

Intermediaries driving eco-innovation in SMEs: A qualitative investigation

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Abstract

Purpose: The purpose of this paper is to identify the role intermediaries can play in an SME's pursuit for corporate sustainability with a focus on eco-efficiency innovation. The research identifies drivers and barriers for eco-efficiency innovation, and highlights effects induced through collaboration between SMEs and local authorities, on the one hand, and consultancies, on the other.

Design/methodology/approach: This paper is based on an exploratory qualitative interview study among German SMEs of the metal and mechanical engineering industry that have participated in "Ecoprofit", an intermediary based program that aims at introducing organizations to the concept of sustainable development through implementation of eco-efficiency innovations.

Findings: Our key findings are that first, the proactive approach by a public intermediary (here local authority) is one essential push factor to trigger eco-efficiency innovations in SMEs with low absorptive capacity. Second, we find that SMEs may need facilitation for eco-efficiency innovation from different types of intermediaries (public and private) with different levels of support, which can range from customized and individual to more loosely held support, such as networks.

Originality/value: Our study discusses the challenges of corporate sustainability with a focus on eco-efficiency innovations for SMEs and proposes a 'complex intermediary' consisting of a local authority and consultancies as one means to engage SMEs in sustainability. Moreover, it focuses on SMEs in the B2B context, organizations that are often overlooked despite their vast impact. Furthermore, by using a single industry approach, in-depth findings for the metal and mechanical engineering industry are presented.

Keywords: eco-efficiency innovations, absorptive capacity, learning networks, intermediaries, metal and mechanical engineering, small and medium-sized enterprises

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1. Introduction

Small and medium-sized enterprises (SMEs) are increasingly challenged to contribute to sustainable development (Jamali *et al.*, 2009; LePoutre and Heene, 2006; Luetkenhorst, 2004), that is, to be involved in alleviating social grievance as well as environmental degradation. On the one hand, SMEs can benefit from dealing with sustainability-related issues, for example, through cost saving (e.g. increased energy efficiency) or by realizing competitive advantage (e.g. successful new products). On the other hand, handling sustainability issues can become a very insolent and complex endeavor for some SMEs. In the context of sustainability, SMEs are faced with challenges such as resource constraints in terms of time, knowledge, financial and human capital (EUC, 2007; Lee, 2009; Perez-Sanchez *et al.*, 2003) as well as factors related to managerial and organizational structure such as no or few personnel dedicated to sustainability management or an ad-hoc, informal management of sustainability issues (Jenkins, 2004; Spence, 1999). Yet, even though dealing with such issues may, at first, present a complex endeavor for some SMEs, they may collaborate with parties outside their organizational boundaries such as universities, governmental bodies, or consultancies to gain access to knowledge and to direct assistance to better deal with sustainability issues (Jenkins, 2009; LePoutre and Heene, 2006; Valliere, 2006). For the purpose of this paper, we refer to these external organizations as *intermediaries* (Howells, 2006).

Against this background, we are interested in the role of intermediaries in an SME's effort to implement eco-efficiency innovation. To this end, we focused our research on *Ecoprofit*¹ as it is a program that aims to introduce organizations to the concept of sustainable development by use of a 'complex' intermediary (i.e. composed of more than one party, as will be explained later) in which a local governmental body and an environmental consultancy provide direct and indirect forms of assistance to SMEs. This program emphasizes eco-efficiency, that is, the combination of economic and environmental performance to create economic gain while reducing negative environmental impact (Schaltegger and Synnestvedt, 2002). Such innovations fall into the category of environmental innovations which include enhanced processes, products, and organizational practices that reduce or avoid negative environmental impacts (van Hemel and Cramer, 2002; Rennings, 2006; Rennings *et al.*, 2006; Beise-Zee and Rennings, 2005). As eco-efficiency innovations are often linked to financial

¹ Ecoprofit is a registered trademark. However, for reasons of readability, we will refrain from using the registered trademark sign ® each time we mention Ecoprofit. Moreover, Ecoprofit is a program that is executed through a partnership between consultancies and local authorities. For reasons of readability, we will henceforth refer to this partnership as "Ecoprofit".

benefits (e.g. cost saving), they can constitute a feasible first step for SMEs with limited resources (financial, time, knowledge) to initiate a more sustainable mode of business operations.

Based on an interview study among German SMEs from the metal and mechanical engineering industry, we explore the role of a complex intermediary in the pursuit of more sustainable business operations of these SMEs. In particular, we focus on the question *if and if so, how the model of Ecoprofit* has helped SMEs to implement changes. However, in order to have a long-lasting positive impact on the environment, it is essential that these activities are also a trigger for continuous change in the future. Therefore, we aim at exploring *how lasting these changes are*.

We will attend to the central questions of this paper in five steps. *First*, we will outline the current literature on sustainability in the context of SMEs. Here, we will place particular emphasis on eco-efficiency innovation and the role of intermediaries. On this basis, we will analyze Ecoprofit as a complex intermediary constellation. In a *second step*, we will provide information on our qualitative interview study to then, in a *third step*, lay out the central findings. In a *fourth step*, we will discuss our findings, elaborating on potential reasons why SMEs are willing to interact with intermediaries arguing from an absorptive capacity perspective. Additionally, we will examine the long-term effects of the interaction with intermediaries. The purpose of this step is to derive propositions for future research. Following, this paper concludes with some final remarks regarding limitations and further research avenues.

