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Innovation Contests for Sustainability-Oriented Product Innovation

Findings from a Worldwide Shoe Innovation Contest

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1. INTRODUCTION

Companies have been increasingly pressured by new regulatory regimes and stakeholders to transcend the focus on economic and technological innovations and to address more environmental-friendly and socially-desirable products and services (Horte and Halila, 2008; Roth, 2009; Sharma and Starik, 2004), i.e. to engage in sustainability-oriented innovation (Hansen et al., 2009; Wagner, 2009). Moreover, companies have realised that sustainability-oriented innovation (SOI) can be a key to opening new markets and opportunities. Hart and other researchers have found that the capability to develop sustainability-oriented products and services is a source of competitive advantage (Hart, 1995; Lam et al., 2005).

Environmental innovation (or briefly “eco innovation”) is a subtype of sustainability-oriented innovation, directly addressing some of the most pressing issues such as climate change, and environmental degradation (Rennings, 2000). The impact of eco-innovation depends on two main factors: First, the *degree of eco-radicality;* this determines the impact on the environment (Brezet & van Hemel, 1997). Second, the *degree of (conventional) innovativeness*; this influences the diffusion processes and, thus, whether the eco invention indeed turns into an innovation. Overall, eco-innovation – as well as sustainability-oriented innovation more broadly, has greater risk as it deals with environmental impact in addition to conventional success measures such as market success.

Firms and, more specific, research and development (R&D) departments, have limited knowledge on existing sustainability-related issues, and limited internal capabilities in tackling these effectively. Accordingly, firms have shown increasing interest in collaboration with external (expert) stakeholders when addressing SOIs. For example, companies collaborate with non-governmental organisations (NGOs) to develop environmental-friendlier products (e.g., Holmes and Moir, 2007; Holmes and Smart, 2009). However, these focused partnerships have been found insufficient when organisations strive to involve broader groups and larger quantities of stakeholders. Recent years have seen a development of *applications* particularly suitable to support this opening of the innovation process and integrate diverse stakeholders (Wagner, 2009). Among these applications to address broad diverse and distributed knowledge from external (and also internal) experts are *innovation contests* (e.g., Bullinger et al., 2010; Leimeister et al. 2009; Piller and Walcher, 2006).

Given the surge of practical realisations of innovation contests during the last years, it is surprising that only a small set of empirical studies exist that look at the potential of innovation contests for SOIs. One major study by Halila and Horte (2006) is in a public/national context and thus limited when it comes to implications for firms. Horte and Halila (2008) extend the previous study and compare eco innovation contests with non-eco contests. They focus mainly on the differences in the innovators’ characteristics. Hansen et al. (2010) look into a crowdsourcing approach for innovative services in the field of SOI. As this approach has no competitive elements integrated, implications for innovation contests are restricted. Roth (2009) also introduces an crowdsourcing-based innovation contest in the context of sustainability, however, focuses on the social dimensions rather than environmental. Against this background, our research addresses the following question: *Are* *innovation contests suitable to generate SOIs and if so, which is the degree of innovativeness in conventional and ecological terms?*

Based on a case study of a major European innovation contest in the shoe industry, we derive a two-dimensional classification system using an environmental and conventional innovativeness dimension ("Eco Impact-Innovativeness Grid). On this basis, we derive a typology with four types of innovations for which we suggest specific implications for practice.

The reminder of this paper is structured as follows: first, the literature review introduces environmental innovation, classification systems of innovativeness and innovation contests. Second, our case study research approach is elaborated. Subsequently, we present the empirical results from a major European innovation contest in the shoe industry and present a classification system for innovations. Finally, we discuss findings and present a brief conclusion.

Background

In the present chapter, we use extant literature to introduce sustainability and environmental innovation, environmental innovation classification systems and innovation contests. Each aspect is dealt with in one of the following sections.

1.1 Corporate sustainability and eco innovation

SOI has been identified as important normative strategy to address some of the global non-market challenges (e.g. climate change, poverty, intragenerational justice). SOI can be considered a new way of thinking about innovation which includes a set of additional criteria. In the present paper, we focus on *eco innovation* (Rennings, 2000) as a specific subtype of SOI. Eco innovations can either address societal challenges directly by developing radical new technologies (e.g. clean technologies, renewable energies). Eco-innovation can also target the reduction of negative impacts of conventional products (e.g. eco-friendlier materials in products), in the sense of Hart's 'product stewardship' (Hart, 1995). In either case, two dimensions are important to judge the eco-benefits of innovations: *life-cycle* and *innovation type* (Hansen et al., 2009).

Physical life-cycle and life-cycle assessment (Kloeppfer, 2008) ensure that evaluation of eco-impact is done holistically by assessing impacts in all phases of the life-cycle from resource extraction to end-of-life. Along the life-cycle, eco innovation can be addressed using three basic strategies (Fichter, 2006; Hart, 1995; Schaltegger et al., 2009): *(eco-)efficiency*, *consistency*, and *sufficiency*. *Efficiency* is a relative measure of desired output divided by environmental outputs (waste, energy consumption, resource use). In the long-term, efficiency alone is not sufficient to achieve sustainability, as *rebound effects* overcompensate for efficiency gains (Greening et al, 2000). *Consistency* deals with industrial ecology with the aim to use harmless materials and sources of energy and closed-loop value chains ("from cradle-to-cradle"). Thus, consistency does not target for reduction, but for a change in quality. The third strategy, *sufficiency,* aims at "having enough" and thus intends to change consumer behaviour. Next to reduced overall consumption levels at the consumers' side, firms can facilitate sufficiency by transcending mere product provision to provide more service-intense products, product-service systems (PSS) and full service business models (Mont, 2006; Hansen, 2009). Examples cover after sales repair services; performance leasing; shared use; and entirely dematerialised products such as a virtual voice box at the side of the telecom provider. Increased service content can increase the lifetime of products, reduce waste and cut the number of (aggregated) products necessary.

In order to address efficiency, consistency and sufficiency holistically, innovation needs to go beyond the technological level and consider also other *innovation types*. An out-of-the-box thinking in *functions* is necessary (Fichter, 2006; Mont, 2006). Instead of focusing on specific products/technologies (e.g. cars), thinking about best provision of the overarching function (e.g. mobility provided through car sharing). *Function efficiency* then also allows to devise new products based on the *integration of functions* (Charter and Tischner, 2001; Fichter, 2006).

Functional innovation is often dependent on *socio-technical systems change* (Geels, 2005), as a change of the following aspects is necessary: user behaviour, institutions and regulatory policies. Consider for example the shift from private cars to car sharing where users' flexibility decreases and amount of pre-ride planning increases (Hansen et al., 2010). Even bigger socio-technical systems changes are necessary when, for instance, changing the energy system or the mobility system at large (Geels, 2005).

