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Analysis

Environmental effects of sustainability management tools: An empirical analysis of large companies

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ABSTRACT

Given the huge global environmental problems and their political and economic impacts, companies are challenged to improve their performance with regard to issues such as climate change. To successfully reduce corporate environmental impacts, management not only needs to develop environmental strategies, it also has to use effective sustainability management tools for their implementation. There are many studies reported in the literature on sustainability management tools such as life cycle assessments or sustainability reports. However, with few exceptions little is known about the efficacy of these tools. We address this research gap by analyzing survey data from the largest companies of five industrialized countries and empirically test the impact of implementing sustainability management tools on key dimensions of corporate environmental performance. The findings show that the implementation of sustainability management tools does reduce environmental impacts per unit of revenue. However, different groups of tools are found to be effective for different purposes.

1. Introduction

The current level of environmental impacts must be reduced substantially on a global level if the earth's limited carrying capacity (see Arrow et al., 1995; Costanza et al., 2014; Wetzel and Wetzel, 1995) is not to be exceeded (Loorbach et al., 2010; Whiteman et al., 2013; Winn and Pogutz, 2013). Research on planetary boundaries (e.g., Biermann, 2012; Rockström et al., 2009) shows that environmental system thresholds have already been crossed for a number of dimensions of global environmental pollution, such as greenhouse gas emissions (Rockström et al., 2009; Steffen et al., 2015). Scientists, international organizations, and governments have worked to define "the safe operating space for humanity with respect to the Earth system" (Rockström et al., 2009, 472) and to determine how humans and human systems will be impacted by transgressions of these boundaries (Baum and Handoh, 2014).

In this context it is also important to identify which actors are the most significant contributors to the transgression of planetary boundaries, and are thus also key actors to finding solutions for these central environmental problems. Callens and Tyteca (1999), Shrivastava (1995) as well as Geels (2011) highlight the crucial importance of large companies for sustainable development. For one of the currently most discussed planetary systems, the global climate, Heede (2014) points out that nearly two thirds of the worldwide emissions of industrial methane and carbon dioxide (CO_2) from 1751 to 2010 were emitted by not more than 90 companies. Heede's (2014) study exemplifies the necessity of large companies to substantially reduce the level of their environmental impacts as a necessary condition for humanity staying within planetary boundaries.

There have been repeated calls to develop business organizations that better respect planetary boundaries (Loorbach et al., 2010; Whiteman et al., 2013; Winn and Pogutz, 2013). Numerous surveys on corporate sustainability document that companies have indeed started to address this challenge by seeking strategic answers to a wide variety of environmental issues (e.g., Galbreath, 2010; Evansh and Tzavara, 2012; Lacy et al., 2010). However, successfully addressing environmental challenges does not only require companies to develop sustainability strategies, it also necessitates the actual implementation of related measures (Figge et al., 2002; Hahn and Scheermesser, 2006). In business such implementation is realized by means of sustainability management tools (SMTs), which are defined as management methods that specifically

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serve the purpose of implementing corporate sustainability (Figge et al., 2002; Hahn and Scheermesser, 2006; Schaltegger et al., 2002). Numerous SMTs have been described in both practitioner and academic publications (e.g., Hahn and Scheermesser, 2006; Herzig et al., 2006; Schaltegger et al., 2002). International surveys on SMTs demonstrate that companies do make use of these tools, though to varying degrees (Hörisch and Windolph, 2014; Schaltegger and Harms, 2014).

Despite the growing use of SMTs in corporate practice and the increasing academic attention they receive, little is known about what environmental impact they actually have when implemented. As a company is unlikely to adopt measures whose effects are uncertain, this lack of knowledge impedes efforts to reduce corporate impacts on the environment. Greater knowledge of the efficacy of SMTs is thus crucial if corporate efforts to support sustainable development are to be increased. This is the motivation for this research, which involves the quantitative investigation of whether sustainability management tools are effective in reducing key environmental impacts in the corporate practice of large companies. Our findings indicate that the implementation of sustainability management tools does reduce environmental impacts per unit of revenue and furthermore specifies which SMTs are most effective for which purposes.

The remainder of this paper proceeds as follows: The next section reviews previous research in the field and develops the research question. The third section describes the empirical methodology we used, including characteristics of our sample and the main econometric models. Section 4 discusses the main results of the research. Finally, the conclusions and implications of the research are provided in the last section.

2. Literature review

2.1. Current state of research on sustainability management tools

The crossing of planetary boundaries underscores the urgency that corporations make a significant contribution to sustainable development. Corporate environmental performance (CEP) is not an a priori given factum, but instead the result of management decisions and activities implemented with the support of SMTs (Hahn and Scheermasser, 2006; Schaltegger et al., 2002). Therefore, large companies are challenged to improve their environmental performance by implementing SMTs.