2. Literature Review

The integration of sustainability-related aspects and innovation can be beneficial for business: they can reduce costs (e.g. through an energy management system), reduce risks (e.g. through enhanced safety features), increase sales and profit margins (e.g. through the introduction of premium organic brands), increase reputation and brand value, become more attractive as an employer (e.g. through better alignment between personal and company values), and build up innovation capabilities (Schaltegger, 2011). Despite these potential benefits, dealing with sustainability-related issues constitutes a challenge to most organizations. As a consequence, many instruments, concepts, and tools have been developed to assist businesses in their effort to alleviate environmental and social issues (e.g. Schaltegger *et al.*, 2007). However, most of these tools were designed for or are used by larger corporations (Graafland *et al.*, 2003). As SMEs are not simply smaller versions of their larger counterparts (Tilley, 2000; Welsh and White, 1981), they might require different tools or a different approach to dealing with social and environmental issues than those offered to large corporations. Therefore, this section of the paper will first explore the challenges SMEs face when wishing to implement changes towards sustainability and will then go on to discussing the potential role of intermediaries in this process. In a third and final step of the literature review, we will introduce Ecoprofit as a complex innovation intermediary.

2.1 *SME characteristics and Eco-efficiency Innovation*

SME literature in general places much emphasis on identifying those aspects of SMEs that differentiate them from large corporations. These differences are often referred to as “characteristics” or “peculiarities”² (del Brio and Junquera, 2003; Spence, 1999; Vyakarnam *et al.*, 1997). In recent years, many scholars have explicitly addressed the question of such characteristics in the context of corporate sustainability, i.e. the integration of sustainability issues into core business (examples are: Jenkins, 2004; Moore and Spence, 2006; Preuss and Perschke, 2010; Perrini, 2006; Spence, 1999; Spence and Lozano, 2000; Spence and Rutherford, 2001; Schaper and Savery, 2004).

In summary, this body of literature puts forward a range of both disadvantageous and advantageous characteristics that may influence the integration of sustainability into business activities. Advantageous SME characteristics, such as informal ways of communication, flexible and lean organization structures (Bos-Brouwers, 2009) may lead to a less bureaucratic management of environmental and societal issues. The dominant and entrepreneurial role of the owner-manager, for instance, may affect the reaction to changing markets and can, hence, facilitate behavior towards product innovation to conquer market niches (Jenkins, 2006). The peculiarities, i.e. the potential disadvantages, faced by SMEs imply certain challenges for *innovation* in the context of corporate sustainability (del Brio and Junquera, 2003) and its *implementation* in SMEs (Jenkins, 2006, 2009; Luetkenhorst, 2004; Russo and Tencati, 2009; Sweeney, 2007). Resource constraints, for example, lack of time, personnel, knowledge, and financial capital (Azzone and Noci, 1998; Bos-Brouwers, 2009; del Brio and Junquera, 2003; Spence, 1999) may result in fewer investments in and implementation of eco-efficiency innovations (Noci and Verganti, 1999). Overall, eco-innovation indeed occurs in SMEs, but to a varying degree, that is SMEs may follow a reactive, anticipatory, or innovation-based strategy (Noci and Verganti, 1999).

According to del Brio and Junquera (2003), SMEs tend to follow a more *reactive approach* towards management of sustainability as well as to innovation (both sustainability and non-sustainability-related) (Scozzi *et al.*, 2005). As a result of this more reactive approach, SMEs seem to innovate more incrementally than radically (del Brio and Junquera, 2003). On top, the majority of SMEs are micro-businesses with less than ten employees (Census, 2011; Klees, 2008). To implement highly sophisticated tools such as sustainability accounting (Bennett *et al.*, 2011), advanced employee training schemes (Kotey & Volker, 2007), or an elaborate stakeholder management may present an enormous and probably not accomplishable endeavor for such small organizations. Dealing with all potentially important stakeholders (e.g. customers, suppliers, regional organizations, NGOs) would consume a substantial amount of time that is one of the scarcest resources of SMEs. Advanced employee training schemes usually require large financial investments by the employer which is often unfeasible for a

² The term “peculiarities” is often used when referring to disadvantageous SME characteristics such as inherent resource constraints.

micro enterprise. Similar arguments may also be found to apply to the remainder of the SME spectrum, thus organizations with up to 250 employees (EUC, 2007).

Based on the outlined resource constraints and entailed difficulties in pursuing a corporate sustainability scheme, it could be argued that SMEs with a more reactive stance might be more drawn towards those solutions that have a clear and direct impact on their financial performance (Sub *et al.*, 2005). Therefore, actions that improve the financial performance (or are not diminishing it) while improving the environmental performance might be best suited for SMEs with an initially reactive approach towards sustainability to start their respective engagement. This ratio of economic value created to environmental impact added (Callens and Tyteca, 1999; Figge and Hahn, 2002) is often referred to as eco-efficiency (Dyllick and Hockerts, 2002; Schaltegger and Sturm, 1998). It is either improved by reducing environmental impact whilst keeping the same economic value, or by expanding economic value whilst remaining at a constant level of environmental impact (Schaltegger and Sturm, 1990; Schmidheiny, 1992). Eco-efficiency measures can be taken in various dimensions; these include energy, water, resource efficiency, material, waste, and pollution intensity (Verfaillie and Bidwell, 2000; von Weizsaecker *et al.*, 1997).

