A DEAD END OR A WAY TO PROSPERITY? EFFICIENT AND EFFECTIVE STRATEGIES TOWARDS ECO-SUSTAINABILITY IN SWEDISH SME´S

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For producing companies, managers' motivation for eco-sustainability (ES) improvements in products and value chains differs, and for companies that decide to work on ES issues, there are different routes to take. In this article we focus on two of those routes, the "eco-efficient" and the "eco-effective" one.

Eco-efficiency can be seen as "doing things the right way", i.e. to get more from less, to minimize, to aim for zero waste, energy and water use etc. Eco-effectiveness can be seen as aiming at "doing the right things", i.e. develop products and industrial systems that maintain or enhance the quality and productivity of materials through subsequent life cycles.

Some companies chose to execute their ES vision through the eco-efficient route, e.g. through Environmental Management Systems (EMS), or Eco Design while others take the eco-effective route through for instance design for sustainability, with principles of Cradle-to-Cradle, Biomimicry etc. For many companies, choosing the efficient route is more familiar with its ongoing business logic. But after the low hanging fruits have been harvested there is a risk of marginal cost increases for every additional reduction step taken. Proponents for the eco-effective route aim at ES through more radical innovations but these solutions may require substantial changes in value chains.

Less researched reasons to a firm's ES progress are the motivational factor and the organization as interpretation system. Although this study comprise only five companies, some interesting observations in this respect have been made.

The organization as interpretation system may help understand a company's choice of ES route, eco-efficient or eco-effective. Eco-efficient companies can expect, at some point in time, to face raising ES costs which they should take as signs that the time may have come when a switch to a more eco-effective approach as a way forward. A shift from eco-efficient to eco-effective may require a substantial change of the company's senior management setup.

INTRODUCTION

From the general definitions of, and political visions for a sustainable development (United Nations General AssemblyAssembly 2005) or principles for ecological sustainability with healthy and continuously functioning ecosystems, down to corporations' daily activities, the gap in time and scale can be huge. Although we are all co-creators of our future society (Spangenberg, Fuad-Luke et al. 2010)the scale of the eco-sustainability (ES) issue, and the timeframe to address it can have different motivational implications for management. Some individuals and firms become motivated – see possibilities and believe their contribution matters while others become detached and believe their small role (and impact) in this big world of actors doesn't matter (Hardin 1968; Ostrom 1991).

A firm's motivations (beyond profit) are articulated in its vision and mission statement and executed by its CEO with help from the staff the CEO recruits. The eco-sustainability concern of contemporary society put expectations on firms to do common good, for example by becoming eco-sustainable (Lovins, Lovins et al. 2007). Therefore, many companies now address the eco-sustainability issue in their vision-and-mission statement. This, however, does not necessarily show how motivated the firm's board of directors, CEO, and senior management is for eco-sustainability issues.

Some companies chose to execute their eco-environmental vision through the *eco-efficient* route, e.g. through Environmental Management Systems (EMS), ISO 14001 certification, ECO design with LCA analyses and so forth. Others take the *eco-effective* route through for instance design for sustainability (Sherwin 2004), with principles of cradle-to-cradle (Braungart, McDonough et al. 2007), Biomimicry (Benyus 2002
), or similar concepts.

Each of these two routes has its proponents and opponents. The eco-efficient route is primarily reductionist while the eco-effective is emergent/radical. Hitherto, the scientific community has not been able to evaluate under what conditions one may be superior to the other (Bjørn and Hauschild 2011). There may however be other and more important reasons to a firm's progress to become more eco-sustainable than which of the two routes they chose. The motivational factor, i.e. to what extent eco-sustainability is a true motivator for the firm's board of directors and CEO and the organization as interpretation system has mainly been neglected. This paper looks at these two factors in five Swedish SME's in the outdoor industry and how they plays in, and what managerial implications this gives.

The paper is structured as follows: First an overview of the literature on eco-efficiency, eco-effectiveness and on the organization as interpretation system. Second, the methodological issues of the case studies are addressed. Third, the empirical material is explored and finally some findings and implications are further discussed.

