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Investigating the importance of sustainability information in Product Development and Design

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Abstract
To further improve the sustainability performance of products, a sustainability information framework beyond mere product and process data has been developed. This was done under the assumption that access to and use of such information may increase firm knowledge on sustainability issues as well as firm ability to develop sustainable products, and thus enhance competitiveness by adding value to products beyond functionality, quality, and cost. The present article reports the results from two case studies in the Norwegian furniture industry. Categories of sustainability information which firms find most important and relevant to product development and design has been identified, as well as factors influencing accessibility of such information. Systematically identifying and compiling sustainability information in the way proposed by the framework is suggested useful for developing requirements and specifications, for general decision support, and for generating knowledge that may inspire entirely new product meanings.

Keywords: Product development and design, sustainability, information, knowledge, furniture industry.

Introduction

Product development and design rests heavily on information to achieve its main tasks [1] and may further be regarded as an information transformation process [2]. Relevant information is thus a prerequisite for making knowledge based decisions. Aiming at developing more sustainable products, identifying which information on sustainability issues that could be of importance is thus highly relevant.

Product development and design has traditionally been the target of much interest from researchers and practitioners working to improve the sustainability performance of products. Up to 80% of environmental and social cost factors of a product are determined in these early phases [3]. Therefore, improvements to the sustainability performance of products can be made most efficiently in these early phases. Using more and other types of information than

current industrial practice to generate sustainability knowledge and awareness may be ways for firms to improve the sustainability performance of their products. The knowledge generated may be used for developing requirements and specifications, for general decision support, and for inspiring entirely new product meanings. Sustainable products may be one way of adding value to products beyond functionality, quality, and cost, and thus increase competitiveness of firms.

Information on sustainability issues, or sustainability information (SI) is here defined as *stakeholder information elements potentially capable of contributing to knowledge in product development and design by combining the environmental, social, and economic dimensions of sustainability.* SI includes information beyond mere product and process related data, as well as sustainability expectations from firm stakeholders, towards the product itself, or towards the firm which requires the involvement of a broad network of stakeholder groups [4]. The SI definition is derived from the triple bottom line (TBL) concept [5], information and knowledge theory [1, 6], and stakeholder theory [7].

Building on previous works by the authors [4, 8-10], the purpose of this article is to investigate the following research questions: 1) What sustainability information relevant to product development and design is considered important to furniture manufacturers? 2) How accessible is this information? 3) What are the factors influencing perceived importance and accessibility of such information? The novel contribution of this article is the presentation of new results based on solid empirical work within two large furniture manufacturers performed in 2011.

Theoretical background

Research explicitly examining sustainability information in product development is scarce. Several "calls" for more information were identified within the field of innovation [11], and within ecodesign and sustainable development [12, 13]. The main body of literature however examines sustainability information in other contexts like social and environmental disclosure [14, 15], or knowledge acquisition through stakeholders [16, 17]. The most comprehensive work on information identified in literature is the one of Erlandsson and Tillman [18] concerning corporate environmental information collection, management, and communication, which identifies stakeholders as important influencing factors, although the study predominantly focuses on product and process data.

As SI was found to be scattered across fields, a framework with was developed by combining information elements from these different fields to allow for further studies on SI and to support product development and design work [9]. The SI framework has a holistic stakeholder approach beyond supply chain actors; it addresses a broad range of environmental, social, ethical, and economical issues, and includes information elements beyond product and process data.

Research design – the case of the furniture industry

Two case studies in the Norwegian furniture manufacturing industry were conducted. The two firms were selected based on their interest in sustainability issues and their current high environmental performance. The firms have in-house product development departments and manufacture their furniture in Norway. Firm A is a premium brand office chair supplier which operates mainly within the European market. Firm B is a premium brand sofa and arm chair supplier which operates world-wide. Both firms have an interdisciplinary employee group working with product development and design, 23 persons in Firm A and 24 persons in Firm B. Table 1 summarizes main characteristics of the case firms.

Table 1 Details of two case studies

	Firm A	Firm B
Main product	Office chairs	Sofas and arm chairs
No. of employees	366	940
Turnover (million) 2010	US$165	US$430
Formal interviews	6	10
Formal meetings	2	2

A research protocol describing data collection methods based on the SI framework was developed and pretested before conducting the research [19]. Semi-structured interviews were conducted with product designers, engineers, product development-, environmental-, and purchasing managers. Field notes were written up sequentially following each interview. Data were analyzed with the objective of identifying those information elements considered most important and most accessible to product development and design. This meant ranking the information elements with quantitative criteria, and to accumulate all interview results for each case firm.