1.2 Degree of innovativeness

The degree of innovativeness can be both related to newness and to eco impact, as will be explained in the following subsections.

1.2.1 Innovativeness in a conventional sense

In the new product development (NPD) literature, the degree of innovativeness usually relates to the *degree of novelty*, which in turn depends on *to whom* it is *new*. As Garcia and Calantone (2002) show in their review of roughly 20 years of research, the *who* can relate to anything from macro to more micro: the world; the industry; a scientific community; the marketplace; the firm; or the customers. Thereby, changes to the world, marketplace or industry are considered *macro*, while the firm or its customers are subsumed as *micro*.

Typologies for the degree of newness are subject to continuous debate amongst researchers and practitioners. Subsuming the most important streams of the discussions, we find that various dichotomous and multi-category typologies have been developed:

- *Two basic classes (dichotomy).* While many of the new products or services only consist of minor changes to existing solutions, i.e. *incremental innovation*, others are totally new, influencing markets or whole industries and helping firms to achieve a sustaining success. As Bessant and Birkinshaw state, this so called *discontinuous innovation* has one main benefit: it takes companies out of the zero-sum game that characterises many industry battlegrounds (Bessant, Birkinshaw and Delbridge, 2004). They require organisations to move into unchartered territory, right from the ideation stage to market introduction.
- *Three classes.* Garcia and Calantone (2002) suggest three major types, *incremental*, *really new*, and *radical*. Radical innovations are only those which are new both on

macro and micro levels as well as which inherit a change in technology *and* marketing, and is thus rarely achieved. In contrast, really new innovations are those which have only either a technology or marketing discontinuity on the macro level, not on both.

- *Five classes.* Altshuller (1988) has proposed a more detailed classification system using five classes (apparent solution, minor improvements, fundamental improvements, new generation solution and rare scientific discovery).

The classification of eco innovations roots in these developments, however, has some specifics, as elaborated next.

1.2.2 Eco innovativeness

In contrast to the conventional understanding of innovativeness as “novelty”, (eco) innovativeness primarily relates to the submission of the innovation to the ecological environment, i.e. the potential eco impact[1] (Brezet, 1997). Based on the classification systems presented above, literature provides modified versions for *eco innovations.* Usually, these cover four to six types of eco innovativeness, ranging from incremental to radical innovations (Brezet, 1997). Whilst the poles of the eco-innovativeness continuum remain comparable to earlier presented models, eco innovation can be classified to a set of specific eco classes. These apply particularly at the more radical end of the continuum (Fichter et al., 2006; Wagner, forthcoming). *Functional innovations* and *system innovation* play a major role for sustainability, as the eco impact (factor 5 and factor 10, respectively) is considered to be considerably higher than in other innovations. Brezet (1997) explicitly takes this consideration into account in his eco innovation categories (product improvement; product redesign; function innovation; system innovation). Halila and Horte (2006) develop an even further detailed classification system with six classes (Table 1).

Table 1 Classification systems for eco-innovativeness (based on Halila and Horte, 2006)

Brezet, 1997 (eco innovation)		Halila and Horte, 2006 (eco-innovation)
Class	Eco-efficiency improvement factor	
Product improvement	2-3	1 Product care
		2 Minor product improvement
Product redesign	max ~5	3 Major product improvement
Function innovation	max ~10	4 Functional innovation
System innovation	max ~20	5 System innovation
		6 Scientific breakthrough

The classification systems in table 1 illustrate again that eco innovativeness classes usually relate to conventional innovativeness classes on the same level (e.g., *functional innovation* and *scientific breakthrough* relate to *really new* and *radical innovations*, respectively). However, this relation is not forcibly bidirectional: to directly link conventional innovativeness to eco innovativeness might be dangerous, as a high degree of innovativeness does not necessarily come with higher eco impact. Not all innovations necessarily have a (positive) environmental impact.

So far, we have introduced specific criteria for eco innovation (life-cycle phases; efficiency, consistency and sufficiency and technological level versus functional level) as well as two general types of classifications systems, one considering innovativeness in conventional terms of "newness" and another one in terms of eco impact. Whilst this has contributed to the understanding of eco innovation in contrast to other innovations, the question remains how the *innovation practices* must look like in order to develop innovations with higher eco impact.

Academia and practice use a set of such practices, in particular to integrate outside innovators into the inside innovation process (Neyer et al., 2009). We argue that this "open innovation" (Chesbrough, 2003) with external stakeholders is key in eco-innovation, as this allows to integrate the "voice of environment" (Hart, 1995). The following section further elaborates this concept.

1.3 Open Innovation and Sustainability Innovation Contests

Traditionally, new product and service development have been the task of the respective organisations. During the last decades, this perception has been broken down due to empirical evidence that in many markets innovation is initiated by customers or users (Franke and Shah, 2003 von Hippel, 1988). Manufacturers can profit from customers' innovative potential by involving them in new product development. In consideration of these outside innovators (Neyer et al. 2009), manufacturers can and should open up their innovation processes and use external ideas and paths to markets as they strive to advance their products and technology (Chesbrough, 2003).

In his seminal paper, Hart (1995) already recognises that integrating the "voice of environment" in product development is also an important means for SOI. In contrast to early studies on open innovation, where more formal stakeholders such as consumers, suppliers, and other partners are at the heart of analysis, eco innovation also integrates informal stakeholders. For example, some companies collaborate with NGOs to develop environmental-friendlier products (e.g., Holmes and Moir, 2007; Holmes and Smart, 2009). Moreover, adversarial stakeholders such as activist and other pressure groups can become a source of knowledge (Sharma and Starik, 2004; Wagner, 2010). This integration of broad and diverse expertise and perspectives supports the identification of environmental aspects. For these purposes, the inside innovation processes must be open and flexible, allowing for the incorporation of outside sources of knowledge and innovation.

Among the open innovation processes used to attract and activate interesting outside innovators are, e.g. lead user method (Lüthje and Herstatt, 2004), toolkits (Franke and Piller, 2004; Hansen et al., 2010; von Hippel, 2001), communities (Füller et al., 2006) or *innovation* *contests* (Bullinger et al. 2010; Piller and Walcher 2006). An innovation contest[2] is a (web-based) competition of innovators who use their skills, experience and creativity to *provide a solution* for a particular contest *challenge* defined by an organiser (Bullinger et al. 2010).