Two routes to eco-sustainability

Eco efficiency

During the industrial revolution, making things by using fewer resources has been a cornerstone in production of goods and services (Lovins 2008) but is today often refereed to as *eco-efficiency*. The concept was popularized by the World Business Council for Sustainable Development (WBCSD), before The United Nation Conference on Environment in Rio de Janeiro in 1992 (WBCSD 2000). WBCSD describes eco-efficiency as a management philosophy "which encourages business to search for environmental improvements that yield parallel economic benefits" and eco-efficient achievements are made by "the delivery of competitively-priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the life-cycle to a level at least in line with the earth s estimated carrying capacity" WBCSD (2000).

The eco-efficient approach is today commonly used in industry through standardized frameworks like the ISO 14000 family with the Environmental Management Systems ISO 14001, and quantitative tools such as Life Cycle Assessment (LCA) with described standards ISO14040 and 14044, or supported by frameworks like e.g. lean manufacturing and Six Sigma (Lovins 2008). The ISO 14001 system has emerged to be the EMS standard mostly used in industry (Könnölä and Unruh 2007). ISO estimated that 154 572 certificates had been issued worldwide in 2009 (ISO 2009).

In a study among 272 companies in Swedish manufacturing industry between 1991 - 2007 Arnfalk et al. (2008) shows that those companies that have implemented ISO14001, especially SME´s, have a more systematic environmental work that others. Results from this are often incremental improvements like reduced energy consumption, substitution to less toxic substances, use of more renewable resources and reduced weight etc. Lovins (2008) argues that eco-efficiency is a "great place to start" as it is both profitable and familiar to business.
Benefits from such work are of substantial importance but a reductionist approach may never reach sufficiently low and may face rising marginal costs for further eco-environmental improvements.

Opponents to eco efficiency claim that much more radical decrease in energy and resource use are necessary, like the Factor 10 Club (1994), Hawken et al. (2000), Manzini (2001), von Weizsäcker et al. (1997). Eco-efficiency with e.g use of LCA is criticized for being a tool-driven approach (Rossi, Charon et al. 2006), being unsuitable for SME´s, and were focus easily ends up on metrics leading to incremental changes, and thus hinders companies to become truly sustainable (Dyllick and Hockerts 2002). Könnölä and Unruh (2007) argues that there is a risks that EMS leads to lock in effects and hinders radical innovation. Braungart et al. (Braungart, McDonough et al. 2007) argues that the eco-efficiency goal of zero hinders imagination:

> *"As long as human beings are regarded as "bad", zero is a good goal. But to be less bad is to accept things as they are, to believe that poorly designed, dishonorable, destructive systems are the best humans can do. This is the ultimate failure of the "be less bad" approach: a failure of the imagination.*

Eco effectiveness

More radical or "goal driven" strategies towards eco-sustainability (Rossi, Charon et al. 2006), described as the *eco-effective* route in this article, comprises a range of eco-sustainability concepts or frameworks like e.g. The Natural Step [1] with its system conditions and principles for strategic planning through Backcasting (Holmberg 2000), Bio mimicry or the concept of Cradle to Cradle (2007). There are of course differences between these concepts but they share the same overall focus and goal of "making the 'right things'" or to go beyond eco-efficiency (Figge and Hahn 2004).

The Cradle to Cradle principle, as one example of a "goal driven vision", (Rossi, Charon et al. 2006) has gained growing interest from industry and communities with it's promise to be compatible with unlimited growth (Bjørn and Hauschild 2011). It has however also been criticized for lack of transparency, difficulties when trying to identify chemical substances, and potentially leading to lock ins to a small number of suppliers (Prendeville, O'Connor et al. 2011). Bjørn and Hauschild (2011) describe a gap between the LCA community and Cradle to Cradle proponents were Cradle to Cradle is criticized for not being a serious concept for sustainable design and points to some areas were there is a potential of achieving sub optimizations e.g energy use from recycling or supporting the choice of e.g. waste scenarios(Bjørn and Hauschild 2011)

What route to chose?

Eco-efficiency can be seen as "doing things the right way", i.e. to get more from less, to minimize, to aim for zero. More product or service value with less waste, less resource use or less toxicity. Eco-effectiveness can be seen as aiming at "doing the right things", i.e. develop products and industrial systems that maintain or enhance the quality and productivity of materials through subsequent life cycles. Both routes can be seen as having a visionary, unreachable goal – zero impact for eco-efficiency and to enhance the quality and productivity of materials for eco-effectiveness.

