Sustainability Management within Selected Large-scale Enterprises in Germany

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Abstract. Sustainability is a very important factor in long-term entrepreneurial success. Company-wide sustainability management is mandatory and requires software support if it is to be conducted efficiently. Thus, the aim of this paper is to point out the challenges and difficulties facing large-scale enterprises in Germany while implementing and maintaining company-wide sustainability management. We conducted a multiple-case study of seven selected German companies. The results show that the selection and deployment of sustainability instruments differ from enterprise to enterprise. However, all of the enterprises studied exhibited substantial uncertainty about the extent of possible future governmental regulation that would make an adaptation of existing systems necessary causing high costs and requiring high resource deployment. This is why software-support of sustainability instruments is often done with Excel-based solutions or other home-grown programs.

Keywords: sustainability management, ERP systems, environmental management information systems, EMIS, multiple-case study

1 Introduction

Not only countries such as China and India, which are at the center of current debates and discussions concerning climate change and the immense economic growth in these and other newly industrialized and developing countries, are facing economic, but also ecological and social challenges, as are their business partners. The demand for sustainable development continues to increase in both developed and developing countries. Customers and politicians are demanding that businesses take over responsibility for environmental and social issues, while financial analysts, external credit assessment institutions and investors are becoming interested in corporate efforts to promote sustainability. Therefore, sustainability and sustainability

management will be a very important strategic task to enterprises, which are now concerned with the challenges of sustainability management [1], [2]. Thus, sustainability is becoming an important factor in long-term entrepreneurial success.

In general, for an enterprise wishing to fulfill the demands of sustainability, company-wide sustainability management is mandatory. The function of such management is to control the economic, ecological and social effects caused by the enterprise, to ensure, that, on the one hand, the sustainable development of the enterprise is reached and, on the other hand, to ensure that the sustainable development of the economy and society affected by the enterprise are also improved [3]. Hence, properly implemented, sustainability management can create new opportunities. These may include the emergence of new markets, image improvement, increased employee motivation and the reduction of production costs. To support these developments, a multiplicity of concepts and instruments already exist.

However, at this point, the question arises of how and to what extent information systems (IS) can be deployed in such a way that the additional expenditure and effort caused by sustainability management can be efficiently and permanently embodied in an enterprise's organizational structure and processes. One kind of IS support that fits this criteria is the so-called environmental management information system (EMIS). EMIS are organizational and technical systems for the systematic collection, processing and allocation of relevant environmental and sustainability data on an enterprise [4], [5]. More closely EMIS can be limited to software systems. EMIS software systems are used for the collection, documentation, planning and controlling of the environmental effects of an enterprise's operational activities. Thus, they can support environmental and sustainability management [6]. Other alternatives for sustainability management support are found in the integration of "green" key performance indicators (KPIs) into enterprise resource planning (ERP) systems and the interface between ERP systems and EMIS. However, both alternatives are rarely provided by ERP manufacturers. Some of these approaches will be described in more detail later on.

Thus, the complexity of sustainability management, as well as its integration into operational data processing, represents an additional challenge for enterprises. Especially for small- and medium-sized enterprises (S&MEs), EMIS implementation and integration projects are often difficult to handle, since they are faced with a lack of financial, material and human resources [7]. Additionally, S&MEs often do not have the appropriate IS-infrastructure necessary to support company-wide sustainability management. For example, a survey of 124 Saxon S&MEs in the year 2009 showed that only approx. 28% of these enterprises had implemented an ERP system or planned to implement one [8].

Regarding sustainability management and EMIS, the situations of large-scale enterprises and S&MEs are totally different, as shown by previous research (cp. [9], [10]). A survey of 83 German S&MEs showed that only 28 companies are aware of sustainability or see this topic as being important in the future. Thus, few S&MEs were using IS support as part of their sustainability management. Only a small variety of sustainability management instruments and concepts were used [10]. A multiple-case study that compared two large-scale enterprises with two S&MEs supported these results. In fact, the two S&MEs were aware of sustainability, but one company

did not deploy any sustainability management instruments, and the other one used only one instrument [9].

Since many large-scale enterprises started sustainability projects a few years ago, we will exclude S&MEs from our study. In a few years, it will certainly be interesting to see whether and how S&MEs follow the current trend.