Eco-efficiency innovation can be applied to all types of innovation: process (production of goods and services with less input), product (more efficient products), and organizational (reorganization of structures or implementation of new management tools) (Rennings, 2000; Rennings *et al.*, 2006). Whilst improved eco-efficiency can be achieved through all innovation types (Ar & Baki, 2011), this paper focuses on process innovations as it is the more common form of innovation in the manufacturing industry (Bigliardi *et al.*, 2011) which lies at the center of attention in this paper. Eco-efficiency process innovations enable the production of goods or services with less input of resources (e.g. energy) and encompass innovations in end-of-pipe and cleaner production technologies (Rennings *et al.*, 2006).

In summary, eco-efficiency innovation might be a feasible starting point for SMEs to begin the process of corporate sustainability. However, the question remains how SMEs which struggle with a lack of time and personnel and which are not equipped with the necessary knowledge to implement eco-efficiency innovation are to be engaged in the process. Against this background, the next section of this paper will discuss how SMEs can access to and make use of essential external knowledge through collaboration with innovation intermediaries.

2.2 *Role of Intermediaries in Eco-Efficiency Innovation*

One possible solution for SMEs is to use collaborative initiatives to acquire knowledge outside their own organizational boundaries (Clarke and Roome, 1999). By doing so, SMEs gain access to and exchange relevant sustainability information (Spence *et al.*, 2003). Moreover, SMEs can collaborate or seek network contacts to reduce time and knowledge constraints and increase their absorptive capacity

(LePoutre and Heenem, 2006). Absorptive capacity is of particular importance to the innovation performance of an organization and refers to an organization's ability to take in new impulses from outside and translate these into innovations (Cohen and Levinthal, 1990). It encompasses the process of recognizing and understanding external knowledge, assimilating it to the firm context, and continuing to create new knowledge (Lane *et al.*, 2006). Thus, collaborative approaches are crucial as they diffuse practices and policies (Battaglia *et al.*, 2010) and can, hence, support the implementation of sustainability-oriented innovations.

Collaboration with external organizations can take different forms e.g. networking or cooperating (Biondi *et al.*, 2002; Bos-Brouwers, 2009; Clarke and Roome, 1999; de Bruijn and Hofman, 2000; Hartmann *et al.*, 2002; LePoutre and Heene, 2006; Murillo and Lozano, 2009; Torri, 2010). Networks are more loose forms of engagement as it is easier to leave them than cancel contractual agreements and thus, might be a potential option for SMEs wishing to engage in environmental innovation processes. However, as manufacturing SMEs are considered to have low networking skills (Bigliardi *et al.*, 2011), we will focus on a different form of collaboration, namely collaboration with intermediaries as this is considered "good innovation practice" (Vermuelen, 2006).

Intermediaries are commonly understood as third-party organizations that help to achieve desired objectives (Perset, 2010) which may provide a necessary external impulse, motivation and advice to initiate or continue with, for example, environmental protection (Gombault and Versteeg, 1999). Literature recognizes various types: governments and local authorities, NGOs, universities, consultancies – to name but a few (del Brio and Junquera, 2003; Howells, 2006; Massa and Testa, 2008; Zeng *et al.*, 2010). These can be clustered into three distinct groups: public, non-profit, and private (Kolk *et al.*, 2008). Public intermediaries are governments and (publicly funded) science partners or universities, as well as other publicly funded bodies. NGOs belong to the non-profit group whereas consultancies and industry associations fall into the private group. More specifically, in the context of innovation, an intermediary that assists in the innovation process – "innovation intermediary"- is "an organization or body that acts as an agent or broker in any aspect of the innovation process between two or more parties" (Howells, 2006, p. 172).

To make the potential role of such innovation intermediaries more tangible, we will briefly outline various *levels* of intermediation as identified by Howells (2006).

- *Foresight, diagnostic and scanning / information processing*: At this level of intermediation SMEs are able to gain a more comprehensive view of environmental challenges, what sustainability entails, access external expertise and benefit from resource exchanges (see also de Bruijn and Hofman, 2000; de Bruijn and Tukker, 2002; Hartman *et al.*, 2002; Hartman *et al.*, 1999; Roome, 2001). For example, CERAM assists businesses in identifying the latest technological changes and assists them in choosing the one most suitable for them.

- *Knowledge processing, gathering and combination:* Intermediaries at this level assist in combining knowledge from two or more parties. This knowledge can stem from different internal parties or from two distinct organizations.
- *Gatekeeping and Brokering:* At this level, intermediaries can act as negotiators or support others in understanding and translating contractual agreements.
- *Testing, validating and training:* Here, intermediation involves actions such as prototyping, inspection or scaling of innovations undertaken by a business.
- *Accreditation and standards:* Innovation intermediaries can also assist in selecting, implementing or certifying various standards, e.g. ISO 14001.
- *Regulation and arbitration:* This level of intermediation does not only refer to policy regulation but also to informal arbitration, for example between consumers and producers.
- *Intellectual property:* Intermediaries can help SMEs to protect their intellectual property through patents or other regulations.
- *Commercialization:* Another level of intermediation aims at exploiting the innovation by identifying potential markets and consequent strategies for serving these markets.
- *Assessment and evaluation:* Some of the intermediation activity also emphasizes the assessment of respective technologies in terms of performance.