The difference is that "A goal-driven approach shifts the first-order question to what is desired rather than to the results the tool is capable of delivering" (Rossi, Charon et al. 2006).

The organization as interpretation system

In this study, we assume that an organization is an open system that interacts with its environment (Katz and Kahn, 1978). An organization's (inter)action is preceded by data collection and an interpretation of that data (Daft and Weick 1984). Also ES-actions follow this sequence of data collection => interpretation => action. Daft and Weick (1984) use a model of the organization as an interpretation system and classify the organization's interpretation mode along the dimensions of (1) management's beliefs about the analyzability of the external environment and (2) the extent to which the organization intrudes into the environment to understand it, see figure 1.

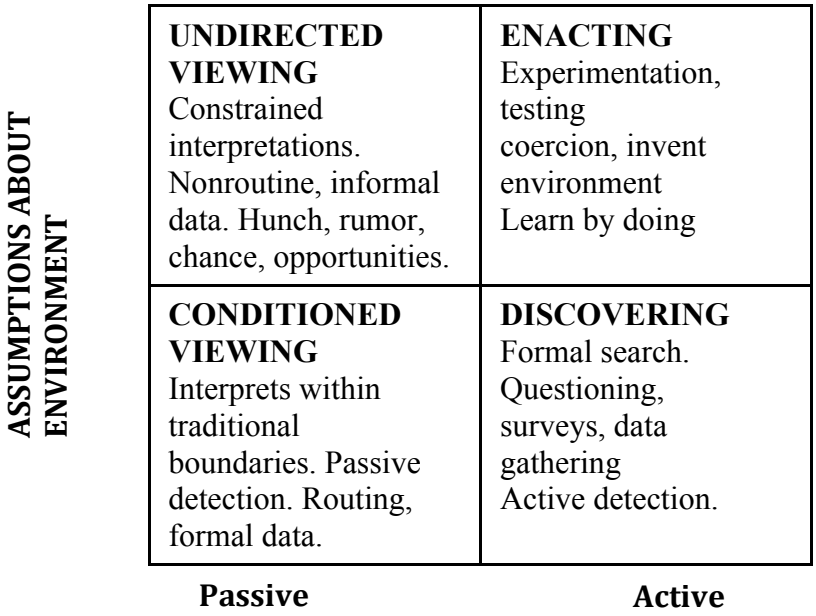

Figure 1. Organizational intrusiveness: A model of organizational interpretations modes: Source: (Daft and Weick 1984.)

Organizations that passively probe their environment interpret it within traditional boundaries or act on hunch, rumor, chance or opportunities depending on whether they assume the environment is analyzable or not. Organizations that more actively probe their environment either (a) assume the environment is unanalyzable and probe it through experiments, tests and ”invent” the environment through learning by doing or (b) assume the environment is analyzable and probe it by formal search, surveys and data gathering (Daft and Weick 1984.)

Motivation for change

The extent to which the organization intrudes into the environment to understand it is dependent on its management's level of motivation. The gap between what is and what should be from an ES perspective is one factor that affects motivation in the ES domain of management. Another is the company's performance versus stakeholder expectations and demands. The gaps combined forms a triggering mechanism for change (c.f.Dutton and Duncan 1987). Dutton and Duncan (1987) describe the creation of momentum for change through a process of strategic issue diagnosis where a gap analysis and a stakeholder demand forms the triggering mechanism. After triggering, an issue assessment in terms of one urgency- and one feasibility assessment forms the momentum for change. An assessment that indicates the issue is urgent and feasible can motivate radical/reorienting change while other urgency/feasibility combinations more likely results in incremental changes.

Hence, a company with highly motivated management regarding ES issues can be expected to actively probe its environment on ES issues. Among those, companies that assumes the environment is analyzable may be more inclined to use efficiency-based tools while companies that assumes the environment is unanalyzable are more inclined to experiment, test and invent through learning by doing, i.e. use effectiveness-based tools (Daft and Weick 1984.)