Results and discussion

Table 2 presents the combined results from both case firms. The table includes information elements considered especially important to product development and design in the furniture industry. Their corresponding accessibility presented per stakeholder group is also included. The firms responded quite similarly on SI importance for the following stakeholder groups: government, NGOs, academia, industry associations, shareholders, financial institutions, competitors, and internal stakeholders. The results varied more the stakeholder groups: media, suppliers, and customers.

Table 2 High importance SI in two Norwegian furniture manufacturers combined

Stakeholder group	Furniture industry Description of sustainability information element ("information on……")	Access High (H) Low (L)
Government	Pre-regulations (new regulations) concerning sustainability issues	H
	National guidelines and priorities within Integrated Pollution Prevention and Control (IPPC)	H
	Export/import countries' sustainability regulations	H
	Purchasing guidelines and requirements for social and environmental responsible public procurement	H
	Mandatory requirements under Registration, Evaluation and Authorization of Chemicals (REACh)	H
NGOs	Requirements for sustainability-labelling or sustainability certificates managed by NGOs	H
	Campaigns targeted at specific products, substances, firms, practices, or industries (negative information)	H
	Sustainable performance test results and ranking lists(NGOs' "black lists")	H
Media	Interests, values, preferences, and dislikes related to a product or firm	H
	Documentaries and campaigns targeted at specific products, substances, firms, or industries (negative information)	H
Shareholders	Attitudes and values on sustainability issues	H
Academia	Sustainability issues through knowledge exchange, practice transfer (workshops, students), and research	H
	Priority settings for new sustainability related research areas and calls	L
	Work and cooperation with standardization organizations	H
Industry Associations	Sustainable technologies and other relevant sustainable issues	H
	Current or pre-regulations concerning sustainability issues	H
Competitors	Communication and marketing material on sustainability issues	H
	Adherence to legislation or voluntary sustainability-labelling or sustainability certificates/standards	H
	Corporate sustainability policies, management systems, and performance	H
Suppliers	Use and volume of hazardous substances in product or in packaging	H
	Adherence to legislation or voluntary sustainability-labelling or sustainability	L

Stakeholder group	Furniture industry Description of sustainability information element ("information on…….")	Access High (H) Low (L)
	certificates/standards	
	Honesty, trust, respect, and fairness in business relations	L
	Service, price, quality, cost, and delivery	H
	Innovation abilities and product development activities	H
	Financial situation and stability	L
	Use of reusable and recyclable materials	L
	Labour practices (SA 8000, fair labour code of conduct, and ILO's Decent Work standard)	L
	Adherence to the UNs Human Rights Declaration	H
	Local impacts on natural resources, land, and biodiversity at suppliers' production facilities	H
	Energy use (non-efficient, non-renewable and non- sustainable sources of energy), or commitment to energy saving projects	L
	Supplier's supplier selection programs and purchasing policy	L
	Sustainability communication with stakeholder groups, including communication of sustainable benchmark results to customers or markets (e.g. AA1000, GRI)	L
	Corporate sustainability policies and management systems	L
Customers	Perceived personal factors and benefits from the product (satisfaction), perceived product meaning	H
	Sustainability perception as to the product (e.g. if the product is considered better/worse than similar products on the market)	H
	Behaviour in a social-cultural market context, what influences the purchase decision?	L
	Preferences for sustainable products from sustainable firms	H
	Fashions and trends within the product segment - trend sensitivity – the wish to have up-to-date products	H
	Use of current product on market or similar products if product does not exist, with respect to sustainability aspects (lifetime, durability, reliability, upgrade options, maintenance requirements, and EOL scenarios)	L
	Lock-ins and habits of unsustainable practices	H
	Perception of firm sustainability image (reputation)	L
	Sustainable performance requirements towards delivered product or service	H
	Preferences for services instead of physical products. Social barriers towards shared use of products or open-mindedness towards renting and shared use.	L
Internal Stakeholders	Labour practices (SA 8000, fair labour code of conduct, and ILO's Decent Work standard)	H
	Adherence to sustainability standards (e.g. ISO 14000-series)	H
	Freedom of speech and open information in firm	H
	Commitment to transparency in firm decision making	H
	Commitment to use effective environmental accounting systems and management tools with performance indicators (e.g. TBL accounting, LCA, EPD, GRI)	H
	Internal investments in sustainable technologies	H
	Commitment and adherence to corporate sustainability policies and management systems	H
	Adherence to sustainability-labelling (e.g. EU Flower, EU Energy Label, Nordic Swan, German Blue Angels, Forest Stewardship Council, Marine Stewardship Council, Fair Trade, Energy Star, etc.)	H
	Education and training programs for employees (sustainability related and other programs)	H
	Impacts on local natural resources, land, and biodiversity at production facilities	H
	Commitment to advertising norms, i.e. responsible marketing (e.g. green washing, not provide damaging offers)	H
	Motivational activities towards customers to promote recovery of products and components for reuse, recycling, or treatment/disposal, and to keep records of and track where the firm's products are (EOL instructions)	H