Hence, collaboration between an SME and innovation intermediaries can lead to an enhancement of an SME's innovation capacity, and more specifically, result in building up absorptive capacity for eco-efficiency innovation. First, the innovation intermediary can support recognizing and understanding new external knowledge through *knowledge processing; gathering and combination;* as well as *accreditation and standards.* Second, the assimilation of external knowledge to the firm context can be facilitated at intermediation levels of *assessment and evaluation; regulation and arbitration; testing, validating and training;* as well as *gatekeeping and brokering.* Finally, the process of enabling the firm to continue to create new knowledge can be facilitated at the level of *commercialization and intellectual property* rights. We thus argue that through collaboration with intermediaries, SMEs are, on the one hand, able to locate, acquire, and utilize knowledge necessary for eco-efficiency innovation, and, on the other, have access to direct assistance and can consequently supplement their scarce resources (e.g. time, financial, human). In the following subsection, we will now describe the Ecoprofit initiative as one possible form of a complex intermediary.

2.3 *An Introduction to Ecoprofit*

The core idea of Ecoprofit (“*EC*ological *PRO*ject For Integrated Environmental *TECH*nology”), which originated in Austria in 1991 (Martinuzzi *et al.*, 2000), is to facilitate eco-efficiency innovation. It introduces organizations from various industries to eco-efficiency innovation through means of education as well as through the usage of customized problem solving. More specifically, it aims to improve the eco-efficiency of processes, products, practices, and services in organizations (Krenn and Fresner, 2009). In this collaborative scheme, local authorities, companies with headquarters based in that local area, and professional consultants work together to involve SMEs in learning networks and to transfer sustainability-specific knowledge into the companies.

In his definition of an innovation intermediary, Howells (2006) refers to a single organization. However, in the case of Ecoprofit, the participating SMEs are facilitated by both *consultancies*, whose foremost role it is to provide the SME with direct assistance, and *local authorities*, whose primary role it is to facilitate learning networks and collaboration with other companies or organizations. Due to this intertwined facilitation by local authorities and consultancies, we consider the Ecoprofit initiative as a ‘complex intermediary’ and we thus, consider it as one single actor.

The main objectives of Ecoprofit are strengthening the company economically, improving competitiveness, reducing industrial emissions, and extending internal company know-how (CPC, 2010; Ecoprofit, 2008a; Martinuzzi *et al.*, 2000). The improvement of competitiveness and the reduction of environmental impact are achieved through the implementation of eco-efficiency innovations in the respective companies.

In Germany, Ecoprofit has been implemented in around 80 locations with currently over 2000 participating organizations. At present, Ecoprofit has three modules: the beginner program (module 1), the Ecoprofit club (module 2), and “from Ecoprofit to EMAS/ISO” (module 3). During the second module, companies that have completed the first module can interact in a peer-learning and peer-coaching process, that is, a learning network is established. In this paper we will discuss the beginner program in detail, as it introduces companies to eco-efficiency innovation and touch upon the learning network in the discussion of our findings, as it is one attempt of Ecoprofit to establish lasting learning structures for sustainability.

Before introducing the beginner program in companies, the region or city, during the preparation and license agreement phase (phase 1), has to acquire the license from the Cleaner Production Centre (CPC) Austria. The idea and complete structure of the program are then presented during a kick-off event (phase 2) to interested companies. The costs of the beginner program are usually covered by a mixture of public grants and company contributions of about €10,000 (CPC, 2010). The *beginner program* consists of five phases (see Figure 1):

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In the workshop-series (phase 3), the first knowledge transfer process with the participating companies takes place. Here, the employees of the companies are trained in the central aspects of an integrative environmental management system. Parallel to phase three runs the operational implementation in which the companies receive individual consultations and are analyzed externally (phase 4). At the end of this phase, a firm-specific program is developed and implemented collaboratively. Phases three and four represent a learning network which is, however, not formalized in the sense of the Ecoprofit club, an extra module after the completion of the beginner program. The implementation of the processes is evaluated by an independent commission (phase 5). After successful completion of the program, the companies receive a certificate, which they can use for marketing purposes. On the whole, it is the aim to strengthen both local authorities and local companies to contribute to sustainable regional development (Krenn & Fresner, 2009).

When relating the activities of Ecoprofit back to Howells' (2006) levels of intermediation, we propose that Ecoprofit serves for "scanning and information processing", "knowledge processing", "accreditation and standards", and "regulation and arbitration" in that:

- Ecoprofit offers support in identifying the best suitable eco-efficiency innovation to implement; it thus *scans the information* for the SME.
- This can alleviate restraints related to lack of time and personnel.
- Through the workshops and individual consultancies, *knowledge is transferred* to the participating SME and thus a lack of knowledge is counterfeited.
- Moreover, Ecoprofit also serves as *informant for legal and other regulatory enquiries* that the SMEs might have that reduces risks related to environmental challenges.

Therefore, we consider Ecoprofit a complex innovation intermediary that pays particular attention to information and knowledge transfer as well as direct assistance in implementing innovation so as to improve eco-efficiency in SMEs. In order to gain greater insights into Ecoprofit and its role in the achievement of more sustainable business practices in SMEs, we conducted an exploratory interview study which will be presented in the following section.