In the scientific discussion on effective versus efficient routes to improved ES, there is limited investigation regarding the potential impact from management's motivation and from the type of interpretation system a company constitutes. This paper research that issue through a qualitative investigation of five companies in the outdoor industry.

Method

This research is a qualitative study based on a selection of SME´s [2] in the Swedish outdoor garment industry. The design, choice of materials and choice of chemicals to get the right properties out of garment can have a significant negative eco-environmental impact. The outdoor industry serve outdoor-active customers that may be expected to have a stance on eco-sustainability that influence their outdoor garment choice. This makes the outdoor industry especially interesting for studies on how companies in this business address eco-sustainability.

Five SMEs [1] were chosen based on how they described their attitude and actions towards sustainability in their market communication on their websites, both those who claimed leadership and those who had only little information about sustainability aspects. The five companies' CEO's or Directors of Sustainability were contacted and appointments for interviews were made with persons responsible for eco-sustainability issues.

Interviewing is a common method for data collection in qualitative research (Fontana and Frey 1994); (Kvale 1997). Interviewing is a complex social interaction between two or more persons, and it is therefore important for the interviewer to pay attention to the various symbolic, linguistic and emotional responses that the interviewee demonstrates (Alvesson 1994)The interviewer needs to be aware that the interview situation comprises more than answers to questions but includes a variety of symbolic interactions.

The data analysis of qualitative material makes certain demands on the researcher (Silverman 1993; Huberman and Miles 1994). Rather than just pinpointing different quotes into categories as in the grounded theory model(Glaser B G and A. 1967), the researcher who chose a qualitative research method needs to actively engage in an interpretation of the empirical material. By coding with an "informed perspective", the researcher can analyze qualitative information using both emic/etic (Boje 2001)and inductive/deductive (Merriam 1994) approaches.

An interview guide was developed and adhered to during the personal and semi structured interviews.

The interviews, which took place during Spring 2011, were held at the respective company's premises and lasted for about 1-2 hours each. They were recorded and then transcribed. The following positions were interviewed for each of the companies.

	Company A	Company B	Company C	Company D	Company E
Number of employees	130	20	22	20	10
Approx. Turnover (million €)	58	3	5,5	10	3,6
Interviewed Representatives	Director of Sustainability	CEO + Director of Sustainability/Industrial Designer	CEO/Product Designer	Product manager	Product Designer + Product developer
				Product developer (at a later phone interview)	

Figure 2. Basic facts and positions of interviewees in the five analyzed companies.

The characteristics shown for the two main ES routes have been used to qualitatively categorize the interviewed companies based on their described motivation and actions.

Cases

Both the efficient and effective companies shared a lot of activities and challenges but there were some clear differences in how they described their approach to and implementation of ES activities as summarized below.

Observations at companies choosing a more "effective" route towards ES

Managers' motivations:

Out of five interviewed companies two were identified as taking the eco-effective route (company B and C), based on the managerial attitude, that here clearly saw ES as a core company value. They were determent to "do the right things", even if theese activities often were more expensive. Their shared vision was to work with closed material loops and fully recyclable products. They also mentioned the idea of a possibility to provide functions rather than traditional selling products in the future. Their experience was that ES aspects worked as an extra comfort for their customer when buying an, often expensive, product – which strengthened the purchasing decision and loyalty to the brand. ES performance was however not seen as the unique selling point. Their attitude towards ES was that of opportunity-driven curious, and they continuously tried to innovate and learn about ES issues.

Some statements from these interviews regarding their attitude were;

"Thinking about Sustainability has for sure complicated things, but we find it much more challenging and fun, not just thinking about functionality and performance all the time!" (Company B)

"Some of our suppliers use us as trackers, they know that we always wants what isn't on the shelf, and they often find it worthwhile to produce samples as others will follow in our tracks!" (Company B)

Development and implementation of ES solutions

The two Companies with a more effective approach (B and C) had both decided to tackle a major challenge in the outdoor industry; production with recycled and fully recyclable materials. The way of working towards fully recyclable materials and products was however different. One company (C) had chosen a supplier of recycled Polyester based on repolymerization that could provide fabrics and membranes in the same polymer type and thus eliminated the need for non-ES Teflon membranes like Gore-Tex, leading to less dependence from one supplier and gaining better ES performance in the product lifecycle (see table 2).