Whilst innovation contests have been mainly organised by companies, as shows the detailed study of Bullinger and colleagues (2010), the authors have also identified a number of non-profit organisers, which frequently address sustainability challenges. Among both, profit and non-profit oriented organisers, the topicality of sustainable innovation is steadily increasing. For instance, *What's your crazy green idea?*[3] (run by the XPrize foundation) and *Google's Project 10 to the 100*[4] strive for solutions that can improve the situation of an individual, a company or an entire society. Halila and Horte (2006; 2008) report of an annual environmental product innovation contest running for seven years from 1998-2004 covering 541 submissions. *Save our Energy*[5], an innovation contest to strengthen energy efficient behaviour of citizens, has been organised with the support of a major European city. A committee of 17 partners from industry (*insiders*) and academia (*outsiders*) jointly organised the innovation contest. The consortium consisted of eight regional partners from industry (e.g. a housing cooperative) and service (e.g. public transportation), and two municipal partners (e.g. responsible for urban planning) and seven university partners (Adamczyk et al. 2010). A total of 308 participants were activated and submitted 163 potential innovations between September and November 2009, out of which four have since been realised.

In order to advance academic knowledge in the field of sustainability innovation contests, we use a case study research approach for investigating their outcomes regarding the relationship between innovativeness and eco impact.

2. RESEARCH APPROACH

To investigate the research question, we conducted a single case study (Yin, 2003) of a major European eco innovation contest in the shoe sector. In the following we present the innovation contest in general and how the data was collected and analysed.

2.1 Research field

The present study was conducted within a large integrated research project funded by the European Commission ("Custom Comfort and Environmental-friendly made shoe" - "CEC-made shoe") that covered over 40 partners from research institutions and industry across Europe. The "CEC Shoe Design Contest" was run between October and December 2007. It has mainly been driven by a major player in the field of fashion, *Hugo Boss*. Designed cross-business, four companies from the area of shoe design, manufacturing and sales supported the focal company during design and implementation of the contest.

The task of the innovation contest was to "Design an innovative 'bio' shoe based on aesthetic trends, authentic materials, cultural values, and regional roots and techniques!" (the term 'bio' relates to organic/environmental friendly in most languages in Europe). A worldwide online marketing campaign in designated fashion and eco forums as well as paper-based measures to attract and activate potential participants started about four months before the contest.

The contest platform included conventional features such as login and personal profiles, submission upload (texts, pictures, documents), commenting and voting. Free access to the innovation contest platform with only minor technical prerequisites (i.e. a computer with access to the Internet) allowed for participation from interested designers with very diverse social, ethnic and cultural backgrounds, forming a powerful innovative flash mob for sustainability.

The network of registered users consists of about 400 members from nearly 50 countries - a geographical overview of participants is given in Figure 1. In total, more than 66 innovative designs (in the following simply referred to 'submission'), and about 500 votings by community members have been cast.

Figure 1 Geographical dispersion of participants and submissions

2.2 Data collection and analysis

Data collection and analysis are characterised by collection of multiple data sets and cross-examination of results in order to reach a detailed and balanced picture. The main source of data considered exists of the submissions and evaluations to the innovation contest. It is examined by the use of a slightly adapted variant of consensual assessment technique (Amabile, 1982), often applied to asses creativity. Calculation intra-class correlation coefficients (ICC) for each evaluation criterion allows to checking inter-rater reliability of jury members as well as of jury and community members.

Further data (activity logfiles of six months, i.e. details of user registrations, submissions, votings and comments; interviews with expert jury; web-based surveys with expert jury and contest participants) was also collected which we used for triangulation and validation, but do not explicitly present it in this paper.

3. RESULTS

Answering our research questions on the suitability of innovation contests to generate eco innovations, we have elaborated three strands of results. First, we present the results of the innovation contest and their assessment concerning the degree of eco impact. Second, the evaluation by experts and community members concerning conventional evaluation criteria is subsumed. Based on both dimensions, in the third strand of results, an eco impact-innovativeness grid is illustrated.

3.1 Evaluation according to eco innovation classes

3.1.1 Assessment approach

We classified each of the 66 submissions using the six eco-innovation classes presented in the background section (product care, minor, major, functional, system, scientific breakthrough). Specific criteria for classification were established based on Halila and Horte (2006) which take into account particularities of the shoe industry (Table 2).

Besides these deductive categories, we inductively identified an additional (sub)category. Some submissions which seem to explicitly address the eco theme, did this only on a superficial level, mostly on the level of the visual design/style, without any potential eco impact. In literature, such symbolic measures have been referred to as "*greenwashing*" (Laufer, 2003; Schaltegger and Burritt, 2010). In contrast to other (non-innovative) examples from the class of "product care", submissions classified as "greenwashing" make false claims and could ultimately mislead consumers' perception. We thus decided to establish a distinct subcategory in order to further analyse the nature of such submissions. The following table introduces our classification system.

Table 2 Criteria for eco classification in the context of the shoe industry

Eco-innovation class (deductive)	Subclass (inductive)	Criteria for classification	Example
1 Product care	a. Standard	All submissions without clear (or contradictory) environmental improvement	Change from one material to another without clear eco impact
	b. "Green washing"	*Submissions that address the environment explicitly, however only on the level of (visual) design, without actual eco benefits*	*Adding green style features visually*
2 Minor product improvement		Applying consistency (substitution of harmful materials) or efficiency (less material) to selected components/materials	Substituting a PVC upper with leather
3 Major product improvement		Apply eco thinking to all components; and/or use innovative eco-materials	A shoe made of 100% bio-degradable materials
4 Functional innovation		Innovations that go beyond a single pair of shoes (e.g., integration of functions; function efficiency through product-service systems)	Create a shoe 'system' that allows for easy parts refurbishment
5 System innovation		Regime transition that requires change in at least three of the following areas: producers, consumer behaviour, regulatory policies, infrastructure	Eco-friendly shoe (system) depending on new types of ground floors in cities/ buildings
6 Scientific breakthrough		4 or 5 which "change the game" on a larger scale, i.e. multiple industries affected	New eco-friendly shoe paradigm

The first two authors independently classified each submission based on the information provided (visual sketches, texts and commentaries) according to the criteria specified in the above table. Where differences in the classification occurred, we discussed these and reclassified them in agreement.

3.1.2 Assessment results

A large majority of the submissions belongs to the category of *product care*, followed by *minor product improvements*. *Major product improvements* and *functional innovation* account to roughly 6 and 7 percent respectively. *System innovation* or *breakthrough innovation* were not discovered (Table 3; see exemplary shoe designs of each category in **Fehler! Verweisquelle konnte nicht gefunden werden.** in the annex).