3. Methodology

This paper is based on qualitative exploratory research and is of interpretative nature (Silverman, 2008). We chose a qualitative approach to gain greater understanding of the field of study (i.e. the role of intermediaries in an eco-efficiency innovation process) as this approach leaves space for insights that were not anticipated by the researcher (Stebbins, 2001; Wolcott, 2009). More specific, an interview study was undertaken. The following subsections outline the research sample, data collection, and method of analysis of the undertaken empirical work.

3.1 Research Sample

The selection criteria of the sample was five-fold: All potential interview partners needed to (1) be an SME (2) have participated in the Ecoprofit scheme, and (3) have completed it at least five years prior

to the interviews, (4) operate in the metal and mechanical engineering industry and (5) had to be located in Germany. In the following paragraphs, we will elaborate on these five criteria.

(1) Small and Medium-Sized Enterprises

The SMEs in our sample were required to be in line with the EU definition that classifies companies with less than 250 employees as such (TCEC, 2003).

(2) Ecoprofit

As discussed under subsection 2.3, Ecoprofit can be considered a complex innovation intermediary. Therefore, it constitutes an appropriate program to investigate the effects of collaboration between SMEs and intermediaries to achieve more sustainable business operations.

Moreover, we chose Ecoprofit as it is recognized as Best-Practice example by the European Union (ECE, 2011; EUCOM, 2004) and has received various international rewards, such as the “Dubai International Award for Best Practices to improve the Living Environment 2002” (Ecoprofit 2008). Furthermore, it has already spread internationally to countries such as Germany, the Netherlands, Hungary, Slovenia, Russia, Italy, and China (Balcázar, 2010).

As the beginner program, regardless of the regional setting, follows the same structure, a comparison between the participating SMEs is feasible. This would not have been the case if the SMEs participated in different programs i.e. interacted with altogether different types of intermediaries.

The sample for this exploratory study was selected from a privately owned, yet publically accessible database (<http://www.arqum.de/datenbank/>) related to Ecoprofit.

(3) Participation before 2005

One part of our research question is to investigate if sustaining change was reached through the collaboration with an innovation intermediary. For this purpose, it is essential that there is a time lag between participation and interview as significant changes in an SME’s environmental behavior should be expected with a delay between three and five years after program participation (Altham, 2007; Henniscke, 2000; Rosenfeld, 1996). With this time lag in our sample, we are able to better investigate the long-term effectiveness of such programs, as several years of project duration, post project experience, and network establishment can be accounted for.

(4) Metal and mechanical engineering industry

To ensure better comparability of the findings, this paper presents a one-sector focus (Jenkins, 2006). The metal- and mechanical engineering industry was chosen for various reasons. First, this industry is one of the five major industries in Germany (Kritikos and Schiersch, 2010; VDMA, 2010). Furthermore, the industry is a key supplier to many other industries such as automobile, electronics,

and construction and therefore faces pressures to implement sustainability (Steiert, 2009). Finally, it is an under-researched sector for two reasons: first, many studies of sustainability deal with industries operating in business-to-consumer markets. Second, sustainability-related issues and particularly corporate sustainability is primarily investigated in large companies to which more than 80% of metal- and mechanical engineering companies do not belong (Kritikos and Schiersch, 2010).

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(5) Germany

The single country focus was chosen in order to further enhance comparability. Sustainability-related issues are regulated and incentivized differently – both from a governmental and from a consumer perspective – between countries. Thus, we decided to focus on Germany and the German Ecoprofit initiative.

3.2 Data Collection

During the conducted research, various types of data including information from the private database, interviews, company websites, and corporate reports were collected. The latter were incorporated to supplement the database and interview data (Eisenhardt, 1989). The following paragraphs will outline which information was derived from which source.

Database: The private database was consulted to obtain data about eco-efficiency innovations implemented in the sample firms. The information is sector-specific and presents innovative eco-efficiency measures accomplished by companies who took part in the one-year Ecoprofit scheme between 1998 and 2010. The data is structured according to the following dimensions: a) eco-efficiency measures taken in the companies (for example in the field of hazardous materials or energy consumption); b) achieved benefits (for example monetary); c) the year of implementation; d) contact information of the company; and e) the manager responsible for the program.

Interviews: Based on the information provided in the database, we conducted telephone interviews with seven SMEs from the metal and mechanical engineering industry (see Table 1 for company characteristics). This paper followed Weaver et al.'s (1999) suggestion that a high level executive is the best source to acquire accurate data. Accordingly, the interviews were conducted with three owner-managers and four non-owner-managers. They took place between June and August 2010.

This research capitalized on semi-structured interviews to gain insight into the interviewee's perception by giving them the opportunity to answer freely within predefined topics (Silverman, 2008). The interview guideline comprised three sections: company structure, corporate sustainability with a focus on eco-efficiency, and the role of intermediaries.

All interviews were held by the same two authors. The interviews were digitally recorded and transcribed. For the preparation of the present article, all data used (codes, quotes) was translated from German into English by the first author and carefully cross-checked by the second and third author.

Archival data: Information that could be found on company websites or in newspaper cuttings were used to supplement the data collected during the interviews. This data was obtained via a Google search of the respective company names.