Overall, the aim of this paper is to point out the challenges and difficulties large-scale enterprises in Germany are facing as they implement and maintain company-wide sustainability management. The paper is structured as follows: After a short description of the terms "sustainability" and "sustainability management", the possibility of using IS to support sustainability management is discussed. Subsequently, this theoretical discussion is supplemented, supported and/or disproved by a multiple-case study mainly based on interviews with seven selected large-scale German enterprises. The focus of these interviews was on the experiences and challenges faced during the implementation of sustainability management programs. Finally, the paper ends with a summary and critical appraisal of the main results.

2 Background

Sustainability and sustainability management have become more and more important to business activities. For many companies, it is now essential to act in sustainable ways and set up effective sustainability management and reporting systems with "green" KPIs. Therefore, the topic of sustainability has been widely discussed in the literature (e.g. [2], [3], [11], [12], [13], [14], [15], [16], [17]). From some of these discussions a three-pillar concept of sustainability has emerged. The pillars are: economic, ecological and social sustainability. In coordinating them, enterprises are confronting high expenditures and expending great effort. They face four challenges while trying to become "sustainable":

- **Ecological challenge**: The (direct and indirect) impact of entrepreneurial activities on ecosystems must be considered and reduced to amounts that do not cause irreparable damage to these systems [17].
- **Social challenge**: The overall social effects caused by entrepreneurial activities and enterprises themselves must be improved [17].
- **Economic challenge**: The environmental and social aspects of economic affairs must be considered and managed, as much as possible, while conducting all business activities [3], [14].
- **Integration challenge**: The three previous challenges must be integrated, as must sustainability management, into entrepreneurial management schemes and organizational structures [3], [14].

To master these sustainability challenges and/or implement sustainability management, different concepts and instruments may be used:

- sustainability reporting
- sustainability management approaches (ISO 14001 or EMAS)
- ecological controlling
- ecological balance sheets

- material flow and energy flow calculation

A detailed description of these individual concepts and instruments will not be part of this paper. Details can be found in existing literature that describes and discusses the specific concepts (e.g. [3], [12], [18], [19], [20]).

3 Environmental Management Information Systems (EMIS)

Environmental management information systems (EMIS) are organizational and technical systems for the systematic collection, processing and allocation of relevant environmental and sustainability data on an enterprise [4], [5]. More closely, EMIS can be limited to software systems. These software systems are used for the collection, documentation, planning and controlling of the environmental effects of an enterprise's operational activities [6]. There are several ways of differentiating EMIS. For example, there are so-called morphological schemata that classify EMIS according to their different aspects (e.g. [9], [21], [22]).

Another substantial characteristic used to distinguish between EMIS is their ability to be integrated into existing operational applications infrastructure [23]. EMIS can be divided into three different categories, depending on their degree of integration [5]:

- **Stand-alone systems:** These systems are mostly developed for very specific functions. Therefore, they are isolated solutions that are barely integrated with other information systems.
- **Add-on systems:** Here, EMIS are subsystems of other information systems in order to support environmental and sustainability management. On the one hand, add-on systems use and provide their own data/databases. On the other hand, common databases are built to create synergies between the systems.
- **Integrated systems:** Integrated systems result from the complete integration of EMIS functionality into the operational information infrastructure. This can be achieved if all subsystems use a common, redundancy-free database. However, today, such information systems as ERP systems can hardly offer the functionality of EMIS. Several integration concepts and specifications have been developed to address this – for example, "ECO-Integral" [24] and the "Publicly Available Specification (PAS) 1025" [25]. These days, only a few vendors provide functionality for sustainability management within ERP systems. For example, SAP supports such functionality within its "SAP Business Objects Sustainability Performance Management" and the module "Environment, Health & Safety" [26]. Another example is Microsoft Dynamics AX, where the so-called "Environmental Sustainability Dashboard" is integrated within the version AX 2009 [27]. Other integrated systems or integrated "green" functions are found rarely in the ERP market.

Table 1 summarizes the advantages and disadvantages of the three types of EMIS.

Table 1. Advantages and disadvantages of EMIS (cp. [28])

Attribute	Stand-alone systems	Add-on systems	Integrated systems
Expandability	--	+	+
Communication possibilities	--	+	++
Uniformity of user interfaces	--	-	++
IT effort and expenditures	+	+	-
Data collection effort	--	+	+
Costs	++	+	--
Organizational support	-	+	++

Legend: very positive ++, positive +, rather negative -, very negative --

4 Sustainability Management in Selected Enterprises

4.1 Case Study Design

We selected a case study research methodology, which allows holistic, in-depth investigation. We chose an exploratory multiple-case design with seven top and middle managers of seven large-scale companies in Germany. We selected companies from different industries, to gain a broad overview. The selected companies and interviewees are described in table 2.

