information.

The main motivation for Kappa BADENKARTON is to create a higher transparency on their corporate activities. This is expressed with the following goals:

- Support of resource-efficient production by minimising material and energy input, reducing emissions and avoiding and reducing waste,
- Transparency of usage of environment by accounting and balancing material and energy flows, and

- Availability of up-to-date environmental data by ensuring data safety and coherence, avoiding redundancies, providing a common data base and achieving independency from single persons within the enterprise.

The developed concept will be integrated in the SAP R/3-system, as this represents the standard controlling system in the enterprise to bundle all information. The objective is to apply only existing IT Systems and to keep the different numbers of applied IT Systems manageable.

3.2 Implementation Procedure and First Results

For the integration of an Environmental Performance Indicator System (EPI System), a top-down approach was chosen. This means that the information requirement of the users was analysed at first. Then, an EPI System was developed and set up containing the required information. Based on this, an integration of the EPI System into the organisation of the company is described. This is followed by the analysis of the IT landscape and the design of an IT concept to integrate the EPI System into SAP R/3 containing a description of data formats and software interfaces.

3.2.1 Structure of the Environmental Performance Indicator System

The most popular of the production oriented instruments are Environmental Performance Indicators (EPI). Their implementation and use is described in various guidelines (BMU/ UBA 1997, LFU 1999, WBCSD 2000) and even within the ISO 14000 series (ISO 14031). EPIs are absolute or relative measurements with environmental focus. They can be used to describe amount, mass, concentration, costs or other environmentally relevant figures within the company. With EPIs, actual performance can be compared with targets to make sure that targets and objectives are reached (e.g. Kottmann et al. 1999). EPIs allow to structure environmental information and to reduce complexity.

At Kappa BADENKARTON, collected data were structured in a hierarchical EPI System (categorisation according to BMU/ UBA 1997) as monthly input- and output-flows (of material and energy) as well as efficiency indicators regarding input, process and output. Additionally, the EPIs reference directly to a “place” in a hierarchical system in the enterprise (like a machine, a process, a business unit, similar to the cost centre structure). Thus, actions can be assigned but also realised efficiency potentials credited.

3.2.2 Analysis of IT-Systems

The information requirement by the users leads directly to the required data. In producing companies, these data are often spread in many different IT systems. A similar situation was found at Kappa BADENKARTON. Relevant data can be found in the following IT Systems:

- SAP R/3 is used for accounting, controlling, purchase department and material management. Stock inventories and costs of raw materials can be found there.
- The process control system acquires a multitude of technical parameters from production, e.g. consumption of auxiliary materials, water, energy and many process parameters (machine output, state of production, chemical parameters, temperature, etc.).
- The production data acquisition holds data on production performance and controlling and serves for evaluations for the operative support of production.
- Microsoft Excel is used to create and provide balances and parameters e.g. of the waste and waste water management or to do some data interpretation by the controlling.

The data partly have different reference systems with respect to time, space or product. Some data are not acquired with the required data or not in the IT-Systems at all, e.g. water, waste water, waste or consumption of auxiliary materials. It is planned to install additional meters there connected with the company IT-Systems.

Concept for IT-Integration

Based on the IT-analysis the concept for IT integration will be developed. The decision where in the ERP-system the EPI System will be implemented is still to be made. Alternatives are the usage of a Data Warehouses (SAP Business Warehouse) or the development of an SAP-table structure and the application of simple algorithms in the SAP-system. Functionalities have to be defined to calculate and analyse the indicators and to allocate them on “places”. Criteria for the decision between both alternatives are complexity of the EPI System, occurring amount of data and required analysis functions. From the enterprise perspective, an easy to maintain and cost-efficient solution is desired.

Furthermore, it have to be proved, which interfaces are necessary for data exchange and integration. Alternatives are an online-connection or manual files upload with data from the other IT-systems, whereas the can manual upload be cheaper installed. Some data have to be entered by hand in a front end mask. A generic data exchange format has to be defined for the interfaces.

3.3 Conclusion

With the “top-down”-approach the information demand of the different business units and their employees were firstly identified and structured. After that, the available supply of data in IT-systems was analysed “bottom up”. Many process-related data existed already. For some parts (e.g. material input, consumption of electricity), the monthly, place-related level of detail of EPIs were missing. Thus further action were identified to extend the data base to calculate the need EPIs. A higher accuracy of data acquisition will lead to higher acquisition expense (Weber 2002). Thus data gaps were prioritised in the project team before new measurement systems were installed.

The necessary multi-disciplinarity of the project leads to high requirements on project management. Potential users and business units were involved already at an early date, e.g. the required level of detail of the EPIs. The experience in the project shows, that external moderation and guidance is very helpful and often required.

The current implementation of the EPI System at Kappa BADENKARTON shows that industrial enterprises have less concrete experience with definition of an EPI System. Particularly a consolidated methodological knowledge on Environmental Accounting Instruments is necessary for the structuring of the system and the consideration between completeness and feasibility.

Many data existed already, but they were distributed in different Systems. Some of the data was too inaccurate for the calculation of the efficiency indicators, so that additional data acquisition is necessary and will be realised within the project.

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