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Eco-innovation in SMEs

An in-depth case analysis of transforming SMEs through effective partnerships

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ABSTRACT

Through eco-innovations small and medium sized enterprises (SMEs) can contribute to sustainable development. However, in an SME context eco-innovations entail managerial complexities given advantageous and disadvantageous SME characteristics. Hence, this paper addresses the question how eco-innovations can be effectively diffused amongst SMEs. Public support programs, often functioning as public private partnerships (PPPs), are one way to diffuse eco-innovations. Through an embedded multi-case study approach we analyze five region-specific PPPs based on the “Ecoprofit” initiative. Here, we find three different eco-innovation strategies for SMEs (reactive, anticipatory, innovation-based) as proposed by Noci and Verganti (1999). Due to varying levels of absorptive capacity these SMEs respond differently to the handholding mechanisms offered by the PPP. Moreover, we find that the three SME strategic patterns also apply to the public partner behavior. This has implications for the effectiveness of public support programs, and their potential to transform SMEs into more sustainable companies.

1. INTRODUCTION

Eco-innovation has been a research topic for some time, but usually with a focus on large enterprises (Rennings 2000). However, the majority of companies in most countries are SMEs and they account for roughly 64 percent of industrial pollution (ECEI 2010; Schmiemann 2008). Thus, SMEs are an important contributor to eco-innovation (and more broadly sustainability). Research shows that SMEs have both advantageous and disadvantageous characteristics for eco-innovation (Bos-Brouwers 2010). Furthermore, researchers have identified various strategic postures according to which SMEs are more or less strongly engaged in eco-innovation. For example, Noci and Verganti (1999) have found three "green strategies" (reactive, anticipatory, and innovation-based) ranging from less to more proactive environmental behavior. However, as there are is a much larger share of reactive and anticipatory SMEs than innovation-based SMEs (Noci and Verganti 1999), the question remains how this diversity of SMEs can be stimulated effectively to engage more strongly in eco-innovation.

One means are public support or educational programs aimed at diffusion of environmental technologies in SMEs. Research shows that various agent and peer-assisted handholding instruments (e.g. individual consulting, workshops) exist which can support SMEs to a different degree (Friedman and Miles 2002). We will argue that this also depends on their green strategy and their level of absorptive capacity. In order to provide the required level of handholding a close collaboration between the public partner and SME is necessary and thus a public private partnership (PPP) may emerge (Hansen and Klewitz 2012). As the funding for PPPs is usually limited in time, a major challenge for these support programs is the creation of long-term change. Consequently, many environmental support programs are enhanced with peer-assisted handholding in the form of networking platforms or "clubs" where the companies share knowledge in a more self-organized way (Friedman and Miles 2002; Luken and Navratil 2004; Sage 2000). Existing programs like "National Cleaner Production Centres" (Luken and Navratil 2004), the "Small Business Support Program" (van Berkel 2007), and the Ecoprofit initiative (Martinuzzi et al. 2000; Sage 2000) are all exemplary PPPs offering a variety of handholding mechanisms.

Many of the existing studies evaluating the programs mentioned above take a quantitative approach to determine the program success through descriptive statistics on participation rates and environmental impacts (e.g. Luken and Navratil 2004). These studies mostly neglect the differences of participating SMEs, particularly with regard to their different green strategies. We see the necessity to "take a step back" in order to take a micro level perspective at the actual partners (public actor, SMEs, and other third parties) and their roles in the PPP. We ask how effective policy interventions have been and, more specifically, in which way momentum gained during the programs' runtime is translated into long-term continuous improvement. This is essential as some of the studies tend to be rather optimistic as their authors were directly involved in the programs (e.g. Martinuzzi et al. 2000). Accordingly we pose the following research questions:

(I) *In which way can an SME's green strategy influence the effectiveness of handholding mechanisms offered in the PPP?*

(II) *In which cases can "clubs" represent an effective handholding mechanism for long term continuous improvement in SMEs?*

(III) *How can the behavior of the public partner influence the effectiveness of handholding (and PPPs more broadly)?*

The paper will take an embedded multi-case study approach with five local PPPs based on the Austrian Ecoprofit initiative (Sage 2000)[1]. Our contribution is threefold: first, we show that SMEs with all three green strategy types can be involved in PPPs. Second, we demonstrate that each type – due to varying degrees of absorptive capacity (Cohen and Levinthal 1990) – is able to benefit from different handholding mechanisms and that alternative learning paths are used to compensate for mismatches in the PPP setting. Third, we find that not only the strategy pattern of the SME is important, but that the public partner's level of proactivity can also influence the outcomes of the PPP.

The reminder of the paper is structured as follows: After the introduction, chapter 2 analyses the extant literature on eco-innovation in the context of SME characteristics and green strategies. The role of diffusion-oriented public programs and PPPs is also dealt with. The embedded multi-case study methodology is discussed in chapter 3. The findings are presented in chapters 4 to 8 with chapter 4 showing general perceptions on the Ecoprofit initiatives and chapters 5 to 7 presenting the detailed cases. The last two chapters conclude with our conceptual implications and conclusion.

[1] Ecoprofit® is a registered trademark: ECOlogical PROject for Integrated Environmental Technology. We simply refer to Ecoprofit in the text.

2. LITERATURE REVIEW

2.1 Eco-innovations in the Context of SMEs

Eco- innovations include new or enhanced processes, products, technologies, services and organizational practices that are beneficial to the environment in that they reduce or avoid negative environmental impacts (Hansen et al. 2009; van Hemel and Cramer 2002; Rennings 2000; Beise and Rennings 2005).

Eco-innovation in SMEs (companies with less than 250 employees, TCEC 2003) functions differently than in large companies, because they are not simply smaller versions of their larger counterparts (Tilley 2000; Welsh and White 1981) and are a heterogeneous group in terms of size and sector diversity (Hillary 2006). A growing body of literature puts forward a range of “peculiarities” or “characteristics” that apply to SMEs in the context of sustainability (Klewitz and Hansen 2011; Luetkenhorst 2004; Moore and Spence 2006; Preuss and Perschke 2010; Perrini 2006; Russo and Tencati 2009; Spence 1999; Spence and Lozano 2000; Schaper and Savery 2004; Vyakarnam et al. 1997) and, more specifically, apply to eco-innovation. Both disadvantageous and advantageous characteristics exist. The disadvantageous characteristics addressed are, for example, resource constraints in terms of a lack of time, personnel, know-how, and financial capital (Azzone and Noci 1998; Del Brío and Junquera 2003; Spence, 1999; Bos-Brouwers 2010), which may result in a reluctance to invest in and implement eco-innovations (Noci and Verganti 1999). It may thus be argued that SMEs will primarily focus on issues related to economic performance and hence pursue eco-efficiency improvements (Revell et al. 2010; Suh et al. 2005) as this combines positive effects in both the environmental and economic sphere (Schaltegger and Synnestvedt 2002; Dyllick and Hockerts 2002; Schaltegger and Sturm 1998). In contrast, advantageous SME characteristics, such as efficient informal ways of communication, flexible and lean organization structures (Bos-Brouwers 2010) may lead to fast changes in production routines. Also, the dominant and entrepreneurial role of the owner-manager allows an SME to react more dynamically to changing markets and can facilitate behavior in terms of green product innovation to conquer market niches (Jenkins 2006). In conclusion to SME characteristics in the context of eco-innovations, Noci and Verganti (1999) find that eco-innovation indeed occurs in SMEs, but to a varying degree.

2.2 Three Strategic Patterns of Environmental Behavior

As eco-innovation involves environmental improvement measures going beyond the regulators requirements, they can all generally be considered “proactive environmental strategies” (Aragón-Correa et al., 2008). However, different degrees exist depending on the organizational capabilities of an SME and its unique strategic characteristics (Klewitz and Hansen 2011; Aragón-Correa et al. 2008). Noci and Verganti (1999) recognize three different strategic patterns: reactive, anticipatory, and innovation-based. Reactive strategies apply to SMEs that innovate only through reaction to external stimuli by regulators, governments, and other stakeholders. SMEs that follow an anticipatory strategy consider the

environment as a source of future competitive advantage and adopt green technologies by following timing strategies. With innovation-based strategies, SMEs consider the environment as the most important competitive priority and they translate environmental issues into innovation-based solutions by adopting green technologies and creating new markets for eco-friendly products.

Thus, eco-innovation in SMEs is both influenced by advantageous and disadvantageous SME characteristics, as well as the type of eco-innovation strategy adopted. Literature reveals however that there are few SMEs that deploy an innovation-based strategy, and that rather a larger number sticks to less proactive strategies (Noci and Verganti 1999). Given the varying degrees of proactivity and the weak representation of innovation-based strategies, the question remains how SMEs can generally be *stimulated* to engage more strongly in *eco-innovation*.