Table 2. Overview of the companies and interviewees (number of employees and revenues are rounded)

	Industry sector	Number of employees	Total revenue (in euro)	Interviewee
Company A	construction	ca. 70,000	ca. 20 bn	department manager "corporate responsibility"
Company B	retail industry	ca. 15,000	ca. 3.5 bn	department manager "logistics"
Company C	logistics services	ca. 20,000	ca. 3.5 bn	department manager "corporate development and public relations"
Company D	publishing industry	ca. 13,000	ca. 3 bn	department manager "corporate development"

Company E	automotive industry	ca. 100,000	ca. 50 bn	employee of the logistics department
Company F	IT services	ca. 7,000	ca. 4 bn	department manager "environmental protection"
Company G	food industry	ca. 15,000	ca. 3.5 bn	department manager "corporate responsibility and sustainability"

The unit of analysis in our study was sustainability management within the selected companies. The subunit was the software support of sustainability management.

To gain a deep and detailed view of the enterprises and their structures, we chose direct structured interviews as our method of data collection. Both personal (face-to-face) interviews, as well as telephone interviews, were conducted by two of the authors. We selected semi-structured interviews and adopted a partly-standardized approach. As an interview guide, we developed a questionnaire. This questionnaire was sent to interviewees before the interviews took place, to allow them to prepare for their interviews. Sometimes, during the interviews, we had to deviate from the guide, to address questions in more detail. Occasionally, it was also necessary to reformulate questions, to avoid miscommunication and comprehension errors. The questionnaire and, therefore, the interviews were composed of four groups of topics. Altogether, each questionnaire covered 26 initial questions. In the first section, general background information concerning the enterprise itself (e.g. industry sector, turnover, number of employees) and the interviewee (e.g. area of responsibility/tasks) was discussed. Section two consisted of general questions related to sustainability and the experience of the interviewee with aspects of sustainability. In section three, data was gathered on software systems – in particular, the ERP systems that were implemented and used within the enterprise. Finally, section four contained more detailed questions on software support for enterprise-wide sustainability management. The complete questionnaire will not be included in this paper. However, it can be requested from the first author.

Additionally, after conducting the interviews, we used publicly-available documents from the enterprises (e.g. sustainability reports, balance sheets, financial statements) to triangulate the data.

4.2 Results of the Interviews

The results are structured according to the topic groups covered by the questionnaire. Answers to topic group 1 have already been shown in table 2, above. The interviewee answers presented below are ordered by company, as follows: First, interviewees' own experiences with aspects of sustainability are described. Second, the information

systems infrastructure of their companies is explained. Finally, software support for sustainability management and related challenges is detailed.

4.2.1 Results for Company A

Sustainability is of high importance for company A. By this company, sustainability is understood as "the cooperation of economic, sociocultural and ecological influences". The enterprise feels a high degree of responsibility, since the projects of construction companies always affect both people and the environment directly. Since the end of the 1990s, company A has published a number of ecological reports and employed several sustainability concepts and instruments. Different KPIs have been measured and the following instruments used: EMAS, ISO 14001, sustainability reporting, ecological balance sheets and other ISO standards, as well as company-specific KPIs.

Due to the structure of company A, the ERP systems SAP and Microsoft Dynamics NAV are both used. However, each of these systems is used in different parts of the company and for different purposes. Additionally, specific calculations are made, and project management software is used, whose functionality is not covered within the ERP systems. Here, considering a medium-term planning horizon, company A intends to integrate these functions into the SAP system, as well.

Concerning software support for sustainability management, it was mentioned that "independently of the individual instruments, some of the necessary 'green' data are drawn, as far as possible, from the ERP systems". Currently, company A is developing an SAP-BI (business intelligence)-based component that will enable the generation and evaluation of KPIs and instruments for sustainability management within the SAP system. The programming of these additional functions is being done by an external IT consulting company. The first pilot projects are being conducted at the company-wide level. So far, the sustainability instruments employed have been supported by using Microsoft Excel and Microsoft Word. "Inquiries were started and made manually" throughout the enterprise, with requests that the necessary data be provided. Afterward, these data were transferred into Excel by hand.

After the completion of the new software components, the data are to be drawn directly by the responsible departments from the ERP systems and/or directly entered using a web-based questionnaire. Unfortunately, due to the status of the current project, no data were available on the evaluation of software support for sustainability instruments. The interviewee expects that the expenditure and effort needed for the generation of sustainability reports will, thereby, be reduced and that errors (particularly when transferring data by hand) will be avoided. Also, it is expected that data collection and calculation of KPIs for possible audits will become easier and more comprehensive.