3.3 *Method of Analysis*

The purpose of an interview study is to identify commonalities and differences between responses of people in equal positions or situations. Therefore, in order to analyze the collected data, a thematic approach was chosen (Stebbins, 2001; Wolcott, 2009). In this process, researchers follow an iterative process in which they look for emerging patterns and themes in the data. This process was simultaneously done by the first and second author and cross-checked with the third author, thereby achieving greater objectivity in the identified themes (codes). Following, the qualitative data was quantified in that it was counted how often which code was mentioned to thereby determine its potential significance (Stebbins, 2001).

4. Research Findings

The research findings are structured as follows: First, the eco-efficiency innovations achieved by the sample companies are presented. Subsequently, drivers and barriers encountered are shown. Finally, the effects and relevance of collaboration with intermediaries are laid out.

4.1 *Eco-efficiency Innovations Achieved by the Studied SMEs*

Based on the Ecoprofit database, the eco-efficiency innovations accomplished and the benefits perceived by the SMEs were analyzed (see Table 2). All measures were taken in a one-year period between the years 2000 and 2003.

The studied companies engaged most strongly in the categories waste/waste disposal, energy and hazardous materials. According to the database, the companies derived both environmental and economic benefits from eco-efficiency innovation, whereby monetary benefits prevail.

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Based on the initial findings on the nature of eco-efficiency innovation accomplished in the SMEs, the paper now turns to the qualitative data from interviews and corporate documents for a more in-depth analysis of drivers and barriers as well as on the role of the complex intermediary constellation.

4.2 *Drivers and Barriers of Eco-Efficiency Innovations*

The identified drivers for eco-efficiency innovation in our sample were clustered according to the business case for sustainability drivers as identified by Schaltegger (2011), namely: profit and sales

margin; reputation and brand image: attractiveness for employees; risk management as well as cost and cost reduction. As shown in Table 3, the studied companies most frequently related to cost-efficiency, proactive contact by external initiatives, and a desire for continuous improvement as central driving factors, hence, cost and cost reductions as well as risk management are the primary drivers.

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The studied SMEs perceived (see Table 4) the *lack of resources* (such as personnel and time) as a central barrier to deal with sustainability and eco-efficiency.

Surprising was that a significant number of interviewees considered sustainability as *irrelevant to their sector*. The following statement serves as an example of this attitude:

„There are only few environmentally harmful measures that are relevant here [referring to the sector]. That’s more relevant in the chemical sector or pharmaceutical, that’s where it makes sense. But here with us [...] in the sector are only few things damaging the environment.” (Owner-manager, C6)

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4.3 *Intermediaries and Collaboration for Eco-efficiency Innovation*

Part three of the interview picked up on the theme of collaboration with intermediaries during the Ecoprofit-scheme (see Table 5). All of the studied companies deem the capacity to capitalize on external support mechanisms in the form of innovation intermediaries as relevant. Further, in comparison to *conventional networks* (such as industry networks), *innovation intermediaries* were considered important by almost double as many SMEs. This is even more astonishing in that all studied companies are active members in at least one regional or industry network.

The interviewees also stated, in general, that it is crucial to acquire knowledge externally and receive support during the implementation phase (see Table 5). For some interviewees, it was particularly important that the external initiative goes beyond mere consulting to truly engaging in actual implementation (see Table 5).

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4.4 *Effects beyond Ecoprofit*

The findings suggest that intermediaries can facilitate eco-efficiency innovation in SMEs. Yet, the question remains whether these remain to be a one-off activity, or are a trigger for continuous innovation efforts. Therefore, the interviews also addressed sustainability measures taken after the one-year program (i.e. the Ecoprofit beginner module) had terminated.

The studied companies generally showed that a range of process and organizational innovations (e.g. ecological water management; ISO 9001) and, to a far lesser extent, product innovations were achieved after the participation in the Ecoprofit-scheme (see Table 6).

----- PLEASE INSERT TABLE 6 HERE -----

Despite the fact that the studied companies completed the Ecoprofit-program at least seven years prior to the interviews, the overall number of eco-innovations undertaken remains low. Moreover, if considering that the studied companies received individual consulting phases and were accompanied in the implementation processes, it is surprising that although most companies did take further specific environmental measures, these remained of ad-hoc nature and were limited in scope. Overarching organizational innovations in the sense of management instruments and tools, have not received broad attention. Only one of the companies introduced an ISO system with eco-indicators integrated in core business monitoring (see Table 6).

In the following section, we will now go onto to further discussing our findings.

5. Discussion

We will discuss the previously presented findings in three steps. First, we will argue that a complex intermediary may strengthen an SME's absorptive capacity for eco-efficiency innovation. Second, we will elaborate on the role of the local authority as an external stimulus to change towards more sustainable business operations by also highlighting the reasons for SMEs to participate in a support program like Ecoprofit. In a third and final step, we will discuss the potential to induce long-term effects through a program like Ecoprofit.