2.3 Public Private Partnerships for Diffusion of Eco-innovations in SMEs

One means to stimulate eco-innovation in SMEs are *diffusion-oriented programs* aiming at the adoption of environmental technologies (Kemp 1995). *Diffusion-oriented policies*, in general, aim to increase an economy's innovation capacity in that governments serve as facilitators of change and aim to diffuse technological capabilities. This is done primarily through strengthening the industrial and scientific infrastructure, promoting technology transfer, and encouraging collaboration between different actors (Cantner and Pyka 2001; Ergas 1987). Furthermore, SMEs are increasingly recognizing governments, trade associations, professional and business networks as catalysts for future change in terms of active support for environmental activities (Hansen and Klewitz 2012; Revell et al. 2010; Biondi et al. 2002; de Bruijn and Hofman 2000; Hoevenagel and Wolters 2000). Here, local authorities are attributed a special role for implementing programs that encourage and educate SMEs (Bradford and Fraser 2008*).* Thus, diffusion-oriented programs follow the "carrot rather than stick-principle" and provide active support in terms of education and training programs (Parker et al. 2009). Such *soft regulation instruments* are one possible response to market failures in the context of sustainability (for example to deal with natural resource questions) (Weiermair et al. 2008). Thus, the role of policy makers to provide supportive frameworks that facilitate the development of organizational capabilities (learning, networking, innovation) in SMEs, is increasingly recognized (Jenkins 2009). Examples for such government supported programs that aim to diffuse environmental innovation amongst SMEs are found all over the world, such as the "National Cleaner Production Centres" in developing nations (Luken and Navratil 2004), the "Australian Small Business Support Program" (van Berkel 2007), the UK-based "Better Business Pack" (Friedman and Miles 2002), the "Eco-Efficiency Centre" in Nova Scotia (Côté et al. 2006), or the Austrian-based but internationally deployed "Ecoprofit initiative" (Klewitz et al. 2012; Zeyen et al. 2011; Martinuzzi et al. 2000; Sage 2000), to name but a few programs.

More specifically, in *public diffusion-oriented programs* governmental bodies, that is local authorities, can actively seek out the partnership with private actors (here SMEs) in which case they may also be termed a public private partnership (PPP). Such partnerships are

only just emerging, as the “divergent views between business and government” were traditionally considered obstacles to such a partnership (Kolk et al. 2008). PPPs are loosely defined (Hodge and Greve 2007), and thus, various forms are possible, such as service or management contracts, leasing, or licensing (Weiermair et al. 2008). For the purpose of this paper, PPPs are understood as a “constitutional arrangement” (Hodge and Greve 2008: 545) between a local authority and an SME with the aim to share risks, costs, and resources to lead to a long term partnership (Hodge and Greve 2007; Van Ham and Koppenjan 2001; Weiermair et al. 2008; Malmborg 2003, 2004; Martinuzzi et al. 2000).

2.4 Handholding in PPPs

However, the major challenge of PPPs for eco-innovation lays in maintaining an SME’s interest and actually changing behavior (Friedman and Miles 2002) on a long-term basis. Here, the dissemination routes and their means of *handholding* becomes crucial, that is the degree to which SMEs are individually guided through the process of using support programs for effective diffusion and adoption of innovation within the company (Friedman and Miles 2002). Both “agent-assisted” and “peer-assisted” handholding instruments can spur learning in SMEs (Bessant et al. 2009). Agent-assisted handholding deals with the direct support of the SME by the (public) partner and can encompass means such as distribution of learning material, questionnaires, external evaluation and benchmarking, site visits, help-lines, and award schemes.

Whilst some of the previous instruments mentioned encompass some degree of peer-assisted handholding (for example workshops or joint site visits), peer-assisted support is most strongly found in SME *networks* (Friedman and Miles 2002) or “learning networks” (Bessant et al. 2003; Clarke and Roome 1999). Through *networks* SMEs can access expert knowledge throughout and more importantly after program duration (Friedman and Miles 2002). As Keeble and Wilkinson (1999) point out, SMEs tend to learn better collectively, for which networks can provide the setting (Biondi et al. 2002) which may lead to sustained change (Roberts, Lawson, and Nicholls 2006). Localized networks are particularly important to compensate for SME peculiarities related to firm size (Walker and Preuss 2008). Consequently, many environmental support programs are enhanced with locally based networking platforms or “clubs” (Friedman and Miles 2002; Luken and Navratil 2004; Sage 2000) to secure long-term commitment to environmental technology adoption and progress (Sage 2000).

As mentioned above, as one important PPP using these various handholding mechanisms, Ecoprofit will be analyzed more in detail in this paper and is therefore introduced next.

2.5 An Introduction to the Ecoprofit Initiative

The Ecoprofit initiative is a diffusion-oriented public program based on a PPP concept and one of the most successful initiatives in Europe to diffuse eco-innovation amongst organizations, including SMEs. Ecoprofit 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). Through education and customized problem solving it introduces organizations from various sectors to eco-innovation. More specifically, it aims to improve the eco-efficiency of processes, products, practices, and services in organizations (Krenn and Fresner 2009).

Ecoprofit was developed in Austria in the early 1990s by the Environment Department of the City of Graz. The concept has also served as a blueprint for other local authorities wishing to quickly introduce local sustainability initiatives for SMEs. It has already spread internationally to countries such as Germany, the Netherlands, Hungary, Slovenia, Russia, Italy, and China (Balcázar 2010). In Germany, Ecoprofit has been implemented in around 80 locations with at present over 2000 participating organizations. With the foundation of the 'Ecoprofit network Germany' in 2000, the program itself is continuously evaluated, discussed, and developed (City of Munich 2008). At present, Ecoprofit has three modules: the beginner program (module 1), the Ecoprofit club (module 2), and "from Ecoprofit to EMAS/ISO" (module 3). The beginner program and Ecoprofit club as specific forms of agent-assisted and peer-assisted handholding will be analyzed in more detail below.

3. METHODOLOGY

3.1 Research Strategy

The topic of PPP to diffuse eco-innovations has been researched for several years and both qualitative and quantitative studies already exist (Côté et al. 2006; Friedman and Miles 2002; Luken and Navratil 2004; Monkhouse et al. 2006; Sage 2000; van Berkel 2007). We thus consider the field to be developing towards intermediate theory (Edmondson and McManus 2007). We chose the multi-case study research strategy for a "freshness in perspective to an already researched topic" (Eisenhardt 1989; cf. Yin 2003). The cases are interpretative of nature (Silverman 2008), particularly informative (Walker and Preuss 2008), and from which research can draw rich descriptions and possible explanations for the studied phenomenon (Glaser and Strauss 1980). In a cyclic process, we used both preliminary theory and inductive reasoning for collecting and analyzing the data; ultimately, we contribute to theory building in the form of explicit propositions (Eisenhardt and Graebner 2007).
As already stated in the literature review, the target of our study is the Ecoprofit initiative Germany. In our case study we have three embedded units of analysis (Yin 2003) in that each case represents a unique partnership setting of a regional Ecoprofit initiative. Accordingly, the individual case consists of a local authority administering the Ecoprofit program, a participating company, and the consultants involved in the implementation of eco-innovations in the company. With this approach we are able to increase the validity by using "numerous and highly knowledgeable informants who view the focal phenomena from diverse perspectives" and thereby including perspectives outside the individual organization (Eisenhardt and Graebner 2007: 28).

3.2 Case Sample

As stated in the prior section, here a "case" refers to a specific region in which Ecoprofit is implemented and includes three units of analysis (SME, local authority, and consultancy). Still, the major unit of analysis is the individual SME and its approach to eco-innovation. Accordingly, the selection of the (overall) cases was done based on the selection of SMEs.
Given the heterogeneity of SMEs also in terms of sector diversity (Hillary 2006) and thus differences in the relevance of sustainability, we chose a sector-specific focus to ensure better comparability of the findings (Jenkins 2006). The metal and mechanical engineering industry was chosen for various reasons. First, it belongs to one of the five major industries in Germany (Kritikos and Schiersch 2010; VDMA 2010). Secondly, the industry is a key supplier to many other industries such as automobile, electronics, and construction and thereof faces pressures to implement sustainability (Steier 2009). Thirdly, it is an under-researched sector because on the one hand, most studies of sustainability deal with industries operating in business-to-consumer markets and on the other, eco-innovation is primarily investigated in large companies to which more than 80% of metal and mechanical engineering companies do not belong (Kritikos and Schiersch 2010).