Table 3 Classification of submissions into eco classes

Eco-innovation class	# (%)	Description of the submissions' eco characteristics
1a Product care	38 (57.6%)	No actual environmental impact recognisable or potential negative impact (e.g. use of PVCs, nylon)
1b Greenwashing	5 (7.6%)	*Explicit link to environment, but only by visual optics:* - imitations of natural material (e.g. artificial feathers)
2 Minor product improvement	14 (21.2%)	*Replacement of most harmful materials (especially PVC and other plastics), whilst partly maintaining conventional materials for the sole/heel (e.g. rubber; metal):* - coloured leather, wool, fur, cotton, silk, horse hair etc. used for the upper and for additional (stylistic) design elements - partly used wood for soles
3 Major product improvement	5 (7.6%)	*Shoes made purely from eco-friendly materials with some additional innovative aspect:* - leather with eco-friendly dye; natural rubber (latex) *Processes:* - design considers disassembling/ recycling - made of single material (removes composite materials; easier recycling etc.)
4 Functional innovation	4 (6.1%)	*Design serves as replacement for otherwise multiple pairs of shoes:* - Convertible shoes ("two in one") - Modular convertible shoe (conversion and partial replacement/refurbishment)
5 System innovation	-	-
6 Scientific breakthrough	-	-
TOTAL	*66 (100%)*	

Next to the prior eco classification, we used the evaluation by expert jury and community members for the conventional evaluation of the submissions.

3.2 Evaluation according to conventional criteria

3.2.1 Assessment approach

Evaluation of the submissions in the innovation contest according to conventional criteria was two-fold: community members cast their votes (on a bipolar scale) *during* the run-time of the contest, the jury of experts evaluated once the contest had been *terminated.* The expert jury consisted of design experts from the five participating companies (one from each organisation).

They evaluated the shoe designs according to five criteria (design, innovativeness, feasibility, task alignment and overall), each assessed on a five-point Likert scale. The understanding of evaluation criteria was deliberately left to the experts' own understanding (Amabile et al., 1996). The community members could vote submissions using a single (overall) criterion on a bipolar scale.

3.2.2 Assessment results

The figure below illustrates the five criteria evaluated by the experts in combination with the aggregated voting of the community members. Community voting was integrated as a sixth criterion if the submission had been voted five or more times.

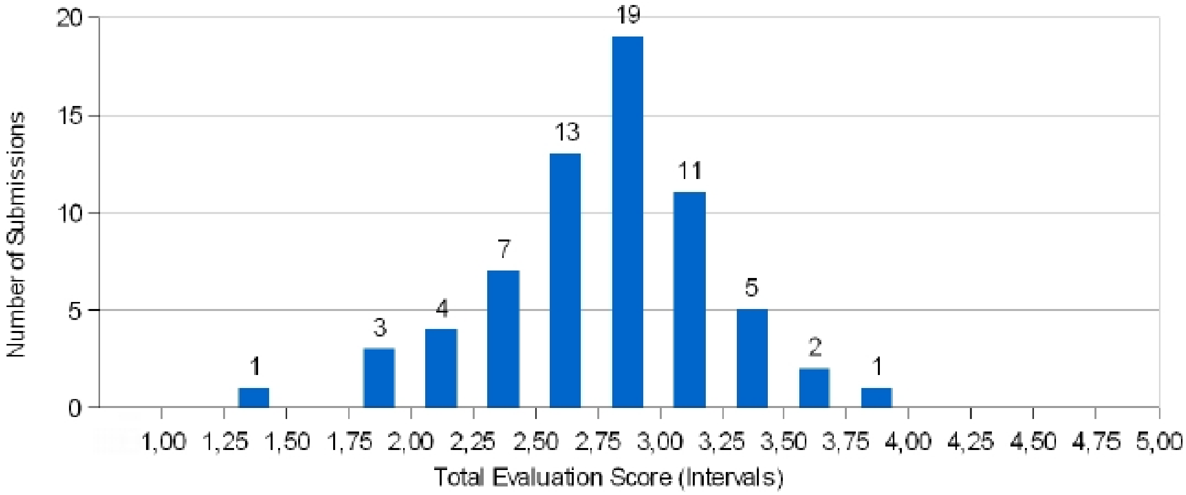

Figure 2 Distribution of the submissions' total evaluation score (intervals)

By a slightly adapted consensual assessment technique (Amabile, 1982), inter-rater reliability (between individual members of the jury of experts) is checked: we calculate intra-class correlation coefficients (ICC; in this case equivalent to Cronbach's alpha). While feasibility is satisfactorily (ICC 0.704), task alignment is only weakly inter-correlated (ICC 0.337). From interview data, the conclusion is drawn that the jurors differ because they had different perceptions of the contest task, in particular with regard to the sustainability aspect. The respective intra-class correlation coefficients concerning the criteria design (ICC 0.642), innovativeness (ICC 0.571) and overall (ICC 0.581) are acceptable. A certain consensus among jury members can hence be approved; the required ICC of 0.7, though, is not reached for *each* of the criteria. Given the small size of the jury, this result is however acceptable.

3.3 Conventional evaluation according to eco innovation classes

In a further step, we analysed the conventional evaluation criteria within the distinct eco innovation classes built earlier (Table 4).

Table 4 Expert jury's classification of submissions according to conventional criteria

Eco-innovation class	# (%)	Experts *(5 criteria)*					Community[1] *(1 criterion)*	Ø *(6 criteria)*
		Innovativeness	Design	Feasibility	Task alignment	Overall	Overall	
1a Product care	38 (57.6%)	2.49	2.92	2.64	2.55	2.62	2.24	2.66
1b Product care - Green washing	5 (7.6%)	2.68	3.20	3.12	2.56	2.84	2.37	2.87
2 Minor product improvement	14 (21.2%)	2.56	3.20	2.80	2.69	2.81	2.65	2.82
3 Major product improvement	5 (7.6%)	3.00	3.48	3.00	2.92	2.96	3.01	3.06
4 Functional innovation	4 (6.1%)	3.15	3.25	3.10	2.85	3.20	3.08	3.10
5 System innovation	-	-	-	-	-	-	-	-
6 Scientific breakthrough	-	-	-	-	-	-	-	-
TOTAL/Average	*66 (100%)*	*2.6*	*3.1*	*2.8*	*2.6*	*2.7*	*2.4*	*2.8*

Results subsumed in the table above lead to the following aspects:

- *"Eco classes and innovativeness"*: Generally, the higher the eco-class, the higher the innovativeness rating by the experts.

[1] Community rating has been integrated if the submission received more than five votes.

- *Green washing*: Though submissions categorised to the green washing class must be technically considered equal to the ones of product care, they receive a better average assessment. They are considered more innovative, to have better design, are more feasible to produce and receive a better overall rating. Still, task alignment is considered unchanged (i.e. experts perceive that through green washing the initial contest task was not better fulfilled than through other submissions in that eco class). The community also perceives the green washing submissions to be slightly better than the rest of the product care class, however surprisingly the community seems to be much more critical than the industry experts.
- *Function innovation limits design*. The functional innovations are clearly considered the most innovative submissions and receive the best overall judgement by the experts as well as by the community. Only concerning the criteria of design, *function innovations* are perceived inferior to submissions classified as *major product improvements*. The attributes built into these submissions (such as conversion/multi use/modularity) seem to have a slightly negative impact on the visual design, in the sense of “form follows function”.
- *Feasibility*: Interestingly, the feasibility score rises the higher the eco class (and innovativeness), except for green washing (for reasons explained above). This could mean that eco innovations are easy to implement, however, such conclusion contradicts the natural expectation that a higher eco class would be more difficult and thus less feasible for development. Analysing each individual submission further, we find that the submissions classified into higher eco classes show a higher sophistication (in the sense of level of detail, complete description etc). Thus, we hypothesise that “feasibility” was simply interpreted as the submissions level of sophistication, and thus the possibility to derive a concrete specification of production from it (consider that the interpretation of evaluation criteria were deliberately left to the experts, as explained earlier), which could be entirely independent from the eco characteristics.