An increasing amount of research is being carried out on SMTs (e.g., de Beer and Friend, 2006; Herzig et al., 2006; Hörisch, 2013), and political organizations such as national ministries and transnational institutions have promoted the diffusion of SMTs in corporate practice (e.g., European Commission, 2004; Schaltegger et al., 2002). A review of the literature shows that there are many different types of SMTs which serve different purposes. One way to classify them is according to their purpose, that is, how they assist management in the execution of different tasks. Our classification of SMTs is based on the rationale that implementing sustainability goals and strategies requires first information about the current status of sustainability in the company, then a redesign of products and services, and finally communication with stakeholders.

In the first group, sustainability accounting tools provide information as a starting point for sustainability management, helping companies to measure and track changes in current environmental performance. These tools document and analyze changes of physical quantities, such as energy or raw materials (material flow analysis, material flow and energy flow accounting, material flow cost accounting), or as in the case of eco-balance/life-cycle assessment, document the environmental impacts of a product throughout its entire life cycle (Browne et al., 2012; de Beer and Friend, 2006). Sustainability accounting tools can help to improve CEP by highlighting the causes of negative environmental impacts as well as by quantifying these impacts.

A second group of SMTs, indicators, are also used to provide managers with information when taking sustainability decisions. These tools help to put the data gained by the use of accounting tools into context and allow comparisons with alternative solutions or with the performance of competitors. Indicators can for instance help to identify less environmentally harmful alternatives and can thus contribute to avoiding unnecessary causes of pollution. Among these tools are eco-indicators, eco-efficiency indicators, sustainability indicators (e.g., Callens and Tyteca, 1999; Petrini and Pozzebon, 2009; Wallis, 2006) and sustainability benchmarking (e.g., Krajnc and Glavic, 2005).

The third group of tools uses information provided by accounting tools and sustainability indicators to allow companies to actually improve aspects of their products and services impacting the environment. SMTs for product design enable companies to develop products with lower environmental impacts (Charter and Tischner, 2001), for example, by reducing levels of greenhouse gases emitted during production. In this category we include the tools sustainable supply chain management, sustainable design, and eco-design/design for environment (Brouillat and Oltra, 2012; Erol et al., 2011; Seuring and Müller, 2008) as well as the product carbon footprint, which enables companies to calculate the amount of carbon emissions caused by the production of a certain good (Dong, 2013; Trappey et al., 2012).

The fourth group, communication and reporting tools, come into play when companies decide how to communicate their achievements with their stakeholders. Possibilities include publishing environmental and sustainability reports documenting a company's performance to external and internal interest groups (Bennett et al., 1999; Cormier and Magnan, 2007). Sustainability labels communicate the environmental quality of a product to customers and other stakeholders (Franz et al., 2010), thus providing incentives for companies to improve their CEP. Stakeholder dialogues additionally allow companies not only to inform stakeholders but also to reciprocally communicate with them (e.g., Agudo-Valiente et al., 2015; Habisch et al., 2011; Hörisch et al., 2015), providing opportunities to receive constructive ideas from stakeholders on how CEP can be improved.

This literature review of these four groups of SMTs (i.e., accounting tools; indicators; product design; communication) shows that different types of tools also are expected to have an impact on different dimensions of CEP. Whereas some tools, such as the product carbon footprint, primarily address corporate greenhouse gas emissions (Dong, 2013; Trappey et al., 2012), other tools, for example material flow analysis or life-cycle assessment, focus on flows of not only greenhouse gases but also substances such as nitrogen or phosphorus (e.g., Browne et al., 2012; Del Borghi et al., 2014; Mirabella et al., 2014).

A detailed review of the literature on SMTs also reveals that while many tools have been evaluated on a conceptual level (e.g., Erol et al., 2011) or using case studies (e.g., de Beer and Friend, 2006; Krajnc and Glavic, 2005), only few quantitative empirical studies can be found which evaluate the effects of these management tools in practice. For some tools the effects of their implementation are already documented in numerous publications. Environmental management systems (EMS) have probably been analyzed most frequently in this regard. Melnyk et al. (2003) as well as Daddi et al. (2011) demonstrate that implementing a certified EMS enables companies to improve their environmental performance. Similarly, Iraldo et al. (2009) use an empirical dataset to show that the implementation of an EMS within the EMAS scheme improves CEP, and Nishitani et al. (2012) demonstrate, for the case of Japanese manufacturing companies, that the implementation of an EMS reduces a company's negative environmental impacts.

For other tools, however, only few initial empirical analyses on their effects can be found. Henri and Journeault (2010) for example examine the effects of eco-control, and find a positive influence of its implementation on environmental performance. Similarly, investigations of company internal emission trading schemes demonstrate their ability to reduce corporate greenhouse gas emissions (Hörisch, 2013; Lee, 2011).

2.2. Research gap and research question

Overall, most studies on specific environmental management tools, such as environmental management systems and eco-audits, confirm