The companies for this study were selected from a privately owned, yet publically accessible database (www.arqum.de/datenbank/) listing companies which participated in the Ecoprofit initiative between 1998 and 2010. The database reveals 35 companies from the metal and mechanical engineering industry which we all contacted via Email or phone to conduct interviews. Seven companies, all from different Ecoprofit regions, agreed to participate in the study (cf. table 1). The reasons for non-participation of the other 29 companies relate to: no time (in the majority of cases), no response, and no specific reason. All SMEs are family businesses, operate in the metal and mechanical engineering sector in a business-to-business environment, were one of the first companies to participate in the respective regional programs (first-movers), and completed the Ecoprofit beginner program (module 1). From this extensive material, we further limited our paper to five particularly interesting cases. The other two companies also initially interviewed (EN6 and EN7, cf. Table 1) were close replications of the others and were omitted in the present paper due to the constrained space. Still they contribute to external validity given the "replication logic" of case studies (Yin 2003). For reasons of anonymity the individual regions and company names are not revealed.

Table 1: SMEs from metal- and mechanical engineering industry included in sample

Case *	Enterprise code	Staff (#)	Size[2]	Market	Products	Included in report[1]
1	EN1	170	Medium	International (niche market)	High precision machine tools and gear profile grinding machines	+
2	EN2	93	Medium	International and national (niche market)	Heavy anchoring technology	+
3	EN3	65	Small	Regional and national (competitive market)	Purpose machinery manufacturing	+
4	EN4	24	Small	National (competitive market)	Cutting tools with CNC-, grinding-, and measuring technology	+
5	EN5	100	Medium	Regional and national (competitive market)	Steel and metal constructions	+
6	*EN6*	*230*	*Medium*	*International (niche market)*	*Microfinish and superfinish machines*	-
7	*EN7*	*45-50*	*Small*	*National and European (competitive market)*	*Staircase constructions, bending technology, and steel construction*	-

[1]Not all companies were included in the detailed case analysis, as they were representatives of other cases
[2] According to EU definition

3.3 Data Collection

We used multiple methods. First, we used data from the Ecoprofit database mentioned in the previous chapter to analyze the type of eco-innovation in the individual companies achieved through participation in the beginner program.

Second, we conducted interviews in two phases. In the first phase (August 2010), we interviewed the seven companies. In all companies we were able to conduct interviews with the person responsible for Ecoprofit. Subject of the interviews was the general sustainability and eco-innovation approach of the SMEs as well as their role in and perceptions of the Ecoprofit program. In the second phase of the interviews (July 2011), we broadened the scope of interviews to establish embedded cases in that we conducted further interviews with the companies, the local authorities, and the consultancies involved in the Ecoprofit initiative. The conducted semi-structured interviews were digitally recorded and transcribed (Wolcott, 2009).

Third, we used archival data, such as publications on the Ecoprofit initiative, company and Ecoprofit websites, and internal protocols from the Ecoprofit network Germany (from 2006 to 2010) provided by some of the interviewers. Table 2 summarizes the conducted interviews.

Table 2: Total interviews conducted

Phase	Group	#Organizations[1]	#Interviews	Av. duration [min]
Phase 1	SMEs[3]	7	7	16
Phase 2	SMEs[4]	7*	6	25
	Local authorities	7**	4 (+2)[2]	56
	Consultancies***	2 (+1)[5]	4	57
Total	All	16 (+1)	21 (+2)	38

[1] Includes organizations and interviews which were removed from the detailed case analysis
[2] Given program termination several years in the past, the persons responsible for the program could not be contacted; instead a very short call on general information was done with the person we contacted for our interview request.
[3] Three owner managers; three executive managers (maintenance, purchasing); one manager (sales)
[4] Three owner managers; three executive managers (maintenance, purchasing)
[5] Interviews were conducted with the two major consultancies that work with Ecoprofit, and one smaller but experienced consultancy in Ecoprofit
* Company EN3 decided not to participate in the second phase of interviews given time restraints
** As EN3 did not participate in the second phase of interviews, the case was excluded from the in-depth case analysis, and consequently the local authority was not contacted
*** interviews were conducted with two senior consultants (EN1, EN2); two program managers (EN3, EN5); one director of consultancy (EN4)

3.4 Data Analysis

The data was analyzed both using in-depth case-specific analysis and cross-case analysis (Yin, 2003). In a first step, each case is described elaborately through triangulation of data from interview protocols, the database, and internal documents. During the process the two authors and one additional researcher involved in the data collection discussed the

intermediate findings in order to resolve conflicts in cases where perceptions differed amongst each other.

It should be mentioned that a long time span exists between initial Ecoprofit participation and the time we collected data. With regard to our research interest in long-term effects of diffusion-oriented programs we selected companies who participated in the initiative within the past ten years, as significant changes in an SME's environmental behavior should be expected with a delay between three and up to five years after program participation (Altham 2007; Rosenfeld 1996; Hennicke and Ramesohl 1998). Thus, this time lag between program participation and interviews conducted, allows us to investigate the long-term effectiveness of such programs, as several years of project duration, post project experience, and network establishment can be accounted for. Though we are only able to analyze in retrospect (and under full awareness of the related limitations; cf. van de Ven and Poole 1990), such a longitudinal approach allows to evaluate the long term effects of support programs.

In a second step, we used the detailed cases for cross-case analysis in order to identify patterns (both similarities and differences) against the light of preliminary theory. In a final step both descriptive and cross-case analysis were concentrated to fit the scope of the paper.

4. THE ECOPROFIT PROGRAM AND THE ROLE OF DIFFERENT ACTORS IN THE PPP

In this first chapter on results of the empirical analysis, we present the perceived role of various actors in the setting of PPP, followed by a detailed presentation of individual cases in subsequent chapters.

4.1 Partnership Setting

Given the PPP structure of Ecoprofit local authorities, companies, and consultants collaborate to implement eco-innovations in SMEs. With regard to the partnership setting of the PPP, our analysis suggests that a central role lies with the local authorities:

> *"A further success factor is that Ecoprofit is not offered by a private consultancy but is a collaborative project between the city and the companies. This generates a completely different public image and rate of acceptance." (CO2)*

They have a leadership role, secure funding, and need to actively and continuously motivate companies to participate. Overall, the local authorities provide a stable setting for the long-term deployment of Ecoprofit. Thereby, according to one of the consultants, local authorities can create a learning environment for SMEs:

> *"It is not important where the public funding is situated. Crucial is that there is funding. […] Then you also need someone that actively approaches the companies […]. Furthermore, it is important that the support through the local authority is secured […].In cases where the attempt is made to establish the program without the support of the local authority it didn't work." (CO2)*

Whereas the local authorities are crucial for promoting, and maintaining the program, our findings indicate that the consultants play a major role for the initiation and, more importantly, implementation of the program. This is ensured through agent-assisted handholding in terms of guiding SMEs individually through the innovation process (Friedman and Miles 2002).

Overall, the relationships between the partners of Ecoprofit are interdependent in that each actor fulfills a specific role to ensure the success of the program: the *local authorities* are responsible for the framework of the program; the *consultants* provide agent-assisted handholding for eco-innovation directly at the site of the company; and the *companies* dedicate crucial resources (relative to their rather limited resources in general).

As stated in the literature review, Ecoprofit provides three modules (beginner program, club, and "from Ecoprofit to EMAS/ISO"). In the present paper we focus on the first two programs, as the third one was of no relevance within our sample of companies.

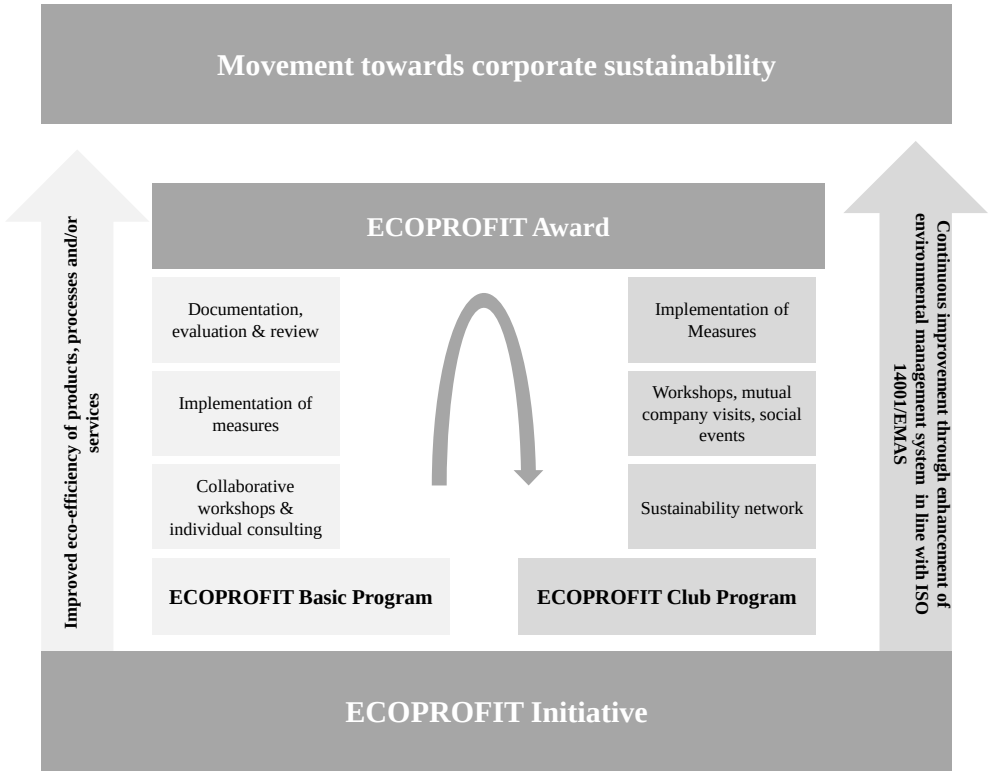

Figure 1: The Phases of the ECOPROFIT-scheme (based on Krenn and Fresner 2009)