We also analysed the *differences between the expert jury and community members* in evaluating the submissions. For this, we used the aggregated voting of the community members as a ‘virtual jury member’ in another analysis. Based on the averaged jury evaluation score and the averaged community member rating of each submission, inter-rater reliability of 0.695 resulted. Community voting in this sustainability innovation contest is hence – generally – quite in line with the opinion of the professionals. However, differences exist depending on the eco-innovation class, as shown in Table 5 (consider that we primarily focused on the experts’ “overall” criteria in the comparison with community results; further, we executed the comparison also using the experts’ criteria of “innovativeness” and placed these in brackets). Whilst in high eco-innovation classes both groups come to fairly comparable evaluation results, moving towards lower eco-innovation classes differences become stronger. The strongest disagree exists regarding the green washing class.

Table 5 Comparison of expert and community evaluation within eco innovation classes

Eco-innovation class	Expert evaluation	Community evaluation	Comparison: differences of experts vs. Community
	Overall (Innovativeness)	Overall	Overall (innovativeness)
1a Product care	2.62 (2.49)	2.24	0.38 (0.25)
1b Product care - Green washing	2.84 (2.68)	2.37	0.47 (0.31)
2 Minor product improvement	2.81 (2.56)	2.65	0.16 (-0.10)
3 Major product improvement	2.96 (3.0)	3.01	-0.05 (-0.01)
4 Functional innovation	3.20 (3.15)	3.08	0.13 (0.07)
Average	*2.7 (2.6)*	*2.4*	*0.29 (0.15)*

Assessment and classification into both eco innovation classes and conventional innovativeness allow for building a two-dimensional grid, which is developed in the subsequent section.

3.4 The Eco Impact-Innovativeness Grid

The previous analysis has shown that eco-impact classes and (conventional) measures for judging the submissions are strongly related. We now take a closer look on the relation between eco innovativeness and conventional innovativeness with the aim to construct an eco impact-innovativeness grid. For this, we use the eco impact class as the first axis, and the (conventional) innovativeness criteria – as judged by the experts – as the second axis. A graphical representation of the sample, using the criteria of innovativeness on the X-axis (interval scale), and the eco innovation classes on the Y-axis (ordinal scale represented by the class index) is given in Figure 3. It should be mentioned that, for the reasons explained earlier, green washing and product care are located on the same level on the Y-axis (though marked as separate series using different shading).

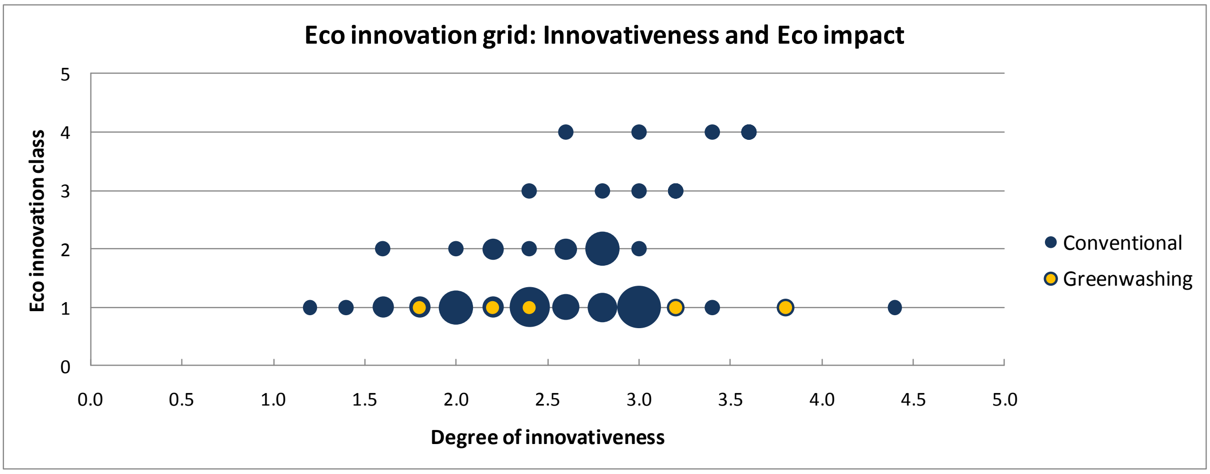

Figure 3 Graphical representation of sample's eco impact and innovativeness *(1=Product care; 2=Minor product improvement;3= Major product improvement; 4=Functional innovation; 5=System innovation)*

In a further step, we used the two dimensions to create four clusters (Table 6).

- We considered eco-innovation classes from product care to minor product improvements (1-2) as "low" and submissions classified as major product improvement or beyond (3-6) as "high".
- For the innovativeness axis, we used the sample's arithmetic mean average score (2.6) as the separator between low and high innovativeness (an additional separation, though not of further relevance to our analysis, has been made at +/-1 units below and above the mean average).

Table 6 Building a typology of eco-innovations by innovativeness and eco-innovation class

Eco innovation class		Innovativeness [#]				
		Low		High		
		[0 - 1.6)	[1.6 - 2.6)	[2.6 - 3.6)	[3.6 - 5.0)	*Sub-total*
Low	1a Product care	2	18	17	1	*38 (57,6%)*
	1b Green washing	-	3	1	1	*5 (7,6%)*
	2 Minor	-	5	9	-	*14 (21,2%)*
High	3 Major	-	1	3	1	*5 (7,6%*
	4 Functional	-	-	3	1	*4 (6,1%)*
	5 System	-	-	-	-	-
	Subtotal	*2 (3%)*	*27 (41%)*	*33 (50%)*	*4 (6%)*	*66 (100%)*

Based on the two-dimensional classification, four clusters were derived:

- *Non-innovation (42.4%):* The many submissions summarised in this cluster are characterised by low innovativeness both regarding eco impact and conventional measures.
- *Conventional innovation (43.9%):* The largest share of the submissions belongs to the cluster characterised by high innovativeness, however, without significant improvement of the eco impact.
- *Niche eco innovation (1.5%):* This cluster is characterised by low innovativeness in conventional terms, however, with high scores concerning the eco impact. Only one submission belongs to this cluster.
- *Mass market eco innovation (12.1%):* A small share of submissions belongs to the cluster characterised by both high innovativeness and eco impact.