4.2.2 Results for Company B

Sustainability is also of great importance to company B. Here, sustainability consists of two components – the social component, in which customers and suppliers are involved in creating a "good neighborhood"; and the environmental component, which involves the efficient deployment of resources and the reduction of the company's carbon footprint. Company B has an enterprise-wide strategic code that

obliges all levels of management to make "positive contributions to the environment" – both social and environmental. However, company B explicitly disclaims the use of sustainability as a marketing strategy and has not endeavored to position itself in the market by taking advantage of its "greenness".

For several years, sustainability instruments and sustainability concepts have been used by company B. These include: sustainability reporting, ISO 14001 and a instrument similar the ecological balance sheet.

Company B also uses a combination of selected ERP modules and software programs, in each case related to the individual parts of the enterprise and their functions. Thus, in company B, a multiplicity of software systems is used.

The sustainability instruments and concepts used by company B are supported by some of these software systems. Different software programs are used for different instruments. As with the ERP systems, there is no exclusive program for the generation of all sustainability KPIs. The different ERP modules and/or additional programs are seen as pure data suppliers for "the sustainability programs". Using different "batch runs", the data are extracted and loaded into the respective sustainability systems. Retransfer of the generated sustainability KPIs into the ERP systems does not take place. This "program variety" has gradually evolved and increased since 2000. However, company B does not intend to integrate its various programs into a single system. Here, above all, the immature and still incomplete sustainability functionality of its ERP systems is regarded as the largest obstacle to sustainability. Also, according to the interviewee, the company is still at high risk of making the wrong types of investments in this area, since there is currently no generally accepted or fixed regulation by the government for the collection, generation and reporting of data on sustainability KPIs.

4.2.3 Results for Company C

For company C, sustainability means "activities with a long-term and substantial focus, encompassing several generations and related to ecological, economic and social factors". However, sustainability management has been practiced within the enterprise for only four years. Therefore, unlike the other large-scale enterprises interviewed in this study, company C can be seen as a "newbie" in the field of sustainability management. Every department, area or section of the company is obliged to act in a sustainable way. For some employees, especially department managers and higher-level employees, sustainability management is included in agreements on objectives. Overall, sustainability is part of the mission statement of company C.

To support sustainability management, the following instruments are used: material flow and energy flow calculation, ecological balance sheets and internal sustainability reporting. In the future, emissions calculations shall be made, too.

Company C uses a SAP system. Additionally, different software programs, including custom-built programs, are used. However, sustainability management and sustainability reporting are not supported by any of company C's software tools. There is no EMIS. Also, the SAP system used does not fulfill these functions. The calculation of "green" KPI and the generation of reports are done with Microsoft Excel. The data needed are extracted from the software programs via batch runs. To improve sustainability management, company C plans to integrate sustainability

calculation into one of its software programs and replace Excel by the year 2011. However, investment in an EMIS or other sustainability software is not planned. Also, this interviewee mentioned the uncertainty of the still non-existent governmental regulations on sustainability management and reporting.

4.2.4 Results for Company D

The interviewee from company D indicated that the company is strongly committed to the three-pillar concept of sustainability. Therefore, economic, ecological and social sustainability are important to this company. The enterprise has been aware of sustainability's importance for more than 20 years and has, therefore, shifted the focus of its "green" activities. For example, company D "integrated" its suppliers, which are expected to engage in sustainability management if they want to continue doing business with company D. Thus, in the long-run, company D could use the KPIs of its suppliers for its own calculations and reporting, too. This is still an ongoing and difficult process. However, for company D, matters of sustainability are a question of the company's authenticity, and, therefore, sustainability management is and will be considered of highest importance.

Company D uses many different instruments for sustainability management: material flow and energy flow calculation, sustainability reporting, EMAS and company-specific KPIs and instruments that were not described in detail during the interview.

Since the enterprise has grown over the years, different ERP systems are used. However, it is interesting to see that all of these systems are from the vendor SAP. Nevertheless, they are not integrated and will not be integrated into one SAP system. The multiplicity of SAP systems will be maintained. The first SAP system was implemented in the early 1990s. Additionally, a couple of specific software programs are used. Some of these have interfaces with SAP systems.