4.2 Ecoprofit Beginner Program

The Ecoprofit beginner program within one region aims to introduce about 15 “beginner companies” each year to the concept of sustainable development and, more specifically, implement eco-innovations. It consists of eight to ten workshops, five individual on-site consulting sessions, and the Ecoprofit award/certification process. The workshop topic range from cleaner production strategies to eco-controlling and monitoring of indicators (Sage 2000; Krenn and Fresner 2009). The individual on-site consulting may include a material flow analysis, the set up of eco-controlling systems, or implementation of a new waste management system (Sage 2000). After a one-year period, the Ecoprofit award is given if certain accomplishments are met, such as a legal compliance audit, the installation of an environmental policy, and an environmental program for the following year (Krenn and Fresner 2009; Sage 2000). To better accommodate to resource limitations of micro and small businesses, an adapted version of the beginner program has been developed with reduced requirements (five workshops and three individual on-site consultations, lower fees for participation), and is offered in some regions.

Our analysis suggests that the beginner program is particularly effective through offering a range of handholding including learning material, workshops, site visits, and individual consulting which are more strongly agent-assisted than peer-assisted (Friedman and Miles 2002). Thereby SMEs are individually guided through the eco-innovation process:

"Ecoprofit is successful through the combination of workshops and on site-visits, they allow to deal with the specific issues of the companies and allow for the exchange. […] Central is the structure of the program. With the working sheets the companies are able to reach goals along the way, like homework, and the professionals keep track of them. […] Without this, the companies would not be able to deal with the workload." (CO4/5)

Such handholding gives diffusion-oriented programs a certain degree of structure which is regarded as particularly important to offset resource constraints in SMEs, as a local authority reflects:

"Ecoprofit offers companies a way to voluntarily introduce environmental protection measures [and]
it was pointed out to us that SMEs are more likely to participate in strongly structured programs such as Ecoprofit." (LA3)

4.3 Ecoprofit Club Program

The Ecoprofit club is based on network relations, with a regular program structure of common workshops, on-site consultation, and opportunity for informal exchange (Sage 2000; Krenn and Fresner 2009). As the Ecoprofit certificate can only be used for a limited time, club membership also includes the opportunity for recertification. According to a consultant, the Ecoprofit club targets at companies that aim to continuously improve their environmental performance and are able to benefit from the specific Ecoprofit program structure:

"It is usually those kinds of companies [that participate in the Ecoprofit club] that still have a concrete need and want to take this up in the club. It is also those companies that are convinced about the system Ecoprofit and want to use it integrate environmental protection in their company in the long term." (CO2)

Overall, the club concept is less structured (thus more flexible and more strongly peer-assisted) than the beginner program and its features can be adapted better to the local setting. The findings from our case analysis suggest that the Ecoprofit clubs serve as learning networks and initiate a continuous learning process, as one of the consultants explains:

"The club functions after plan-do-check-act with the goal to secure and implement the basic knowledge acquired in the beginner program. The clubs helps to do so with its structure and regular meetings to initiate continuous improvement towards environmental management. The networks are important for the exchange of new ideas and new solutions. They also motivate to look for new potential measures […]" (CO4/5)

Furthermore, the club aims to *ensure the long term effectiveness* of Ecoprofit:

"It is often after the beginner program you start the measures but you don't know how to really continue them. Here it is important to have continued support. This is true for the

first two or three years of club membership. Then you stay because you want the communication, stay on top of things and discuss things with other companies" (LA4).

Whilst this chapter presented the overall perceptions of the Ecoprofit program, next we want to look in more detail to the individual characteristics of each of the five PPPs (i.e. cases) and partners therein.

5. AN OVERVIEW OF THE CASE STUDIES

Our findings show that there are distinct differences amongst the five cases: one company (EN1) participated in a program that was later on terminated by the local authority; one company (EN2) decided against any further eco-innovations despite a supportive regional setting; two companies (EN3, EN4), despite supportive regional settings, tapped into different sources of knowledge to continue with eco-innovation; and one company (EN5) has been actively involved in the Ecoprofit-initiative for more than 10 years. The individual characteristics of each partner is presented in a comparative manner in the following two tables, with public actors and consultants addressed in Table 3 and SMEs addressed in Table 4.

Table 3: Partnership setting

Regional setting	LA1	LA2	LA3	LA4	LA5
Size of municipality	Large	Medium	Medium	Small	Small
Overall degree of local authorities' activity/ (innovativeness)	+/++[1]	++	++	+++	+++
- Centre of Competence for Ecoprofit	./.	(+)	./.	./.	(+)
- Beginner program	1999-2005	2000	2001	2000	2000
- Ecoprofit club	1999-2005	2004 no active part lies with city	2003	2002	2002
- Stable financing through federal state / city	no	yes	yes	yes	yes
- Program continuity	termination in 2005	continued	continued	continued	continued
- Cooperation with other municipalities	(-)	(+)	(+)	(-)	(+)
- Linkage with other regional initiatives	(-)	(+)	(+)	(+)	(-)
- Adapted beginner program (micro firms)	(-)	(+)	(-)	(+)	(+)
Consultant's Ecoprofit expertise	*CO1*	*CO2*	*CO3*	*CO4/5*	*CO4/5*
- Ecoprofit specialization	small consultancy with Ecoprofit-experience in different regions (+)	major Ecoprofit consultancy (++)	major Ecoprofit consultancy (++)	major Ecoprofit consultancy (++)	major Ecoprofit consultancy (++)
- Years Ecoprofit experience of consultant	10-12 years	11 years	1.5 years	11 years	1.5 years
Consultant's Ecoprofit competencies					
- Operative level (for example on site consultation, workshop moderation)	(+)	(+)	(+)	(+)	(+)
- Strategic level (for example program development)	(+)	(-)	(-)	(+)	(-)

* The consultant is experienced in the region of both EN4 and EN5
Low: population 1- 500.000
Medium: population 500.000 – 1 mio.
High: population > 1 mio.

[1]Program canceled after 6 years

Table 4: The Diffusion of Eco-innovation in SMEs through the Ecoprofit Initative

Criteria	Case				
	Case 1	Case 2	Case 3	Case 4	Case 5
Green strategy after Ecoprofit-participation	Reactive (Eco) efficiency and product durability	Reactive Eco-efficiency	Anticipatory Eco-efficiency	Anticipatory Eco-efficiency	Innovation-based Environmental protection
General understanding of ecological sustainability Eco-innovation before Ecoprofit	(-)	Energy; incremental process	Energy; incremental process	(-)	Energy; incremental process innovations; green products
Impacts through the beginner program					
- #Staff in environmental team after Ecoprofit	2	1	4	0 (+ OM)	2 (+ OM)
- #OMs part of environmental team	(-)	(-)	1	2	1
- Participation (year)	2003	2002/2003	2002/2003	2001	2001
- Process innovations (#)	Waste (1); energy (1), hazardous materials (1)	Hazardous materials (1); water (1)	Waste (1)	Emissions (2); waste (1); energy (1)	Energy (3); water (1); waste (1)
- Organizational innovations	(-)	(-)	(-)	(-)	Development of monitoring system
Ecoprofit club					
- Membership offered	partly (until 2005)	(+)	(+)	(+)	(+)
- Participation	(-)	(-)	(-)	(-)	(+), since 2002
Eco-efficiency innovations after Ecoprofit					
- Incremental process innovations in eco-efficiency categories	(-)	Energy	Energy, water	Waste, hazardous materials	Energy
- Product innovations	(-)	(-)	(-)	(-)	Strengthening of business area for green technologies through network participation
- Organizational innovations	(-)	(-)	(-)	Internal eco-indicator database ISO 9000 certification	Continuous monitoring of environmental performance
Alternative paths to enhance absorptive capacity					
- Participation in sustainability initiatives	(-)	(-)	(-)	(+)	(+)
- Institutional sources of knowledge	TA	TA	ON	TA LCC/H	TA LCC/H ON

[1] for example Case 1 includes Enterprise 1 (EN1), Local authority 1 (LA1), and consultant 1 (CO1), that is C1 = EN1/LA1/CO1
ON: other networks
TA: trade associations
LCC/H: local chamber of commerce/handicraft

Overall, our findings suggest that the success of the intervention is dependent on both the SMEs' green strategy (reactive, anticipatory, innovation-based) as proposed by Noci and

Verganti (1999) and the local authorities' degree of pro-activity exhibited. Furthermore, our findings indicate that other sustainability initiatives and sources of knowledge, for example trade associations, outside the Ecoprofit program can influence eco-innovation in SMEs.
In the following chapter, findings are discussed in detail. We present the cases in groups according to the SME's green strategy as presented in the table above. We will use the short labels 'reactive SME', 'anticipatory SME', and 'innovation-based SME' to refer to the related green strategies.