Overall, the frequencies of submissions across the four clusters of the eco impact-innovativeness grid show the following: submissions with low eco impact can be both innovative and non-innovative under conventional criteria. In contrast, submissions with a high eco impact (*major product improvement* and beyond) are almost all also considered innovative in conventional terms (except one outlier submission).

4. DISCUSSION

4.1 Eco impact-innovativeness grid (EIIG)

Based on the structure of the eco-efficiency matrix developed by Schaltegger and Sturm (1995), we used our empirical results (especially Table 6) to develop them into an *eco impact-innovativeness grid* (Figure 4). In this discussion, we use the grid to discuss the matter of innovativeness (both conventional and eco), the differences between expert and community evaluation and the implications for subsequent selection processes for the innovation funnel. Finally, limitations are discussed.

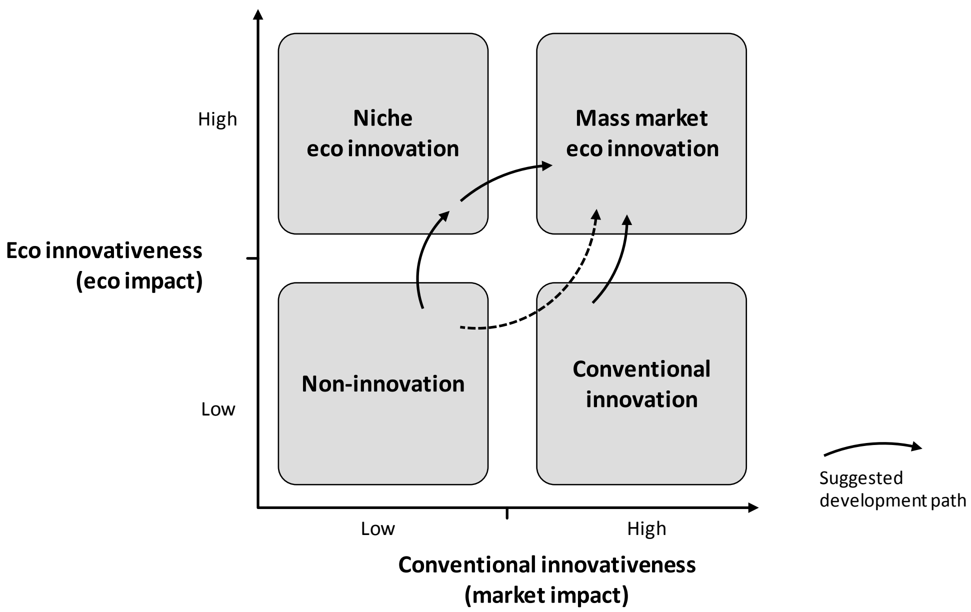

Figure 4 Eco impact-innovativeness grid (EIIG)

4.1.1 Low vs. high innovativeness

Our results contrast findings from prior studies, where a relatively small amount of submissions belong to the *lowest* eco innovation classes. However, prior studies (Halila and Horte, 2006; Horte and Halila, 2008) pre-selected submissions to only include the ones in the final stage of the innovation contests (i.e. removing the ones with lower degrees of eco innovativeness or entirely unfitting submissions).

Moreover, our empirical findings confirm earlier studies finding that innovation contests have *no particular strength for the most radical of form of eco innovation*. As in our study, the study by Halila and Horte (2006) did not identify any submission in the highest two classes of *systems innovation* and *scientific breakthrough*. Considering our finding that higher eco-innovation class often also signifies a higher degree of (conventional) innovativeness, this absence of the most radical eco submissions can also be expected based on findings by Garcia and Calantone (2002) stating that radical innovations are seldom achieved.

Still, important differences exist in the amount of submissions in the class of functional innovations, where we find 6.1% in contrast to Halila and Horte (2006)'s 22%. Probably this difference is due to industry specifics, i.e. we think that it is more difficult to come up with functional innovations for fast moving consumer goods such as shoes than it is for other products or durables.

4.1.2 Innovativeness and sustainability transformation

In the best case, conventional innovativeness and eco innovativeness can be combined – thus a broad acceptance in the mass market can be expected (*mass market eco innovation*). Eco innovations for the mass market are very important as lever for sustainability, as even highly successful innovations in the niche remain with limited overall eco impact (Schaltegger, 2002; Petersen, 2006; Hockerts and Wüstenhagen, 2010).

Though not very common in our results, *niche eco innovation* can also be beneficial for sustainability pioneers. By multiplying such niche firms, significant impacts can be generated on the aggregate level (Wüstenhagen, 1998; Hockerts and Wüstenhagen, 2010).

Probably the largest challenge with regard to sustainability lies in the cluster labelled *conventional innovation* which, in our study, contains a significant amount of submissions. From a normative sustainability perspective, measures have to be taken to (a) increase eco innovativeness (and thus eco impact) and hence to move innovative submissions to the *mass market eco innovation* cluster.

The EIIG has important implications (see arrows in Figure 4) for both the *innovation contest processes* itself (and the subsequent *selection* processes – as will be discussed later). Regarding the s*etup of the innovation contest* the question raises of how to adapt the innovation contest's design elements (Bullinger et al., 2009) in order to nurture submissions on a higher (eco) class? In line with previous publications on innovation contests, we consider *task/topic specificity* and *community functionality* as especially important:

- *Task specificity*. It seems that task specification, i.e. the solution space of an innovation contest (Bullinger et al., 2010) requires detailed elaboration as to what is expected concerning eco innovation in order to motivate participants to think more radically. For example, in another study by Halila and Horte (2006), the task explicitly mentioned that participants could think of innovation both on the product level as well as the functional level.
- *Community functionality*. The challenges of sustainability require radical innovations (UNEP, 2009). Systems and breakthrough innovations require very broad knowledge sources ("everything there is to know"; Altshuller, 1988). We thus hypothesise that such type of innovation requires a collaborative undertaking with a large amount of participants where users can actually work together on the same submission (beyond commenting and alike). The presented innovation contests did not allow for such team work as it did not offer any community functionality. The recent study by Bullinger et al. (2010) has shown that a lot of collaboration among contest participants can lead to highly innovative solutions. As they also found that very little collaboration is related to highly innovative

solutions, further research should study community-based innovation contests and analyse the impact of community functionalities on the degree of eco innovativeness.

4.2 Expert jury’s and community’s differences in judging innovativeness

Despite our finding that evaluation differs only slightly between community members and experts, when analysing the eco classes (Figure 5), further qualification is necessary.