EOL = End of Life, ILO = International Labour Organization, AA1000 = AccountAbility standard, GRI = Global Reporting Initiative, SA 8000 = Social Accountability standard, TBL = Triple Bottom Line, LCA = Life Cycle Assessment, EPD = Environmental Product Declaration.

Sustainability information importance

SI on regulations and upcoming regulations in particular was considered especially important to both firms. It was emphasized that adapting to upcoming regulations in product development was considered a competitive advantage, which corresponds with a previous finding in the automotive industry [8]. All such "early warning" information signals from governmental and standardization bodies were perceived important to product development

and design. Furthermore, requirements for eco-labels and other relevant certificates were considered a prerequisite in the product development process.

Both firms acknowledged the importance of purchasing guidelines and requirements for environmentally responsible public procurement, but firm A ranked this information element as most important. Firm A commented; *"we have more sustainability knowledge and our products have higher sustainability standards on issues than what is currently demanded in purchasing guidelines from firms or institutions".* Firm A found it problematic that customers' lack of sustainability knowledge sometimes led to favoring of "green washed" firms or products. *Different end-customers* may explain this difference as firm A has both private and public institutions as end-customers and is consequently more dependent on purchasing guidelines than firm B, whose end-customers are primarily private consumers. Different end-customers may also account for that firm B rated SI from media as more important than did firm B. Supplying premium furniture to private end-customers makes firm B more dependent on favorable media attention, than firm A which depends more on procurement guidelines.

Both firms rated SI from academia as important, and emphasized academia as important "knowledge brokers". Especially SI regarding more environmentally friendly materials like bio-textiles, recycled polyethylene-terephthalate (PET), and laminates was highlighted as topics of interest. Research institutions acting as suppliers of knowledge have also been previously reported in research [17]. Shareholders' and investors' values on sustainability issues were in general considered important to product development and design, which comes as no surprise as both firms are owned by private investors. Satisfying investors' and tending to their priorities is always important for privately owned firms. Firm A arranges yearly corporate days where best practices and SI are shared and investors' values on sustainability issues are communicated. Firm B was until recently were owned by a family, who also had several leading positions in the firm. Thus, values and preferences on sustainability issues were shared and communicated on a daily basis in this firm.

Marketing material from competitors on sustainable activities was considered very useful to product development and design by both of the firms, as well as competitors' sustainable performance and activities. However, both firms stated very clearly that they were most interested in such SI if it was supported by trustworthy documentation.

Supplier information was considered important by both firms as suppliers' sustainability performance and activities directly affect the sustainability performance of the final product. It was emphasized in both firms that supplier selection, supplier development, and auditing would be the purchasing managers' responsibility. Both firms practice a "back to back" principle; they check their suppliers and their suppliers' systems for checking other suppliers upstream the value chain. Both firms reported to have code of conduct documents and ethical standards stating supplier obligations. Firm B, for instance, adheres to the UN Global Compact, whereas firm A adheres to Ethical Trading Initiative-Norway. Firm A reported examples of suppliers being terminated from development projects due to poor working conditions in factories. Firm B on the other hand, deliberately sourced *acknowledged suppliers* from Scandinavia or Europe to avoid such problems. Both firms argued that if follow-up costs, cost of poor quality, and transportation costs were added to the purchasing cost of sourcing parts in low cost countries, then the price difference in their product segment (i.e. premium brand furniture) was marginal.

Customer (end-user) expectations and perceptions of the product or firm regarding sustainability issues were in general considered important by both firms. However, there were significant differences in the ranking of information importance which may be due to the different *end-customers*, i.e. institutional customers vs. private consumers. All in all, both firms felt that they were in the driving seat with respect to sustainability issues, rather than

being "pushed" by customers' expectations. The demand for more sustainable furniture has until now not been very noticeable for either firms, but both hope their unique position will give them a future competitive advantage in this respect.