The other company (B) had chosen Polyamide in their products due to better abrasive performance. The strategy to stick to Polyamide showed to be problematic as their supplier at first indicated that recyclability was possible but later, after having performed tests, withdraw that claim. Contamination from other materials in the product, mainly polyurethane that was added for performance reasons, made recycling impossible. Even if this was a drawback for the producer they saw it as a challenge and started an intensive search for other alternatives of recyclable Polyamide that could meet their specifications and vision for closed cycles.

Company B also claimed that they had spent a lot of time and energy during the years trying to inspire their competitors to aim higher towards ES, knowing that they by themselves, being a small player, would gain if their bigger competitors became more proactive.

Some common statements from these interviews regarding design and development were;

"Just because something e.g. a really technically feature is possible to do, a lot of the brands do that. And it will look technical, but will it add value to the customer?" (Company C)

"A couple of years ago you could design products that looked good and averaged performance without knowing anything about materials. Today you have to go down to the molecule level, that for most designers is will be a long journey to reach" (Company B)

"We have policies mostly in our brains. If there is a material with better eco performance we choose it even if it is more expensive! Then the product will be more expensive, and we will have to lower our margins! (Company C)

"The product flora has grown tremendously among our competitors, but we don't' want to adapt to that. Where's the need for ten jackets with small variations? We want to make a clear choice for our customers with one really good jacket instead, and if the customer don't like that that's fine with us!" ! (Company C)

"A better environment mustn't be a competitive advantage! Our policy is to share our knowledge to our competitors and in our value chain we gladly share contacts, it's just to give us a call! We want them to meet and come up with better products. But that's not the common way among suppliers and manufacturers, everyone sits in

their pipe with their secrets." ! (Company B)

"Designing for a long product life is most important. A big problem is finding polyester fleece that doesn't easily get pilled by wear and washing. Then the hoodie wont be used at the office anymore, and also bind more moisture when rock climbing, then it's loose, loose."! (Company C)

The effective companies had also initiated their own take back program were their resellers collected worn out products and sent back to the producers. The recycling program were part in a vision for closed material loops, and even if the companies were aware that the time from purchase to end of life could be long, (for some products estimated up to ten years or more) and that the quantities of collected products were too small for being of real interest to the material recyclers, they saw this as a important activity; to be a leader and good example in driving the outdoor industry towards an eco-sustainable material infrastructure.

Experienced consequences from the eco-effective route

One experienced hurdle was how to get detailed ES data from material suppliers about e.g. recyclability, toxic substances etc. This was often problematic since their suppliers seldom were keen on releasing too specific substance information for competitive reasons. Another related hurdle was how to get through with ES information to their retailers that have a key role to enlighten their customers, which is needed for those who are first to market with new ES features.

The high amount of time required to try affecting the value chain or to search for e.g. the "perfect" solutions/materials, described as "learning by doing", could often lead to costly dead ends and lower margins. As an example, one company (C) had spent four years in searching for a fiber combination for a product that had both high durability against mechanical, good ventilation and high environmental performance. Most of their competitors use combinations of biological/synthetic fabrics e.g. wool/polyester, etc. that makes it less suitable for material recycling. Eventually, this company (C) found that a combination of wool and silk met all their requirements. The problem was however that this combination was approx. 30% more expensive compared to wool. This combination was implemented anyway but with a lower margin. The reason for this was described as doing "the right thing" for the brand.

There can also be implications for suppliers in the value chain as this quotation indicates;

"When we changed to recycled polyester our supplier lost 50% of the production value from us for one year, and it seems that they now know that we are serious with our specifications. And even big suppliers have awakened and start talking about sustainability. But they can't deliver anything that we want yet." (Company C)

"Sometimes the risk has seemed high for us when choosing materials with better eco–performance. But not compared to if some of our competitors would, as we have not yet got stuck in technologies and material combinations as they have!"

"The price for being in the forefront of sustainability has been high but it has clearly been beneficial for us by giving us a stronger brand" (Company B)

Observations at companies choosing a more "efficient" route towards ES

Companies categorized as using a more efficient route in this study share some characteristics as: Approaching ES from an economic perspective, and choosing more reductionist approach e.g. sourcing material with recycled content or substituting to less problematic material from a ES pespective.