Figure 5 Exemplary submissions from each eco innovation class

Eco class	Exemplary submissions
1 Product care	
1 Product care - Green washing	
2 Minor	
3 Major	
4 Function	

We have found that – in contrast to the expert jury - the community devaluates submissions on lower eco stages. Only on higher eco stages are expert and community evaluation consistent. This behaviour has been most strongly observed in the category of green washing. Whereas industry experts seem to value such pseudo eco innovations in prospect of a potential consumer demand, the community members disagreed. We hence theorise that corporate and industry experts are not open yet to really promote (radical) eco innovations – and are too strongly focused on short-term market potential based on overcome consumer attitudes from the past. They maybe overlook that consumers have develop scepticism towards sustainability (Belz, 2006), which is likely to be spurred by green washing. In contrast to industry experts, external stakeholders (community members) may have longer term view as not constrained by profit-considerations. They are also directly affected by environmental problems and thus have strong intrinsic motivation to develop intelligent, eco-friendly products (the low entry barriers for participating in the CEC contest and therefore the very diverse background of participants may have additionally spurred these sustainability-oriented group characteristics). The latter directly supports earlier findings by Piller and Walcher (2006) stating that

> *"experts appear more sensitive to 'solution information' and consumers more sensitive to 'need information'. As a result, product concepts based on expert-screened ideas are likely to be more sophisticated, but may not address consumer needs better than concepts based on consumer-screened ideas"*

4.3 Selection processes for SOI

Another implication concerns the integration into the organisations' innovation pipeline. For determining which of the innovative submissions are further developed, systematic selection processes are key. By providing a second evaluation dimension, the EIIG allows for simple separation into innovative projects with and without (high) eco impact. Selection decisions could then be taken in a more informed way. This is supported by other research on the role of information management finding that the provision of sustainability-related information improves sustainability-oriented decision-making (Burritt and Schaltegger, 2010).

Considering that there may be innovative ideas which could be either green or not, from a sustainability perspective, it would be better to select the ones classified as mass market eco innovation, because it results in higher eco impact whilst not interfering with conventional market goals. If internal experts overemphasise solution information and conventional ideas, a selection mechanism building even stronger on other sources than internal experts, as it is propagated with *open evaluation* may help. Future research could investigate in more detail the role of open evaluation in increasing the share of mass market eco innovation projects in new product development (NPD).

4.4 Limitations and future research

Our results have to be seen in the light of their limitations. First, method-wise, the classification of submissions into eco classes remained in the responsibility of the authors. Whilst others followed a comparable path (Halila and Horte, 2006) and we also addressed the risk of subjectivity with such as a process of independent coding, an evaluation process with external experts from the field of environmental innovation and design could further improve evaluation validity.

Second, we already stated that contest task specificity has an influence on the submissions' level of eco innovativeness. The task of the CEC design contest was stated quite broad, without clearly expressing the meaning of the terms “bio shoe”. This may have lead to a slightly higher portion of submissions with low eco innovativeness than normally would occur. Future research should elaborate more clearly the expectations of the contest.

5. CONCLUSION

This paper examines the suitability of innovation contests to generate SOIs and the resulting degree of innovativeness in conventional and ecological terms. Using an innovation contest in the shoe industry, we have derived three strands of results. First, a large majority of the submissions belongs to the category of *product care.* Second, submissions categorised as ‘green washing’ receive a better average assessment although technically equal to the ones of product care. Third, using eco impact class as the first axis, and the (conventional) innovativeness criteria – as judged by the experts – as the second axis, we develop an eco impact-innovativeness grid. It illustrates that a vast majority of user submissions falls in the classes conventional and non-innovation. Results go beyond previous studies and thus contribute to the fields of open innovation and sustainable innovation.

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REFERENCES

Amabile, T. M. (1982) Social psychology of creativity: A consensual assessment technique, Journal of Personality and Social Psychology, 43, 997-1013.

Amabile, T. M., Conti, R., Coon, H., Lazenby, J., & Herron, M. (1996). Assessing the Work Environment for Creativity. Academy of Management Journal, 39(5), 1154.

Altshuller, G. S. (1988). Creativity as an exact science: The theory of the solution of inventive problems. New York et al.: Gordon and Breach.

Belz, F.-M. (2006). Marketing in the 21st Century. Business Strategy and the Environment, 15(3), 1–5.

Bessant, J., Birkinshaw, J. & Delbridge, R. (2004). Innovation as unusual. Business Strategy Review, 15(3), 32-35

Brezet, H. (1997). Dynamics in Ecodesign Practice. United Nations Environmental Programme (UNEP).

Brezet, H., & van Hemel, C. (1997). Ecodesign: A promising approach to sustainable production and consumption. United Nations publication. The Hague.

Brabham, D. C. 2009. Moving the Crowd at Threadless: Motivations for Participation in a Crowdsourcing Application. AEJMC Conference (August).

Bullinger, A. C., Haller, J., & Möslein, K. M. (2009). Innovation Mobs – Unlocking the Innovation Potential of Virtual Communities. Fifteenth Americas Conference on Information Systems (AMCIS), San Francisco.

Bullinger, A. C., Neyer, A., Rass, M. and Moeslein, K. M. 2010. Community-based innovation contests: Where competition meets cooperation. Creativity and Innovation Management. 19, 3, 290-303

Burritt, R. L., & Schaltegger, S. (2010). Sustainability accounting and reporting: fad or trend? Accounting, Auditing & Accountability Journal, 23(7), 829–846.

Charter, M., & Tischner, U. (Eds.) (2001). Sustainable solutions: Developing products and services for the future. Sheffield: Greenleaf.

Chesbrough, H. (2003). A Better Way to Innovate. Harvard Business Review, 81(7), pp. 12–13.

Ebner, W., Leimeister, J. M. and Krcmar, H. 2010. Community Engineering for Innovations: The Ideas Competition as a method to nurture a Virtual Community for Innovations. R&D Management Journal. 40, 4, 342-356.

Fichter, K., Noack, T., Beucker, S., Bierter, W., & Springer, S. (2006). Nachhaltigkeitskonzepte für Innovationsprozesse. Stuttgart: IRB Verlag.

Franke, N. & Piller, F. T. (2004) Value Creation by Toolkits for User Innovation and Design: The Case of the Watch Market. Journal of Product Innovation Management, Vol. 21 (6).

Franke, N. and Shah, S. (2003). How communities support innovative activities. An exploration of assistance and sharing among end-users. Research Policy, 32, 1, 157-178.

Füller, J., Bartl, M., Ernst, H. & Mühlbacher, H. (2006) Community Based Innovation: How to Integrate Members of Virtual Communities into New Product Development, Electronic Commerce Research. Vol. 6 (1) (2006).

Garcia, R. & Calantone, R. (2002). A critical look at technological innovation typology and innovativeness terminology: a literature review. Journal of Product Innovation Management, 19 (2), 110-132.