Both firms ranked many of the same internal sustainability information elements as important. The strong internal focus by both firms clearly demonstrates that sustainability initiatives on products must start within the firm by having clear visions and goals, competence, and high internal standards on sustainability issues throughout the organization. Aiming at improving the sustainability performance of products without high internal sustainability standards is not likely to succeed, as what management does, not says, becomes the rule. In this respect most Norwegian manufacturers have a head start compared to firms in developing countries, as strict legislation on pollution prevention, internal health and safety standards, as well as a strong business democracy since the early 70s is a good foundation for tomorrow's sustainability initiatives.

Finally, an interesting question to address is which types of SI firms consider not to be of importance, and why. Some general trends emerge in the collected material; information on community development or philanthropy activities, internal population shifts, or direct and indirect employment in developing countries (e.g. the ethics in business decisions regarding second and third world countries), were all considered unimportant for product development and design. Several of the interviewees in both firms emphasized, however, that on a personal level such information should be considered, but in a professional context these issues would not be important. They supported this argument by referring to current firm *strategies and priorities*, which currently do not say anything about these topics. In addition, SI from financial institutions (banks and insurance firms) was mostly considered "nice to have" in relation to product development and design. However, both firms underlined the importance of such information to firm brand and reputation as the firms do not wish to be associated with a partner with questionable sustainability performance.

In terms of profession function, *product development managers* in both firms ranked more SI as important than did the product designers. These managers are responsible for design strategies, for fulfilling and communicating firm goals through design, as well as being the connecting link between product development and management. Due to this role, they are likely to think in ways more strategic, long-term, and holistic. They are also the ones held responsible if a new product fails to fulfill future governmental or customer requirements, which might explain why they rank more information elements as important. Product designers on the other hand have to consider a wide range of information in their work (e.g. product features, functions, emotions, deeper meaning) in addition to SI. As more information complicates their work, they are apparently inclined to be more conservative when evaluating which information elements are important or not.

Sustainability information accessibility

Both firms reported to engage in several *information generating activities* with stakeholders, i.e. activities to make SI more accessible. The firms are active members in standardization organizations and various industry associations, advocating their views on sustainability matters. At the same time, these meeting places become platforms for information sharing between firms in the same industry, and provide firms with a unique opportunity to get early information on planned actions within their field. Research projects and collaboration with academia are yet another activity reported to provide relevant SI.

The firms also addressed needs for more systematic routines for collecting sustainability information. At furniture fairs they critically examine competitors' activities and performance. "Tear downs" are also performed, in which competitors' chairs or sofas are disassembled to obtain product information. Moreover, both firms regularly involve

customers in their development processes, to obtain customers' opinion on prototype models for instance. Collecting SI by way of such activities has previously not been performed; hence both firms emphasized this as an improvement opportunity.
A distinct difference between the firms was noticed in the way they perceive SI accessibility. Firm A ranked more SI as easy accessible than did firm B, which may be explained by *how environmental managers are organized*. In firm A, the environmental manger is organized within the product development department, but not in firm B. Being integrated in the product development department, and also physically situated next to product designers, the environmental manger in firm A can easily forward relevant SI continuously. According to the interviewees, forwarding SI is one of the most important tasks of the environmental manager, in addition to being the environmental champion of the organization, pushing and inspiring environmental product improvements.

Conclusion

Extensive amounts of information are used in product development and design processes. Seeking out relevant SI may therefore be a key to increased sustainability knowledge and awareness in product development and design, which may further enhance firms' ability and opportunity to develop and manufacture more sustainable products. Sustainable products may be one way of adding value to products beyond functionality, quality, and cost, and thus increase firms' competitiveness.
This article has through two case studies explored SI grounded in stakeholder theory beyond mere product and process data. Based on product developers' own priorities, information elements considered most important to product development and design have been identified by combining the results from both firms. The SI introduced may be used in the early phases of product development and design for developing requirements and specifications, in all development phases as general decision support, or for building knowledge on future scenarios which may inspire entirely new meanings to products through sustainability.
All in all, the firms responded quite similar concerning SI importance for all stakeholder groups, except media, suppliers, and customers. Factors suggested influencing SI importance in the case firms are: type of end-customers, type of suppliers, and firm strategies and priorities. Once SI importance has been established, easy access to SI is key to increased knowledge on sustainability issues in product development and design, which again is important to make knowledged-based decisions. Above all, accessibility is a practical issue which can be solved once factors influencing perceived SI accessibility in firms have been identified. The most prominent factors found to influence SI accessibility was in these case studies related to information generating activities and the way the environmental manager function is organized. Besides the practical implications of these case studies described, this article may have an academic value by adding to the limited body of knowledge on information issues in relation to sustainable product development and design. The studies also add to the organizational aspects and the soft side of sustainable product development, by presenting factors influencing sustainability information importance and accessibility.

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