Managers' motivations:

The largest company (A) in the study was using a clear structured efficient strategy with a company vision including quantitative ES goals for their value chain and in their product design. They describe ES activities as core for the company. The sustainability manager described the company as committed towards ES in a structured and incremental way but with a clear distinction that the profitability of the ES activities was of highest priority when making choices. They had started to implement an EMS system (ISO 14001).

"Business is for us the main driver for sustainability, not philanthropy!" (Company A)

" For us product is king, its easy to be more(profitable by increasing volumes and lower the margins" (Company D)

"If we don't see a possibility for our specified margins we don't want to do that product or use that material!" (Company D)

Two companies in the study (D and E) were considered having a more efficient/ reactive or in some case passive, almost confused strategy, were ES aspects and activities were less systematic and were described as trends that they sometimes followed e.g. using recycled materials, but without intention or knowing if it is possible to recycle their products after use. These two companies expressed no thoughts of starting a take back program. One of them (E) argued that recycling was more of a marketing gimmick than having an actual effect on the environment. Their argument was that one the companies in the outdoor business that had implemented a take back program (Patagonia) only had managed to send one 40 foot container back to the material recycler during the last ten years of running their take back-program. One of the more reactive companies (D) argued that they had experienced problems from earlier attempts to introduce products with better ES performance, both quality and profitability, and on top met criticism from environmental experts. These experiences taken together had led to a more reactive approach towards ES activities from their side. An interesting fact is that this company has products (footwear) that since the 1930s (when the company was founded) were, and still today are designed for repair and refurbishing. They have a department that mainly repair and refurbish boots, more as a tradition than based on profitability.

Both of the more reactive companies described that lack of personnel resources and knowledge in ES hindered them from doing more, even as they themselves predicted ES performance to be of more importance in the future.

"There is so much you have to know to claim that recycled material are better for the environment and we are not Patagonia!" (Company D)

"If we believe in and have energy enough, sustainability probably can be a core value for our company!. "(Company D)

Development and implementation of ES solutions

The efficient approach in the three companies (A,D,E) differed from a structured process in (A) to more unstructured processes in (D,E). In A there were lists on substances to avoid and they had their own material development that could specify wanted and unwanted substances. In the others (DE) their sourcing of material was more dependent on knowledge among their suppliers and communication problems was often occurring regarding e.g. substances and after treatments of garments. They also had a passive detection attitude towards the benefits of different possible ES choices and activities. One example was the use of PVC in shoes that company (E) unsuitable in their marketing and thus tried to phase out. Or mixing organic with synthetic fibers. Two of these companies (A, D) had no plans of changing their use of Teflon membranes like the effective one´s.

"We are the ones that choose and decide about what fibers and treatments to use, that gives us advantage compared with the fast fashion companies that often buy from the shelf!" Some of them are extremely good at handle a totally unsustainable business model!" (Company A)

"The three R´s Reduce, Reuse and Recycle is something I usually think of when designing. But it´s so difficult to know the effects from choosing one material for another! (Company E)

"You can buy one of our boots and use it for all of your life if you want to, with the right maintenance. It´s the same as it was when we started in the 1930´s" (Company D)

Experienced consequences from the eco-efficient route

The most structured company (A) saw a challenge in getting the ES strategy out in the organization and being implemented in their Product Life Cyle Management system (PLM).The two more reactive companies (D and E) argued that there were a lack of interest from their customers and one of them had negative experiences regarding quality, profitability and the risk of getting criticized from ES experts.

General aspects for all companies in the study

All companies in the study did still use durable water repellant (DWR) treatments of some type as they considered this as necessary to achieve the required technical function of their products. These substances are identified as problematic from an ES perspective. But the effective ones worked hardest to find substitutes or ways to avoid DWR completely. Both effective and efficient companies used Bluesign[3] certified fabrics and sewing factories. With Blue sign, material producers, mills and sewing factories can label their production plants and products based on how efficient they use energy, water and hazardous chemicals. The Blue sign certify producers based on input/output analyses regarding energy, water, chemicals and emissions to air, water, and working environment, and can be considered as a *eco- efficiency* tool. Blue sign makes it much easier for small producers to find and source material from suppliers

that have more eco efficient materials and production. Three out of five respondents claimed that Blue sign was and in the future will be their main criteria for sourcing and that they already changed their suppliers in favour to Blue sign certified ones, or were planning to do so in the near future.