However, in spite of the multiplicity of software systems used by company D, no system or program is yet in place to support sustainability management. This is done using Microsoft Excel. The interviewee mentioned that the process of using Excel to generate "green" KPIs and reports is complex and extensive. Thus, a project has been initiated to implement a separate software tool for sustainability management. This tool can be seen as an EMIS and shall replace the Excel-based approach. As a result of the first implementation stage, there will be no interfaces between this tool and the SAP systems. Company D intends, first of all, to measure the outcomes of this tool, in regard to effort reduction and improvement in sustainability management, before thinking about integrating and interfacing it with other systems. The "Go-Live" for this tool is planned for summer or fall 2011.

4.2.5 Results for Company E

As a competitor within the automotive industry, company E is highly aware of its responsibility for the environment. Therefore, sustainability and sustainability management are of high importance to company E. The interviewee mentioned the company's "responsibility for society and for the environment". Governance, risk management, compliance and ethical issues were mentioned in combination with the term "sustainability". To handle sustainability management, an administrative

department was installed within the company's organizational structure in the 1990s. The employees of this department are, among other things, responsible for the internal and external communication of sustainability issues, as well as for the strategic positioning of the company in the context of sustainability management. As in company C, there is inter-departmental agreement on the sustainability objectives that must be fulfilled.

Several sustainability instruments and concepts are used in company E: material flow and energy flow calculation, sustainability reporting, EMAS, ISO 14001 and ecological balance sheets.

For more than 10 years, company E has implemented a SAP system for most of its processes, especially for all core processes. The multiplicity of ERP systems that used to exist has been replaced with a single SAP system. Still, there are few software programs that provide functions not performed by the ERP system, e.g. logistical tools.

With regard to sustainability management, there is no tool or software program that supports KPI calculation or report generation. This is done using Microsoft Excel. Again, there are no interfaces with the SAP system or the remaining software programs. The necessary data are extracted from the system manually. Even batch runs, to transfer data automatically, are not done. However, company E does not intend to replace the Excel-based calculations. For the interviewee, the effort needed to conduct manual data transfers and use Excel is not so high that it would justify the implementation of EMIS or other software programs.

4.2.6 Results for Company F

Company F considers sustainability and sustainability management to be important mostly in the context of its products' life cycles. Its sustainability efforts began in the late 1980s. Throughout the years, the concepts and instruments it has used have changed as discussions of public sustainability and ecology have evolved. Today, company F tries to integrate its suppliers into its sustainability management by requesting reports and KPIs. However, this is not always a trivial task.

As company F has been involved in aspects of sustainability for almost 20 years, it has used many instruments and concepts: sustainability reporting, ISO 14001 and ecological balance sheets. Additionally, in the last months of 2010, a pilot project was initiated, to implement material and energy flow calculations in selected departments. The preliminary results of this project are expected within the first half of 2011.

Company F uses a SAP system for its core processes. Additionally, software programs are used for functions not covered within the SAP system.

For the calculation of "green" KPIs and for sustainability management, company F uses Microsoft Sharepoint and its intranet to manage documents, as well as Microsoft Excel to make calculations. EMIS or other tools are not used. For three separate products, company F conducted pilot studies in cooperation with an external service provider who used an EMIS to make calculations and generate reports. However, these were non-recurring projects. Plans to repeat such projects for other products or to implement specific software tools do not exist. Overall, in the opinion of the interviewee, the importance of sustainability will increase even more in the coming years. Therefore, to the interviewee, it is necessary that the government enact clear guidelines for sustainability reporting and KPI calculation.

4.2.7 Results for Company G

The interviewee from company G associates with the term "sustainability" economic activities that consider the ability of "future generations to live in the same way as the current generation does". Sustainability management has been part of company G's corporate strategy for more than a decade. A complex concept of sustainability was developed in 2007. Additionally, company G sees a potential competitive advantage in positioning itself favorably on "green" topics.

Different instruments are used within company G: sustainability reporting, ISO 14001 and ecological balance sheets.

With regard to ERP, a SAP system is used, in combination with other programs.

Sustainability reporting is supported by an external service provider. Internally, no specific tools are used within company G. Which tool the external service provider uses could not be stated by the interviewee. However, company G uses Excel-based calculations to generate reports. Therefore, data are extracted manually from the SAP system. There are no interfaces. In the future, an EMIS shall be implemented, or the SAP system's functionality shall, at least, be enhanced, to cover sustainability management functions. However, detailed implementation or software adaptation plans do not exist. These will surely be made in the future, but "when" has not yet been decided.

4.2.8 Summary of the Results

As the interviews have shown, all seven enterprises deem sustainability and sustainability management very important. Table 3 summarizes the most important results of the interviews.