6. ACTIVATION OF SMES WITH REACTIVE STRATEGIES

In this chapter, the first two sections describe the first two (of five) cases which include SMEs with a reactive green strategy. The third section discusses these partial results.

6.1 Case 1

Regional setting. The local authority (that is the respective environmental agency) offered the beginner program and the Ecoprofit club between 1999 and 2005. Despite seven successful rounds of the beginner program and an active Ecoprofit club, the program was terminated in 2005 due to internal differences within the local authority. Accordingly, the program funding was stopped whereof the program ceased to exist. Thus, company EN1 finds itself in a setting without further support through Ecoprofit.

Company EN1. The company is a family run business with 170 employees that competes in a niche market with a focus on international industrial business customers. It manufactures high precision machine tools and is a world leading manufacturer of gear profile grinding machines. Its major competitive advantages are its innovation capacity for specialized technology and its international focus (for example Brazil, China and the United States). EN1's understanding of ecological sustainability is limited to eco-efficiency gains with a focus on technology and, more specifically, product durability.

Effects of participation in the beginner program. EN1 completed the beginner program in 2003. The environmental team assigned now consists of two staff members. The most innovative eco-efficiency measures from the beginner program include grinding wood waste, optimization of the lighting system, and improvements in the disposal of hazardous waste (see Table 4). Direct benefits relate to reduction in the energy consumption and other cost cuts. Ecoprofit was also done to *"find out, what the others are doing" (EN1)*. After the successful completion of Ecoprofit no further environmental improvements were made, and EN1 continues to persist with a reactive stance recognizable in the following statements:

> *"for us the ultimate goal is to make the processes as cost-efficient as possible […]. If environmental things cause costs, we undertake measures to avoid that." (EN1)*
> *"First of all we aim for maximum cost-efficiency and quality. This cost-efficient organization of processes inevitably leads to certain environmental questions, anyways." (EN1)*

This persistence on reactive behavior is in part explained by the perceived irrelevance of environmental issues to the sector:

> *"And to them [company customers] it doesn't matter at all, if a machine has any environmental characteristics. They are only interested if the machine can produce efficiently." (EN1)*

Furthermore, EN1 is poorly equipped with trained staff and slack time that could deal with additional environmental measures; it is merely a side task. Also, EN1 does not recognize a competitive advantage through further improvement of their environmental performance:

"Important is the continuous improvement of processes and the integration of environmental aspect, but the environment itself is not a driver [for us]. […] We don't wish to reorganize everything ecologically" (EN1).

Relevance of Ecoprofit club program. Even though Ecoprofit club was offered from 1999 to 2005, EN1 saw no benefit in participation and would only be interested if in a sector-specific approach:

"The club would have to include only industrial companies and ideally would have to be sector-specific. The target group needs to be tailor-fit so that you can talk about the same problems and solutions that also fit our company." (EN1)

Also the company has up to now not recognized an advantage in participating in other existing sustainability initiatives:

"It's not about continually getting new ideas, instead we want to optimize existing processes, that is the manufacturing costs, so that we can guarantee the survival of the company." (EN1).

6.2 Case 2

Regional setting. In this case, the local authority has been offering the beginner program since 2000 and the Ecoprofit club since 2004. The region decided to offer Ecoprofit to promote economic growth in the region, and establish trustful relationship between administration and local businesses. The program itself is financed through the federal state. Given the success of Ecoprofit, the region now offers two new programs that are based on the Ecoprofit design but deal with social and other environmental issues. Furthermore, there are additional information services for Ecoprofit members after participation in the program. The authority is also active within the Ecoprofit network Germany and overall, has been identified as a "Centre of competence for Ecoprofit" (City of Munich 2008). However, the authority has increasingly difficulties to find new companies to participate in Ecoprofit. Against this background, a cooperation with another municipality exists to keep the program stable.

Though generally the local authority is actively pushing the Ecoprofit program, it does not do so with the club program, where it takes only an informing role whilst relying more strongly on the SMEs' self-organization. Overall, the local authority can be considered to have a medium level of proactivity taking into account that, on the one hand, it is strongly engaged in the beginner program but, on the other hand, provides only low engagement for the club program.

Company EN2. Company EN2 is a family run business in its third generation with 93 employees. It competes in a niche market and serves international and national customers with heavy anchoring technology. Its main competitive advantages are its specialized know-how and its global focus. EN2's understanding of ecological sustainability is limited to eco-efficiency.

Effects of the beginner program. EN2 completed the beginner program in 2002/2003 with innovative measures such as comprehensive safeguarding of contaminated sites and construction of a detention reservoir for a relief of the purification plant. This led to a reduction in environmental risks and improved environmental compliance. As the responsible executive manager revealed, some ideas developed during beginner program were only implemented almost a decade later:

> *"In 2010 we included a thermal power station for heating and energy generation in the last reconstruction of a production unit. This was already pointed out strongly during Ecoprofit participation and now finally the company decided to do it. This is really thanks to Ecoprofit, here I got the basic knowledge to integrate it into the project planning." (EN2)*

The environmental team, of initially three members during Ecoprofit participation, was reduced to one staff member. After Ecoprofit no particular new measures were implemented:

> *"I could pretty much say nothing [further was done]. We to the usual in terms of environmental protection and waste disposal of certain harmful substances […] if we build new plants we consider energy efficiency." (EN2)*

In retrospect, EN2 indicates that there may be potential to do more if more time and owner-management support was at hand:

> *"The owner-management decided what attitude and time we have for environmental protection. […] There is potential to do a lot more but I don't have the backup [by the owner manager]." (EN2)*

Relevance of the Ecoprofit club program. EN2 decided against participation in the Ecoprofit club, due to missing time and support by his supervisors:

> *"For Ecoprofit basic, I had the time to do so. With regard to the club, the company leadership decided that the basic program was for education and that this would for now be enough."*

EN2 recognizes an alternative to Ecoprofit in trade associations as here a sector-specific approach is offered. So far however, according to EN2, the trade association primarily offers seminars that deal with regulatory issues of environmental protection. Whilst not participating in any regular activity, EN2 welcomes the fact that both actors from the Ecoprofit program as well as the trade association offer help when contacted.

6.3 Summary and Discussion of Cases with Reactive SMEs

In summary, the cases presented demonstrate SMEs with a reactive strategic pattern. Both EN1 and EN2 made only minor investment into incremental eco-innovation. The dedicated resources and competencies are strongly limited and no green image is pursued. Investments into key competencies beyond Ecoprofit are not recognizable (see Noci and Verganti 1999).

However, the regional setting is different in that EN1 is confronted with program termination and thus challenged to tap into alternative sources of knowledge, for example trade associations or local chambers of commerce. EN2 is within a supportive and some extent pro-active regional setting, but is thwarted through a lack of owner-manager support. Overall, reactive SMEs achieve limited eco-innovations through agent-assisted handholding provided in the beginner program. Beyond the beginner program, the SMEs are reluctant to pursue further eco-innovations, given a lack of resources in terms of time and personnel, and – more importantly – a lack of owner-management support. Thus, reactive SMEs support the typical resources constraints argument used to explain reactive behavior of SMEs (Del Brio and Junquera 2003).

Peer-assisted handholding instruments represented in the Ecoprofit club are not of interest to them. We hypothesize that beyond mere resource constraints, these SMEs follow a network configuration (a term describing the scope and intensity of interorganizational relationships between a focal company and other partners) of a "manufacturer" which focuses on direct value chain partnerships (Gemünden et al. 1996) rather than cooperation with more distant players (for example companies from other sectors as represented in the club; also: universities) as sources of innovation.