Among the interviewed companies there is a variation in the use of structured development process and several of the respondents described that the lack of process was a problem. All the interview companies described a need for more process development to handle ES issues. One company compared with the use of quality control (QC) that since long is an establish process, and saw a need for assessment methods in early phases that could identify "unnecessary" or risky concepts before entering the production phase.

A shared picture among the interviews was that with some exceptions (the German market) there were low demands from end consumers and resellers for ES performance in their clothes and gear.

Discussion

Although this study comprise only five companies, the selection of business – the outdoor industry with its inevitable relation to nature – and the selection of companies – SMEs with and without EMS, using both effective and efficient tools, and having motivated and less motivated management and/or board of directors – allows for some interesting observations to be done.

First, both the eco-effective companies were quite active in their intrusion into their environment while two out of three of the eco-efficient companies were relatively passive. The active eco-efficient company was the one having an EMS, ISO 14001. It can be discussed whether the EMS make a company active or whether an active company decides to get EMS as help in their ES work. In this case though, the company was active before it decided to get an EMS.

Secondly, among the three companies with an active intrusiveness to its environment, one was eco-efficient while the other two were eco-effective. The formal search and data gathering approach used by organizations with an assumption that the environment is analyzable have a good fit with the approach of EMS and hence with eco-efficiency. Eco-effectiveness may require a more innovative and entrepreneurial organizational culture which have a good fit with the characteristics of organizations assuming the environment is unanalyzable (c.f. Daft and Weick, 1984).

Thirdly, the two passive companies were both eco-efficient. There may be reasons to doubt that eco- effective companies can have a passive intrusiveness towards the environment given that eco- effectiveness mostly requires more radical change and more radical change can be expected only from higher levels of motivation in terms of sense of urgency and sense of feasibility (c.f. Dutton and Duncan, 1987).

From the perspective of organizations as interpretation systems, the five companies position themselves as in the figure below.

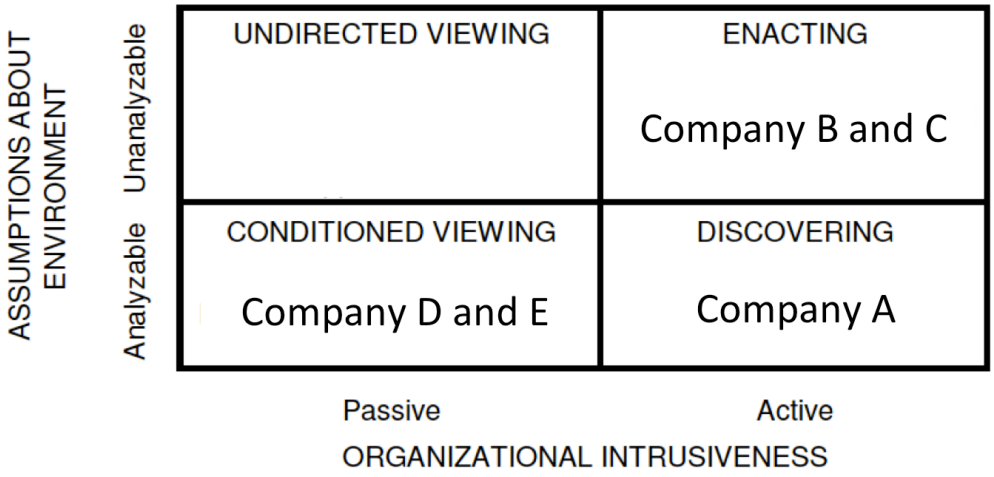

Figure 3. Positioning of the analyzed companies in relation to the organizations as interpretation systems. Company B and C were choosing the effective route, A the efficient/structured route and D,E an efficient, more passive route.