Table 3. Summary of the interview results

Com-pany	Sustain-ability activities since	Sustainability instruments	ERP system(s)	Software support for sustainability instruments
A	end of 1990s	EMAS, ISO 14001, sustainability reporting, ecological balance sheets, further ISO standards, company-specific KPIs	SAP system, Microsoft Dynamics NAV	Excel-based; SAP-BI-based solution from second half of 2011
B	for several years	sustainability reporting, ISO 14001, instrument similar to ecological balance sheets	selected modules of different ERP systems	selected software programs depending on the respective instrument
C	for 4 years	material flow and energy flow calculation, ecological balance	SAP system	Excel-based in combination with batch runs, enhancement of a

		sheets, sustainability reporting		self-developed program in 2011
D	for more than 20 years	material flow and energy flow calculation, sustainability reporting, EMAS, company-specific KPIs and instruments	several SAP systems	Excel-based, EMIS "Go-Live" in 2011
E	since the 1990s	material flow and energy flow calculation, sustainability reporting, EMAS, ISO 14001, ecological balance sheets	SAP system	Excel-based
F	since the late 1980s	sustainability reporting, ISO 14001, ecological balance sheets, pilot project for a material flow and energy flow calculation	SAP system	Excel-based, Sharepoint, intranet
G	since the late 1990s	sustainability reporting, ISO 14001, ecological balance sheets	SAP system	Excel-based, support of an external service provider

In the enterprises included in this study, sustainability has typically been considered important for more than ten years. Only company C can be seen as a "newbie" in this field, with less than five years experience. Mostly, sustainability management is an important component of the companies' corporate strategies. Almost all have implemented SAP systems for their core processes. However, even with well-developed IS infrastructures, there is little software support for sustainability management. Only company B uses different software tools for different sustainability instruments. All other enterprises use Excel-based calculations and reports. Needed data are often extracted from existing (ERP) systems manually or via batch runs. Integrated ERP system functionality and EMIS are not used. Since these Excel-based procedures are often seen as very complex and difficult to handle, some enterprises (companies A, C and D) have initiated projects to replace "Excel-based sustainability management" with specific programs or even with integrated ERP system solutions.

Although several of the enterprises interviewed are willing to invest in more sophisticated IS support, they are currently reluctant to do so because of uncertainty about the extent of possible governmental regulation.

5 Conclusion and Limitations

This paper has shown that a multiplicity of sustainability instruments and concepts exists. The selection and deployment of instruments differ from enterprise to enterprise and depend, among other things, on industry sector and company focus. Although, some software solutions are available on the market that could support the sustainability management of companies these are often stand-alone systems only. Integrated systems are rarely available and "Green" functions are rarely implemented, especially within ERP systems.

The case studies presented here show that all of the large-scale enterprises interviewed possess an understanding of sustainability and its relevance. However, the deployment of different "green" instruments within these companies is very different.

The majority of the enterprises examined have been involved with sustainability since the mid-1990s – or even longer. Thus, they have already undertaken a variety of initiatives aimed at realizing enterprise-wide sustainability management.

However, all of the enterprises studied see substantial uncertainties and risks as being associated with possible new governmental regulations. Thus, for example, five of the seven interviewed enterprises use ISO 14001, since this is an international and well-known standard. The inaccuracy of other standards, e.g. concerning carbon footprint measurement, partly explains why enterprises feel unsure of how to implement them. Thus, investment in such measures seems hardly justifiable. Additionally, the risks caused by the later refinement or extension of such standards and the necessary adaptation of existing systems and instruments would again cause high costs and require high levels of resource deployment. This is why software support for sustainability instruments is often provided by Excel-based solutions or other home-grown programs. EMIS are not used. However, three out of the seven companies interviewed are currently performing projects to enhance their software support for sustainability using EMIS. At present, though, these enterprises fulfill only the minimum requirements of their share- and stakeholders, in order to lower the risk of implementing systems that, later on, must be adapted or even replaced.

The interviews conducted and data evaluated represent a first view of the deployment and use of "green" KPIs and sustainability instruments in large-scale German enterprises. It has been shown that on this still immature topic, qualitative approaches, with purposeful enterprise selection, are very useful. In light of this, further case studies must be conducted to broaden the results of this investigation. Additionally, the experiences of the three companies currently implementing EMIS could provide valuable insights. Therefore, in-depth case studies of these enterprises will be conducted after they have finished implementing their projects.

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