A related concept, absorptive capacity, can provide further explanations. It is broadly defined as the ability of a firm to recognize, assimilate, and apply new outside knowledge to innovate (Cohen and Levinthal 1990). Given the SME context of our case analysis, we understand absorptive capacity as a dynamic capability (Zahara and George 2002) which reveals itself not primarily in R&D expenditure as originally operationalized by Cohen and Levinthal (1990), but rather as a

> *"firm's ability to utilize externally held knowledge through three sequential processes: (1) recognizing and understanding potentially valuable new knowledge outside the firm through exploratory learning, (2) assimilating valuable new knowledge through transformative learning, and (3) using the assimilated learning to create new knowledge and commercial exploitative learning." (Lane et al. 2006: 856).*

Absorptive capacity is also domain-specific. Thus, based on Zahara and George (2002) we analyzed absorptive capacity in the context of eco-innovations in SMEs in terms of how eco-related knowledge is *acquired and assimilated* (potential absorptive capacity: levels of handholding and alternative knowledge sources to Ecoprofit) as well as *transformed and exploited* (realized absorptive capacity: eco-innovations during and after Ecoprofit participation).

Generally, SMEs – particularly when stemming from traditional industries – are said to have limited absorptive capacity (Spithoven et al. 2011) which we also see in these reactive SMEs as they largely remain disconnected from many of the outside knowledge sources. One explanation is that absorptive capacity is path-dependent and affects "expectation formation" (Cohen and Levinthal 1990). Accordingly, missing prior experience in the domain of environmental management can constrain the SME's capacity to determine the usefulness of new external eco-related knowledge and thus inhibit learning opportunities. Against this background, absorptive capacity might also explain why an SME may consider the diversity

of actors (and knowledge) found in a cross-industry knowledge interchange network (such as the Ecoprofit club) as a weakness rather than an opportunity for innovation. Overall, reactive SMEs risk to become "locked-out" (Cohen and Levinthal 1990), a situation in which an organization lacks the necessary prior knowledge to recognize and utilize further important external knowledge.

Consistent with the argument that reactive SMEs lack the capacity to absorb diverse external knowledge, these SMEs call for more sector-specific handholding mechanisms, for example, by *professional or trade associations (but also by local chambers of industry and commerce) (and/or handicrafts).* Prior literature has also identified strongly customized handholding as important for some SMEs (Friedman and Miles 2002) as well as trade associations as important players for stimulating SMEs (Bianchi and Noci 1998; Pittaway et al. 2004). This has two reasons: first, as Parker, Redmond and Simpson's (2009) find, reactive SMEs are better approached indirectly through parties with which they already have built trust. Second, sector-specific preparation of eco-related knowledge enables SMEs with low absorptive capacity to more easily evaluate and absorb it. To this end, a PPP design for reactive SMEs may consider ways to cooperate with more traditional sources of knowledge:

> *"In [specific region] the 'environmental club', the oldest club of the local chambers of commerce in the city, has a long tradition. In [the specific region] the project partners, that is local chambers of commerce, the city and our consultancy, developed a concept, that integrated this environmental club [local chambers of commerce club] into the Ecoprofit club in the form of two joint, cost free events. This is the right way, instead of competing events this kind of cooperation show the companies that we aim to create synergies [between initiatives]."(CO4/5).*

Based on our findings, we are able to put forward our first propositions:

Proposition 1-a: *To stimulate eco-innovation in reactive SME types with low absorptive capacities sector-specific preparation of eco-related knowledge may be fruitful.*

Proposition 1-b*: To effect sustained change in reactive SMEs with limited absorptive capacity, diffusion-oriented programs could cooperate with professional associations and local chambers of commerce (or handicraft) to enable sector-specific capability building.*

Proposition 1-c: *If diffusion-oriented programs include different phases that lead from more agent-assisted (for example consulting) to more peer-assisted handholding mechanisms (for example clubs), the earlier phases may consider to provide sufficient support and time for the SMEs to build up the necessary level of absorptive capacity for the later more strongly peer-assisted phase.*

7. CREATING AND SUPPORTING ANTICIPATORY STRATEGIES

In this chapter, the first two sections describe the two cases of SMEs with an *anticipatory* green strategy. The third section than discusses these partial results.

7.1 Case 3

Regional setting. The local authority has offered the beginner program since 2001, introduced Ecoprofit club in 2003, and now also offers a reduced version of the beginner program for small and micro companies. The local authority introduced the program to support the local Agenda 21 process (that is the local implementation of United Nations action plan for developing regions in a sustainable way), and is financially supported through the federal state. The local authority is active within the Ecoprofit network Germany, now actively cooperates with another municipality to stabilize the Ecoprofit program, and is planning a sector-specific version of Ecoprofit. Beyond Ecoprofit, the region pro-actively informs Ecoprofit participants of other regional sustainability initiatives, provides additional information services, and cooperates with the environmental network of the local trade association within the Ecoprofit club program. However, the region has difficulties to attract new companies to the program, as a range of new networks and initiatives compete with Ecoprofit for the same target group. To this end, the region increasingly looks for innovative ways to cooperate with the trade associations to attract new companies to the program. Overall, the local authority provides a supportive setting with a medium degree of proactivity.

Company EN3. Company EN3 operates in a competitive market, is family run, has 65 employees, and targets regional and to a lesser extent national industrial business customers. Its central technological competency lies within special purpose machinery manufacturing (for example antifriction bearing or CNC-grinding). Its major competitive advantages are its technological competency and strong service orientation. In its sustainability understanding EN3 focuses in particular on eco-efficiency.

Effects of the beginner program. With an initially reactive stance towards environmental improvement, company EN3 was prompted by its local authority to take part in Ecoprofit, and did so successfully in 2002/2003. Its most innovative measure within the program was to “dry out abrasive slurry” which led to direct economic benefits. This external stimulus led to the insight that the program could drive image with main customers and that in hindsight Ecoprofit *“was only the first step to deal with the topic* [eco-innovation] *and then to deduce measures which can also be turned into a competitive advantage” (EN3)*. The established environmental team exists of four staff members and is supported directly by the owner-manager.

After Ecoprofit participation, EN3 has continued to improve its environmental performance through process optimization (in particular, to reduce resource usage). According to the owner-manager a third party external consultant (that is not the Ecoprofit consultant) is requested twice a month to support EN3 with regard to environmental protection, quality control, and occupational health and safety:

> *"[…] We buy these external resources [consultant] but thereby we get an objective consultation through the external perspective and expertise. […] Thereby I, and my team [environmental team] don't only get pointed to new possibilities, but get external pressure to continue with the implementation [of environmental measures]." (EN3)*

Recommended by the external consultant EN3 took also part in a specific ecological water management project promoted by the KfW bank (Germany's state-owned development bank).

According to the Ecoprofit consultant, the existence of such initiatives comparable with Ecoprofit are also a challenge, as sometimes SMEs are confused by the diverse offers:

> *"In the last few years a range of new networks and initiatives have been installed that are competing with the idea of Ecoprofit. […] As they all aim for the same target group this surplus of opportunities increasingly confuses the companies. This […] is particularly true for SMEs that find it increasingly difficult to find the adequate initiative given their limited resources [time and personnel]." (CO3)*

Relevance of the Ecoprofit club program. EN3 generally attributes clubs and other networks a major role, but states that overall there is too little time to get involved in them: *"I'm sure there are many ideas you could follow, but at the end of the day I don't have the time to engage further."* This is also reflected by the local authority: *"the overall participation [in the club] is declining. […] It is difficult to involve SMEs. Only a few come into it, it is more the big businesses" (LA3)*.

7.2 Case 4

Regional setting. The regional environmental agency has offered the beginner program since 2000, now offers a reduced version of it for smaller companies, and has been offering the Ecoprofit club since 2002/2003. Ecoprofit is now one central part of a set of diffusion-oriented programs also covering an initiative for active climate protection and another more sector-specific program on environmental issues. According to the local authority Ecoprofit has remained a high profile program receiving the highest public funding of programs managed by the local authority. To secure the future success of the program the local authority cooperates with training centers, the chambers of commerce and handicraft, and is part of the Ecoprofit network Germany. It registers all companies which are or were actively involved in any of the programs to keep them informed about current sustainability issues and other regional programs and initiatives. Overall, the local authority manages the Ecoprofit program with a high level of proactivity.

Company EN4. This company is a family run business coming into its third generation. With 45 employees it is the smallest company in our sample. The company focuses on national industrial business partners. It manufactures cutting tools and is equipped with innovative CNC-, grinding-, and measuring technology. Its main competitive advantages are its service orientation and its highly skilled personnel for which the company is regularly receiving awards of professional excellence. The owner-manager was stimulated by the local authority to participate: *"I was motivated really through an external hint from the city where we were*

contacted personally to get involved" (EN4). In its environmental sustainability understanding, EN4 focuses on eco-efficiency.