5.1 *Complex Intermediary to Strengthen an SME's Absorptive Capacity*

Businesses in our sample highlighted that being directly assisted by external consultants, actively supported and approached by local authorities and then linked to other SMEs during the one-year Ecoprofit program were the major benefits of participation. Hence, in our sample, the complex intermediary provided different levels of support through different types of intermediaries which successfully pushed incremental eco-efficiency innovations. This resonates with very recent literature on innovation that stresses the importance of the involvement of intermediaries, particularly knowledge institutions (Ar & Baki, 2011), and the importance to assist SMEs in change processes in terms of different levels of support, that is, handholding mechanisms (Friedman and Miles, 2002). A possible explanation for this could be found in interviewees' statement that the transfer of network and personal knowledge was perceived to be beneficial to overcome day-to-day problems in the change

management process towards more sustainable business operations. This is also in line with the findings of Bigliardi & Dormio (2009) who found that information from knowledge institutions is much more relevant for fostering innovation than that of networks (industry or regional). This could be further supported by the insight that through the direct assistance provided by the private intermediary (consultancy) in the form of e.g. on site-consultation, SMEs in our sample, found it easier to translate abstract sustainability goals into actual business practice.

More important, though, is the notion that handbooks or similar information sources were considered less helpful by our sample SMEs. Referring back to the literature, a possible explanation for these perceptions might be related to the concept of absorptive capacity by Cohen and Levinthal (1990). Absorptive capacity is considered to be a function of prior related knowledge of the area of innovation at hand. Therefore, handbooks might be considered to be of less use for those organisations that have no or little prior knowledge on eco-efficiency innovation. Thus, the knowledge that is supposed to be transmitted via the handbook (in terms of explicit knowledge) cannot be linked to any existing knowledge. There have been many studies testing the original concept by Cohen and Levinthal (e.g. Ar & Baki, 2011; Jentunen, 2005; Zhara and Georg, 2002) most of which have found a strong linkage between prior knowledge and the assimilation of new innovation. One of the few exemptions is Varis and Littunen (2010) who found no linkage. None withstanding, many studies also show that intra-organizational collaboration helps to overcome problems of knowledge deficiencies and thereby enhancing absorptive capacity (Ferlie *et al.*, 2001).

Nevertheless, there are other factors despite tacit or explicit prior knowledge that have a strong influence on the adoption of innovation. Some of these include strong leadership, a clear strategic mission, creative and innovative staff and a tolerance for failure (Greenhalgh *et al.*, 2004). These are required to create a receptive context for change (Greenhalgh *et al.*, 2004). In the case of the interviewed SMEs, there was no clearly recognizable environmental or sustainability strategy which again resonates with literature on SME characteristics discussed earlier. In contrast, some of the actions taken were rather spontaneous and not linked to the core business. However, this seems to hold true for many SMEs, particularly in the context of sustainability (e.g. Russo and Tencati, 2009).

Therefore, we propose the following statements for further research:

P1: Innovation intermediaries can strengthen an SME's absorptive capacity through providing direct support at the level of information and knowledge gathering as well as processing, testing, validation and training, and also at the level of evaluating the effectiveness of eco-efficiency innovations.

5.2 Activation of SMEs: the Intermediary as External Stimulus

Cost and cost reduction as well as risk management are primary motives to engage in eco-efficiency innovation in our sample. Particularly for SMEs, whose resource constraints are a major threshold to

overcome, the cost saving potential of eco-efficiency innovations makes even incremental improvements in production processes or a reduction in emissions attractive. Interviewees agreed that Ecoprofit was able to pull this monetary trigger to begin revising business processes more comprehensively. Overall, the sample SMEs have not yet started to view sustainability as an opportunity – with the exception of one company which is engaged in sustainability-oriented product innovation – but tend to take a reactive or anticipatory approach (see e.g. Noci and Verganti, 1999) to sustainability. Thus, for these types of SMEs an initial external stimulus, in terms of proactive approach through the public intermediary (local authority), is an important trigger for SMEs to engage in sustainability.

The reasons for this could be manifold. One potential explanation could be that the formal invitation by officials of the local authority created the need to respond. The SMEs in our sample were all family owned and mostly running operations in their local constituencies. Therefore, an invitation by the local authority might weigh in much heavier than it would for a large corporation with subsidiaries spread across the globe (Koschatzky and Zenker, 1999). Another aspect might be that the approach of a local authority is perceived as more legitimate or trustworthy than that of a consultancy. Thirdly, another possibility could be that until the proactive approach, the SME had not considered any actions. This is partially indicated in one interviewee's statement that they simply participated to get an understanding of what is possible and what others do. Yet another explanation is the fact that some of the interviewees considered their own environmental impact negligible. Their perception had never been challenged as some of them operate in very small business-to-business niche markets, thus could be considered to be located in a 'blind spot' of public awareness. As a consequence, the proactive external approach and invitation to participate in the one-year program might have been the initial impulse for reflecting this unchallenged position. Thus, we propose the following:

P2a: Innovation intermediaries are especially successful in activating reactive SMEs when they are perceived as legitimate intermediaries without self-interest or hidden agenda, as may be the case for local authorities with their public nature and their responsibility for the development of the local economy in which the SME's are embedded.

P2b: The external stimulus (e.g. direct invitation to participate in the initiative) can trigger a reflection process that can then result in an increased willingness to adopt eco-efficiency innovation.

P2c: A successful implementation of eco-efficiency innovations in SMEs with low levels of absorptive capacity is maybe best achieved by a combination of a public (local authority) and private intermediary (consultancy) as they provide complementary services: awareness raising (public partner) and facilitation of the implementation process through direct assistance (private partner).