Geels, F. W. (2005). The dynamics of transitions in socio-technical systems: A multi-level analysis of the transition pathway from horse-drawn carriages to automobiles (1860–1930). Technology Analysis & Strategic Management, 17(4), 445–476.

Greening, L. A., Greene, D. L., & Difiglio, C. (2000). Energy efficiency and consumption — the rebound effect — a survey. Energy Policy, 28(6-7), 389–401.

Halila, F., & Horte, S. A. (2006). Innovations That Combine Environmental and Business Aspects. International Journal of Innovation and Sustainable Development, 1(4), 371–388.

Hansen, E. G., Gomm, M. L., Bullinger, A. C., & Möslein, K. M. (2010). A community-based toolkit for designing ride-sharing services: The case of a virtual network of ride access points in Germany. International Journal of Innovation and Sustainable Development.

Hansen, E. G., Große-Dunker, F., & Reichwald, R. (2009). Sustainability Innovation Cube — A Framework to Evaluate Sustainability-Oriented Innovations. International Journal of Innovation Management, 13(4), 683–713.

Hart, S. L. (1995). A Natural-Resource-Based View of the Firm. Academy of Management Review, 20(4 (October)), 986–1014.

Hockerts, K., & Wüstenhagen, R. (2010). Greening Goliaths versus emerging Davids — Theorizing about the role of incumbents and new entrants in sustainable entrepreneurship. Journal of Business Venturing, 25, 481–492.

Holmes, S., & Moir, L. (2007). Developing a conceptual framework to identify corporate innovations through engagement with non-profit stakeholders. Corporate Governance: International Journal of Business in Society, 7(4), 414–422.

Holmes, S., & Smart, P. (2009). Exploring open innovation practice in firm-nonprofit engagements: a corporate social responsibility perspective. R&D Management, 39(4), 394–409.

Horte, S. A., & Halila, F. (2008). Success Factors for Eco-innovations and Other Innovations. International Journal of Innovation and Sustainable Development, 3(3/4), 301–327.

Kloepffer, W. (2008). Life Cycle Sustainability Assessment of Products. International Journal of Life Cycle Assessment, 13(2), 89–95.

Lam, J., Hills, P., & Welford, R. (2005). Ecological Modernisation, Environmental Innovation and Competitiveness: The Case of Public Transport in Hong Kong. International Journal of Innovation and Sustainable Development, 1(103-126).

Laufer, W. S. (2003). Social Accountability and Corporate Greenwashing. Journal of Business Ethics, 43, 253–261.

Lüthje, C., & Herstatt, C. (2004). The Lead User method: an outline of empirical findings and issues for future research. R&D Management, 34(5), 553–568.

Mont, O. (2006). Product-Service Systems: reviewing achievements and refining the research agenda. Journal of Cleaner Production, 14(17), 1451–1454.

Neyer, A.-K., Bullinger, A. C., & Möslein, K. M. (2009). Integrating inside and outside innovators: a sociotechnical systems perspective. R&D Management, 39(4), 410–419.

Petersen, H. (2006). Ecopreneurship and Competitive Strategies: Striving for Market Leadership by Promoting Sustainability. In S. Schaltegger & M. Wagner (Eds.), Managing the business case for sustainability. The integration of social, environmental and economic performance (pp. 398–411). Sheffield: Greenleaf.

Piller, F. T., & Walcher, D. (2006). Toolkits for idea competitions: a novel method to integrate users in new product development. R&D Management, 36(3), 307–318.

Rennings, K. (2000). Redefining innovation – Eco-innovation research and the submission from ecological economics. Ecological Economics, 32(2), 169–336.

Roth, S. (2009). New for whom? Initial images from the social dimension of innovation. International Journal of Innovation and Sustainable Development, 4(4), 232–252.

Schaltegger, S. (2002). A Framework for Ecopreneurship - Leading Bioneers and Environmental Managers to Ecopreneurship. Greener Management International, 38, 45–58.

Schaltegger, S., Bennett, M., Burritt, R. L., & Jasch, C. (2009). Environmental Management Accounting (EMA) as a Support for Cleaner Production. In A. Tukker (Series Ed.) & S. Schaltegger, M. Bennett, R. L. Burritt & C. Jasch (Vol. Eds.), Eco-Efficiency in Industry and Science: Vol. 24. Environmental Management Accounting for Cleaner Production (pp. 3–26). Dordrecht: Springer Netherlands.

Schaltegger, S., & Burritt, R. L. (2010). Sustainability accounting for companies: Catchphrase or decision support for business leaders? Journal of World Business, 45(4), 375–384.

Schaltegger, S., & Sturm, A. (1995). Öko-effizienz duch Öko-controlling: Zur praktischen Umsetzung von EMAS und ISO 14001. Stuttgart: Schäffer-Poeschel.

Sharma, S. & Starik, M. 2004: Stakeholders, the environment and society: multiple perspectives, emerging consensus. In: Sharma, S. (Ed.): Stakeholders, the environment and society. Cheltenham: Edward Elgar (New Perspectives in Research on Corporate Sustainability): 1–22.

United Nations Environmental Programme (UNEP), & Delft University of Technology (Eds.) (2009). Design for Sustainability: A Step-by-Step Approach. Paris, France.

von Hippel, E. (1988) The sources of innovation. NY, USA, Oxford University Press.

von Hippel, E. (2001) Perspective: User toolkits for innovation, Journal of Product Innovation Management, 18, 4, 247 - 257.

Wagner, M. (2009). The links of sustainable competitiveness and innovation with openness and user integration: an empirical analysis. International Journal of Innovation and Sustainable Development, 4(4), 314–329.

Wagner, M. (forthcoming). Innovation for Sustainable Development, Competitiveness, Free Revealing and User Innovation: An Empirical Analysis. International Journal of Innovation and Sustainable Development,

Wüstenhagen, R. (1998). Greening Goliaths versus multiplying Davids: Pfade einer Coevolution ökologischer Massenmärkte und nachhaltiger. St. Gallen: IWÖ.

Yin, R. K. (2003). Case study research: Design and methods (3. ed.). Applied social research methods series: Vol. 5. Thousand Oaks, CA: Sage (Original work published 1984).

NOTES

1) In the context of this work, we explicitly refer to *potential* impact, as we deal with the very early stage of the innovation process and, thus, the *actual* impact can only be estimated.
2) The term “innovation contest” rather than alternatives like “idea contest” (Piller and Walcher 2006), “ideas competition” (Ebner, Leimeister and Krcmar 2010) or “design contest” (Brabham 2009) illustrate “that a contest is suited to cover the entire innovation process from idea generation to selection and implementation” (Bullinger et al., 2010).
3) http://www.xprize.org/crazy-green-idea (accessed 1.12.2010).
4) http://www.project10tothe100.com (accessed 1.12.2010).
5) http://www.save-our-energy.com (accessed 1.12.2010).