Effects of the beginner program. The beginner program was successfully completed in 2001, with measures such as cutting fluids, improvement of the lighting system, and reduction of noise pollution. These were directly related to monetary benefits, reduction of the energy consumption, and improved waste and water management. However, one of the owner-managers criticized the diversity amongst participating companies which didn't allow for synergies:

> *"The companies were so diverse – from a hospital to a bakery – that there were hardly any synergies. An exchange between companies from the same sector would have been really good, then we could have asked the right questions." (EN4)*

After Ecoprofit participation, the environmental team grew to two members, which are actually the two owner-managers (father and son). Some years after the beginner program, more responsibility was allocated to the son for developing an internal database with eco-indicators and for moving towards certification of the quality standard ISO 9001 (begun in 2003):

> *"In 2010 we decided to intensify the environmental management. Questions to do with the environment are since then given a higher priority and to deal with measures has then risen from about 5-10% to 40%. My son is since responsible for this and is responsible for the integration of eco-indicators into the quality management system" (OM, EN4).*

Relevance of the Ecoprofit club program. EN4 decided to focus on further implementation of the ISO management system and thus they felt that there was no free time for participation in the club and for dealing with the ideas potentially derived from there. Beyond time constraints, the owner-managers missed the sector-specificity of the offer. The little interest exhibited by SMEs to get involved in networks such as the Ecoprofit club is also reflected by the local authority acknowledging that *"for such small companies it is just too much to participate in the club" (LA4)*.

Instead, EN4 decided to become part of another region-wide, publicly supported environmental initiative (promoted by the Regional State Ministry of the Environment and Public Health of Bavaria) in which they have participated for over 10 years. This program ensures that companies monitor their environmental improvement regularly through a standardized questionnaire. On the condition of made improvements, the company is awarded with the initiative's label, which they may use for image purposes.

7.3 Summary and Discussion of Cases with Anticipatory SMEs

In summary, the prior two cases presented are characterized by a medium to high degree of pro-activity of the public partner which led to Ecoprofit participation of SMEs in the first place. With reference to Noci and Verganti (1999), both companies make available

resources and competencies for eco-innovation, invest in key competencies to develop internal competencies and engage in minor networking.

However, the SMEs not solely rely on Ecoprofit offers: despite continued activity of the region by offering the club after the beginner program, the SMEs, after participating in the Ecoprofit beginner program, have tapped into alternative sources of knowledge in the form of other initiatives offered by third parties.

Our findings suggest that like reactive SMEs, anticipatory SMEs need sector specific support, and thus value trade associations highly. Thus, local authorities continue to look for agent-assisted handholding, as provided in the Ecoprofit beginner program, which is, next to a lack of sector-specificity, not found within the Ecoprofit club.

In contrast to reactive SMEs, anticipatory SMEs are able to absorb knowledge from various – if still limited – external sources (that is alternative environmental initiatives and external consultancies). This is, in part, explainable – and in clear contrast to reactive SMEs – given the direct involvement and dominant role of the owner-manager (Bos-Brouwers 2010; Jenkins 2009). Anticipatory SMEs also work on further organizational integration of initial results from the beginner program (for example through managements systems and standards implementation), and thus develop organizational capability for eco-innovation. In other words, they move from specific process eco-innovation to organizational innovations (Rennings et al. 2006).

Anticipatory SMEs have managed to acquire some level of (potential) absorptive capacity as their scope of search for knowledge (Zahra and George 2002) is relatively larger in that they identify and absorb knowledge from various sources. Still, our findings also suggest that the existence of various related initiatives that compete with Ecoprofit can be a challenge. SMEs' resource scarcity does not always allow for participation in various initiatives in the long-term. SMEs may be confused as to which initiative they are best served with and fall back into reactive pattern. Thus, the local authorities are challenged to create synergies between competing initiatives, as already discussed with regard to reactive SMEs. In light of this discussion we propose:

Proposition 2-a: *In order to alleviate effective resource allocation and guarantee long-term participation of SMEs, the public partner in a PPP is challenged to define its role within a set of competing sustainability initiatives and variety of knowledge-sources and to this end create synergies through collaboration with them.*

Proposition 2-b: *As anticipatory SMEs may exhibit a medium level of absorptive capacity and thus cannot deal with a high degree of knowledge diversity, a PPP's club-program may need a higher degree of either sector- or issue-specificity.*

8. EFFECTIVE PARTNERING TO SUPPORT INNOVATION-BASED STRATEGIES

In this chapter the detailed case of the SMEs with the most proactive strategy, and the setting it is embedded in, is presented and discussed.

8.1 Case 5

Regional setting. The local authority's motivation to offer Ecoprofit was related to the need of integrating the local economy better into the process of the local agenda 21. The local authority has offered the beginner program since 2000 and has been offering the Ecoprofit club since 2002 with a varying membership of 12 to 25 companies. In 2011 the active club members were awarded for their 10-year participation, of which one was the SME analyzed within this case. Since Ecoprofit initiation, over 160 certifications (including recertification through the club) in 63 companies were counted. The region is also recognized as a "Centre of Competence for Ecoprofit" (City of Munich 2008). The greatest challenge for this region remains the acquisition of new companies that are not already committed to environmental protection (that is SMEs with a reactive strategy).

To improve Ecoprofit, the local authority is active within the Ecoprofit network Germany, pushes the club idea, and works to develop new modules to address broader sustainability ("From Ecoprofit to sustainability management"). In addition to the Ecoprofit club, together with a neighboring municipality the local authority offers a regular program to discuss broader sustainability issues. Overall, the local authority provides a supportive, pro-active, and innovative setting and is able to maintain a functioning Ecoprofit club.

Company EN5. EN5 is a family run business coming into its fourth generation, has 100 employees, and operates within a competitive regional market. Its core business lies within steel and metal manufacturing (for example steel constructions for halls, roof tops, veneers) and selected products for interior fitting. A minor area of business is the manufacturing of substructures for photovoltaic systems. Its main competitive advantages are its service orientation and technological innovativeness. It has a clear entrepreneurial orientation towards the environment:

> *"Really, we [the two owner-managers] have been environmentally oriented for a long time, primarily due to personal reasons. We are two leaders, my brother and I. We have made it our goal to make the company as green as possible" (EN5, OM).*

Effects of the beginner program. EN5 completed the beginner program in 2001 with its most innovative measures being continuous monitoring of energy consumption and waste management, the installation of a photovoltaic system, and reconstruction of mixing taps. These measures led to direct monetary benefits. After the beginner program, EN5 continues to monitor a range of eco-indicators. Beyond Ecoprofit, EN5 is also involved in citizenship projects within its community for which it received an award in 2009 from the federal state for its exceptional societal commitment. Since Ecoprofit participation in 2001, EN5 has installed an environmental team with two staff members and one owner-manager.

Relevance of the Ecoprofit club program. The Ecoprofit club in this regional setting consists of four workshops per year and two on-site visits within one year. EN5 has participated in the club since 2001 with at least two members of the environmental team. The owner-manager finds that the Ecoprofit club helps to identify new sustainability issues allows to exchange ideas with companies, benefit from other company's experience with risks and benefits of new eco-innovation measures. Overall he thinks that the network ensures a continuous learning process for sustainability:

> *"Overall networks [in a general sense] are useful, not only in the sense of purchasing networks […]. For example, the trade association plays a major role and networks like Ecoprofit [Ecoprofit club] I really support […]. Really because through day to day business you don't get to the core of many things; but if you are in a network [like the Ecoprofit club] , you have to take the time to participate and then you get new ideas" (EN5).*

The heterogeneity of the club members is seen as a benefit by the owner-manager*:*

> *"A sector specific club might have some advantages [for example talk about similar problems] but through the diversity [given by the multi-sector approach] there are actually new ideas." (EN5)*

Another concrete effect of the participation in the Ecoprofit club is seen in strengthening company image and expanding the business network. As EN5 actively seeks out new opportunities for green product development, the club is seen as one source of inspiration and expansion of this new business field:

> *"Yes, we are very interested in this [continue to expand the area of green technologies] and through Ecoprofit [club] we are able to expand out contacts." (EN5)*

8.2 Summary and Discussion of Innovation-based SMEs

In summary, EN5 is is moving towards an innovation-based strategic pattern in that it is well aware and continuously monitors (through for example eco indicators) its environmental performance and actively seeks out various sources of knowledge. It bases the development of key competencies for eco-innovation on partnership and networking. Furthermore, EN5 has gained some experience as supplier of green technologies and uses its network infrastructure to actively build capabilities and expand its green business area. It is dedicated to its green image, though it is not strongly communicated (see Noci and Verganti 1999).

In this last case, the local authority shows the highest degree of pro-activity measured by all potential factors: the club program is pushed through the authority; collaboration with other municipalities is sought; and a customized program for micro businesses is offered. With its award for long-term membership in the club program, this case shows that awards can lead to "a focal point for new interest" and to maintained motivation (Friedman and Miles 2002: 337). Overall, the local authority can thus be considered as a very innovative public partner.