It may be that higher levels of motivation for ES issues in the organization leads the organization into eco-effective directions. If so, it may be expected that highly motivated organizations that use an eco-efficient approach later on will move into a more eco-effective approach when the marginal cost for yet a step towards the goal of zero becomes increasingly higher. On the other hand, it is the assumptions and approaches of senior management that defines the organization's mode of interpretation and to change that mode may require change in the set of individuals that constitute senior management.

Conclusions

There are reasons to believe that the eco-efficient route with its aim towards zero will not be sufficient to reach ES within reasonable economical costs. The more radical historical breakthroughs in for instance energy, medicine and electronics have had significant importance for society, and they probably will have also in the ES domain.

Therefore, eco-efficient companies can expect, at some point in time, to face raising ES costs which they should take as signs that a switch to a more eco-effective approach may be the best way forward rather than believing that their ES work has come to an economic dead end.

However, changing to an eco-effective approach requires a change of the organization as interpretation system. It is defined by its senior management's assumptions about and intrusiveness into its environment. To change an organizations mode of interpretation hence may require a substantial change in its senior management – a task for its board of directors.

What route to choose, the eco-efficient or eco-effective is unnecessary as long as they both contribute to a more sustainable business. The eco-efficient route is most likely not sufficient and will, for a company at some point have to shift to a more eco-effective approach. That shift implies a change in the company as interpretation system. Our suggestion is that more research is spent on how such a change, from an eco-efficient to an eco-effective approach in the company can take place.

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Appendices

	Characteristics of eco efficiency	References		Characteristics of eco effectiveness	References
Objectives Visionary concepts	To get more from less Working towards Zero impact "encourages business to search for environmental improvements that yield parallel economic benefits"	(Huppes & Ishikawa, 2007) (Rossi, Charon et al. 2006) (WBCSD 2000)		Doing the right things Aiming at: "true" sustainability Development of products and industrial systems that maintain or enhance the quality and productivity of materials through subsequent life cycles"	Braungart, M., W. McDonough, et al. (2007). "Cradle-to-cradle design: creating healthy emissions – a strategy for eco-effective product and system design." Journal of Cleaner Production **15**(13-14): 1337-1348.
Systemic view	linear patterns Cradle to grave Product related thinking	Dewberry, E. L. and M. M. de Barros (2009). "Exploring the need for more radical sustainable innovation: what does it look like and why?" International Journal of Sustainable Engineering **2**(1): 28-39.		Cyclic patterns Cradle to cradle	(Stahel 1976 in Lovins, L. H. (2008). STATE OF THE WORLD 2 0 0 8 Innovations for a Sustainable EconomyRethinking Production.)Cuginotti, A. K. M. M. and F. v. d. Pluijm "Design and Decision Making: Backcasting Using Principles to Implement Cradle-to-Cradle."
Improvements	Incremental	Sherwin, C. (2004). "Design and sustainability." The Journal of Sustainable Product Design **4**(1-4): 21-31.		Radical ,	herwin, C. (2004). "Design and sustainability." The Journal of Sustainable Product Design **4**(1-4): 21-31.

Assesment	Eco design tools e.g LCA , Carbon Footprinting (CFP)	ISO 14000		Robust, science-based principles, Back casting, (MSPD) Bio mimicry spiral	Holmberg, J. (2000). "Backcasting - A framework for for strategic planning." International journal of sustainable development and world ecology **7**(4): 291-308. Byggeth, S., G. Broman, et al. (2007). "A method for sustainable product development based on a modular system of guiding questions." Journal of Cleaner Production **15**(1): 1-11. Dreborg 1996; Holmberg och Robért, 2000) (Biomimicry Guild 2009)

Figure 4: Some characteristic attributes from the concepts of eco efficiency and effectiveness

ReCiPe end point	0,799	1,155	16,5	0,705	0,672	0,27
Fabric	Organic Cotton	Conventional grown cotton	Gore Tex	Nylon (Polyamide)	Polyester	Recycled Polyester

Figure 5: Environmental load between some commonly used textile material[4] *(lJegrelius Institute for Applied Green Chemistry 2011). based on LCA Weighting with RECiPe [5] end points in kg of clean materials. Based on the ReCiPe LCIA Methodology with 18 different categories .*

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