5.3 *Long-term Effectiveness Requires Long-Term Support*

The one-year beginner program has been found to be an initial starting point for change. The measures businesses have realized afterwards were diverse: Some have followed the track outlined by the program with (though to a varying degree) and some have even gone back to business-as-usual with no further measures taken at all. These results indicate that Ecoprofit will be able to trigger long-term effects if businesses are involved in concrete follow-up programs. Within the Ecoprofit-scheme such a follow-up program is the Ecoprofit-club. These clubs act on a regional base and serve as a central point for networking amongst SMEs subsequent to the beginner program. Despite the existence of the club, only one sample company (C6) participated in it and uses it as a source of further learning about sustainability. The other six companies attribute this club no specific relevance. The reasons for this might be that those enterprises operating in manufacturing have low networking skills (Bigliardi *et al.*, 2011). Therefore, in order to foster sustained change towards sustainability, it seems important for most of the SMEs to offer more direct and customized ‘hand-holding’ (Friedman and Miles, 2002) during a longer period of time (i.e. a one year timeframe for the beginner program is not enough).

P3: To achieve continuous sustainability-oriented change in SMEs with a particularly low absorptive capacity in this area, rather than broader club offers it is necessary to provide strongly customized handholding means (such as continuous on-site and individual support) in the long-term.

Despite the relatively low level of implemented sustainability measures, it was surprising that even SMEs in the blind spot of public awareness and scrutiny have decided to learn about and to start implementing sustainability management at least to some degree. Given the business-to-business context of the sample firms, cost, risk, and intrinsic aspects seem to be another key for long-term commitment to sustainable development. More specifically, as all organisations interviewed were family businesses, the intrinsic motivation of the owner might have a significant influence on the overall approach of the business towards issues related to sustainability. This resonates with literature that argues that the values and beliefs of the family often very strongly influence the decisions made and actions taken in a business context (Sharma, 2004).

A potential explanation why some businesses terminated their path towards further sustainability-oriented innovations could be, that most of the measures taken during the one-year scheme can be considered as “low-hanging fruits” (Dumphy *et al.*, 2007). This term refers to actions taken that are simple, usually rather low in initial financial investments and that show quick results. Examples of these are light or water management systems that were some of the process and organizational innovations implemented by our interview partners during the Ecoprofit year. Thus, once these fruits have been harvested, additional innovations become more difficult to implement and might require more resources in terms of finance, personnel and time. Subsequently, the inherent resources

constraints of SMEs (for example Russo and Tencati, 2009) might again pose a hurdle for more advanced and integrated innovations. However, at the same time, SMEs are far more flexible and can, sometimes simultaneously, adopt to markets and create new niches (O'Reilly and Tushman, 2004). It would be important to identify how to help SMEs to deal with the ambidexterity.

P4: Eco-efficiency innovation may present a feasible first step for SMEs with a low absorptive capacity on sustainability challenges to build up some initial capabilities to then deal with more complex environmental or sustainability-oriented innovations.

P5: SMEs that do not progress beyond picking the low-hanging fruits may need continuous customized support.

As the discussion of our findings from our exploratory interview study showed, collaboration with a complex intermediary consisting of public and private actors may lead to an increase in an SME's absorptive capacity for sustainability-related issues through providing different levels of support, that is, direct assistance and more loosely held support. However, to continuously involve SMEs in the sustainability agenda that view sustainability from primarily a risk and cost reduction perspective as represented by incremental process innovations, programs such as Ecoprofit are challenged to develop an opportunity orientation in SMEs in order to spur more activities in the area of product and organizational innovation.

6. Limitations and Concluding Remarks

SMEs face particular challenges such as resource constraints in finance, personnel and time, yet are at the same time challenged to address societal demands to contribute to sustainable development. This paper took this situation as a starting point to investigate if innovation intermediaries in the form of a complex intermediary can help SMEs in this process and how lasting these changes are. In order to gain a more precise picture, we focused on eco-efficiency innovation. During our conducted interview study, we found that the initial approach by an external organisation was a trigger to become involved in more sustainable business operations. Moreover, interacting with intermediaries who provide on-site support during the implementation was considered very helpful by our interviewees and indicates that particularly those SMEs that have limited prior knowledge are in need of more help than can be provided by handbooks or other forms of one-off information provision. Despite the eco-efficiency innovations implemented during the participation in the Ecoprofit program, some of the SMEs did not continue their change management towards corporate sustainability. We discussed this finding and proposed the importance of long-term support for those SMEs that require it.

With these findings we can provide useful implications for future research as well as for practitioners despite the small sample size due to the focus on SMEs in one specific industry (metal and mechanical engineering) and their interaction with the same complex intermediary. Our sample indicated that some types of SMEs require 'hand-holding' during their pursuit of sustainability whereas others deal

with these issues by themselves once they have received initial help. Future large-scale studies should further investigate the reasons or these differences in order to determine a typology to be used by practitioners and scholars so as to develop tailor-made support schemes for the respective SME types. Moreover, research should be conducted cross-sector in order to gain greater understanding on the influences of industry norms and values as well as of the influence a direct contact to the end-consumer might have. As Ecoprofit has a strong focus on eco-efficiency innovation, it would be interesting to analyze similar programs focusing on other aspects of broader sustainability-oriented innovation. Through such a comparison, one could gain better insight into which kind of program works for which type of sustainability challenge, or if overall more integrated programs are necessary that deal from the beginning with the challenge to take an integrative approach to sustainability-oriented innovation management.

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