In this case, the SMEs seek out new sustainability topics beyond eco-efficiency (e.g. electric car fleet) pro-actively, works on them in a self-driven manner, and aims to translate them into a competitive advantage. To this end, the company makes significant resources and competencies available (i.e. owner-manager involvement in three-heads strong environmental team). In contrast to conventional statements (e.g. Del Brio and Junquera 2003), this finding suggest that even in medium-sized companies significant formal structures for environmental management can be established, if it is considered strategically relevant.

Innovation-based SMEs have the strongest ability to seek and absorb external knowledge. Beyond the earlier mentioned channels also entertained by anticipatory SMEs (trade associations, alternative environmental initiatives), innovation-based SMEs additionally make use of the Ecoprofit club. Networking, in the form of Ecoprofit club participation is appreciated for the opportunity to have access to a high diversity of partners from various sectors and backgrounds. This is important as "the diversity of alternatives that are generated in problem solving is constrained by the similarity of the actors" (Boons and Berends 2001). The Ecoprofit club is also rather unstructured and the participants need to steer the agenda themselves rather than being told what to do. Together this facilitates generation of new ideas, to stay ahead of changes, and to ensure learning for sustainability in the long term. In order to successfully acquire and transform this diverse knowledge, the SME already needs a sufficient "prior related knowledge and diversity of background" (Cohen and Levinthal 1990), which as our findings indicate, is not to be expected from more reactive SMEs. As innovation-based SMEs seem to benefit from the Ecoprofit club we can hypothesize that they have the highest level of *potential* absorptive capacity (Zahra and George 2002). This leads to the following propositions:

Proposition 3-a: *Cross-sector clubs are characterized with a rather open structure and a large diversity of actors which leads to a high degree of knowledge diversity; for this to be acquired and assimilated, SMEs require very high levels of absorptive capacity most likely available with innovation-based SMEs.*

Proposition 3-b: *Public partners may be more successful in acquiring a critical mass for club offers when sufficient innovation-based (and maybe advanced anticipatory) SMEs are stimulated to participate.*

This external knowledge seeking from diverse partners, including the government, consultants, associations, and various sustainability initiatives, makes innovation-based SMEs come closest to a network configuration called a "spider" (Gemünden et al. 1996), which is an optimal configuration for successful process and product innovation. Interestingly, the innovation-based SME – with a rather average SME size (100 employees) – also indicates that the resource constraints argument and, more specifically, the company size is not a major factor for the choice of a green strategy (Noci and Verganti 1999).

Like anticipatory SMEs, innovation-based SMEs are not limited to eco-efficient innovations but also deals with other sustainability issues. This demonstrates that for innovation-based SMEs the initial focus on eco-efficiency (that is profit raising environmental measures)

becomes too narrow in the long term. As internal documents from the Ecoprofit network Germany reveal, there are already attempts to further develop the program, and thereby address broader sustainability goals. As one of the Ecoprofit consultants explains, the beginner program serves to attract companies to the program, through quick realization of economic benefits, whereas the Ecoprofit club aims to support companies to develop a long-term strategy for sustainability. Therefore, the club deals with:

> *"Here [in the club], we deal with topics such as an environmental program, management instruments, environmental legislation, and other cross-section issues, that enable companies to reorient themselves." (CO3)*

This is, in part, explained through a general shift in the company's attitude towards sustainability:

> *"Increasingly companies are motivated to participate because they want to contribute to sustainable development. To take responsibility for future generations is a motivation that was not heard of 10 years ago. In this, I see a change of culture in that the societal role of companies and the self-perception of companies is increasingly changed." (CO3)*

In the light of the above discussion, we propose the following:

Proposition 3-c: *PPPs for diffusion of eco-innovation are challenged to continuously integrate new sustainability topics in order to stimulate the participation of anticipatory and innovation-based SMEs.*

9. CONCEPTUAL IMPLICATIONS FOR PPPS TO DIFFUSE ECO-INNOVATION IN SMES

Our paper suggests, in line with Noci and Verganti (1999), that SMEs may follow three green strategies (reactive, anticipatory, innovation-based) and that SME size is ancillary for environmental behavior (cf. Powell 1996). Moreover, we argue that an SME's level of absorptive capacity influences the innovation strategy in that reactive, anticipatory and innovation-based SMEs will deal with external knowledge acquisition differently. Accordingly, they may adopt different knowledge acquisition paths and thus require different levels of handholding. Consequently, the success of the PPP does not merely rely on the provision of the most advanced handholding instruments (e.g. clubs), but in ensuring the "fit of instruments" to the encountered SME type. This reflects earlier findings saying that support programs must be tailored to the SMEs' strategic posture and to the learning styles of the owner manager (Parker, Redmond and Simpson 2009).

In this context, we further argue that within the PPP, it is both the behavior of the private actor (i.e. SME) and public actor (i.e. local authority) that play a crucial role for the effectiveness of the diffusion of eco-innovation. This goes beyond findings of Friedman and Miles (2002) which determine "degree of handholding" of intermediaries based on the *variety (or absolute number)* of handholding instruments offered. We suggest that the public partner is also subject to the different patterns of pro-activity which can be related to the three green strategies proposed by Noci and Verganti (1999). A public partner's *reactive strategy* focuses more strongly on agent-based handholding which may be most beneficial to reactive SMEs. *Anticipatory* public partners more strongly customize programs (e.g. to small/micro firms), create new programs with broader sustainability goals, and try to coordinate competing initiatives. Finally, *innovation based* public partners are able to tailor handholding to *all* three strategic postures SMEs may hold and, for this, also successfully design and maintain a club offer. Based on these thoughts, we put forward a two-dimensional typology of strategic patterns of environmental behavior in a PPP (Table 5).

- The diagonal line responds to the cases where strategic patterns of both SME and local authority match very closely.
- The upper right corner describes a situation where the local authority is more pro-active than the SME, and thus has a significant role in "stimulating the SME" but has not yet led the SME to advance to the subsequent strategic pattern. In the extreme (top upper left position), we call this 'whistling in the wind' as the efforts of the public actor more or less crepitates, as a reactive SMEs may simply value it only to a limited degree.
- Combinations in the lower left quadrant (SME driving the PPP) remain unobserved in our cases, but not utterly surprising given that PPPs are intended to address "less proactive" firms with an external stimuli in the first place. Thus, it would be unusual if the SME rather than the public actor were to "take over the driving seat".

Table 5: Typology of interacting behavioral patterns of SMEs and the public partner

Strategic pattern of SMEs	**Strategic pattern of local authority**		
	Reactive	Anticipatory	Innovation-based
Reactive	Maintaining the status quo (EN1)	Stimulating the SME (EN2)	(Whistling in the wind)
Anticipatory		Making progress in a joint effort (EN3)	Stimulating the SME (EN4)
Innovation-based	(Taking over the PPP's driving seat)		Jointly transforming the industry (EN5)

10. CONCLUSION

Eco-innovation in the context of SMEs, on the hand, is influenced by advantageous and disadvantageous characteristics, and, on the other, determined by different strategic patterns. To effectively diffuse eco-innovation amongst SMEs, one means are soft regulation instruments such as diffusion oriented PPP programs that provide agent- and peer-assisted handholding. However, given different levels of absorptive capacity for different strategic eco-innovation patterns, the levels of handholding may need to be adjusted accordingly to better accommodate to the specificities of eco-innovation in SMEs. Moreover, in PPPs both the public and private partner may exhibit different levels of innovation strategies, which in turn may influence the diffusion of eco-innovation and, more importantly, the long term effects of the PPP. In conclusion, we can put forward some implications for public policies and more specifically diffusion-oriented program design. For *reactive* SMEs we propose a concentration on agent-assisted handholding, and higher level of sector-specificity. Here, trade associations, in particular, and to some extent chambers of commerce may be fruitful partners. As *anticipatory* SMEs actively seek out other sustainability initiatives, however, in due time may be exhausted in their resources to maintain oversight given the diversity of existing initiatives, it is important that policy makers ensure “bridge building” between public initiatives. *Innovation-based* SMEs are able to benefit from peer-assisted handholding mechanism, that is networks in the form of clubs. But these SMEs, may require a more advanced program content, that is beyond eco-efficiency. Program development and inclusion of broader sustainability initiatives is a promising step.

This study is limited in various ways. Given the small sample size and case study approach, the drawn conclusions are not generalizable. As the interview data of the companies is limited to high-level corporate officers, we are aware that there may be a bias in terms of symbolic statements that may not represent the actual situation. Moreover, we interviewed only one SME per initiative, for future research it may also be interesting to compare SME behavior within the same initiative.

For future research, we suggest to study in more detail the interactions between our identified patterns of SMEs and public actors. Some of interesting research questions could be: What is the actual role of innovation-based SMEs in the PPP? How does the SME’s pattern influence the pattern of the public actor? What happens in extreme cases where patterns of both actors are in stark contrast to each other (whistling the wind; taking over the driving seat)?

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