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Application of ecodesign strategies amongst Australian industrial design consultancies

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By promoting and applying ecologically sustainable design (ecodesign) strategies in the product planning stage, industrial designers can have significant influence on reducing the environmental impacts of products. Despite this potential, there remains little quantitative analysis of the awareness, application and influence of ecodesign praxis amongst industrial designers. This paper presents a comprehensive content analysis of the websites of 96 industrial design (ID) consultancies in Australia, probing for evidences of ecodesign application in each company's capability statement and project portfolios. Our study found that that less than half of consultancies visibly promote their ecodesign activities on websites.

Reducing the environmental impact of our consumption through the development of appropriate products is one potential facilitator for a necessary shift towards a truly sustainable society (Schmidt-Bleek, 1999). A considerable body of literature is available for product developers who are willing to consider ecological aspects. Industrial designers are significant actors in most product development processes; therefore they have significant potential to contribute to the reduction of the environmental impact of new products. The ecodesign manual by Brezet and Van Hemel (1997) which is addressed, amongst others, to industrial designers, offers 8 strategies and 33 sub-strategies to improve the environmental performance of products throughout their lifecycles (see Table 1).

The literature suggests that early integration of ecodesign during product development guarantees the best economical and ecological outcome (Giudice, et al., 2006; Tischner, et al., 2000). The product development process can be divided in two major phases: the product planning phase and the strict development phase (Melgin, 1991; Roozenburg & Eekels, 1995). During product planning the goals, strategies and policy for the product development are formulated, and ideas for a new product or business are generated and selected; on the other hand the strict development phase involves designing the product and developing plans for producing and marketing the newly designed product.

There is ambiguity in the role of industrial designers in this process; studies suggest that they can ably contribute to both phases (Bakker, 1995; Roozenburg & Eekels, 1995). Bakker (1995) differentiates those industrial designers who work on product planning tasks as taking on a "strategic" role while those in strict development activities are engaged in an "operational" role. She stresses that the particular role industrial designers play in the product development process is crucial to the extent they can implement ecodesign. Lofthouse (2004) asserts that the majority of designers perform operational roles. However Weiss (2002) observes that industrial design (ID) consultancies are increasingly taking over strategic tasks. To what extent they do so is unclear and will be explored in this paper.

Table 1: Ecodesign Strategies

Source: Brezet and Van Hemel (1997)

	Strategy	Sub-strategies
@*	New concept development	Dematerialization, shared use of product, integration of functions, functional optimization of product components
	Product component level	
1	Selection of low impact materials	Cleaner materials, renewable materials, lower energy content materials, recycled materials, recyclable materials
2	Reduction of materials usage	Reduction in weight, reduction in transport volume
	Product structure level	
3	Optimization of production techniques	Alternative production techniques, fewer production steps, lower/cleaner energy consumption during production, less production waste, fewer/cleaner production consumables
4	Optimization of distribution system	Less/cleaner/reusable packaging, energy-efficient transport mode, energy-efficient logistics
5	Reduction of impact during use	Lower energy consumption during use, cleaner energy source, fewer consumables needed, cleaner consumables, no waste of energy/consumables
	Product system level	
6	Optimization of initial lifetime	Reliability and durability, easier maintenance and repair, modular product structure, classic design, strong product-user relation
7	Optimization of end-of-life system	Reuse of product, remanufacturing/refurbishing, recycling of materials, safer incineration

* This strategy has been given the symbol '@' because it is much more innovative than the seven other strategies

Australian context for ecodesign

Like most industrialised countries, Australia has a vivid ID community. Eleven universities offer courses in industrial design or product design. There are over 90 Australian ID consultancies providing local and global manufacturers with expert design advice and directions. Several design festivals and international trade exhibitions are clear indicators of an active design scene.

From 1994 to 1997, the Australian Government funded the EcoReDesign™ program, which brought together Australian designers, researchers and businesses to rethink products for a greener market. Coordinated by the Centre for Design (CfD) at the Royal Melbourne Institute of Technology (RMIT), the program explored the application of life cycle assessment, design for assembly and cleaner production techniques in order to optimize the environmental and economic performance of products. Seven Australian manufacturers participated in the program, which resulted in a series of products demonstrating that the environment can be viewed as an opportunity for creative yet sustainable activities, and not as a threat (CfD, 1997). Even though the EcoReDesign outcomes were perceived as a success by its participants (Sweatman & Gertsakis, 1997) and mentioned as positive examples in ecodesign literature overseas (Tischner, et al., 2000), the program did not continue beyond its 3-year funding. Reflecting on the program's success a decade after its launch, Ryan (2003) concludes that the EcoReDesign™ program did not have a significant impact on the design of mainstream Australian products, blaming this mainly on a weak legislative framework.

Ecodesign praxis

Reports about the state of application of ecodesign in Europe and Asia (Charter, et al., 2003; Lindahl, 2007; Mathieux, et al., 2001; Tukker, et al., 2001) support Ryan's (2003) conclusions about the importance of a progressive legislation as a powerful driver for ecodesign. All conclude that ecodesign praxis has not yet reached maturity. The studies mainly focus on management and engineering departments of manufacturing companies and do not pay specific attention to ID practitioners or ID consultan-

cies. Ecodesign literature specifically addressing the ID discipline largely focuses on information needs of industrial designers and/or suggests tools and strategies for practising ecodesign (Bakker, 1995; Datschefski, 2001; White, 2004; White, et al., 2000). Some exceptions to this trend are described below.

Studies from the UK and Japan dealt more with the actual state of ID involvement in ecodesign praxis. Sherwin (2000) and Lofthouse (2004) investigated in the role of industrial designers employed at Electrolux in ecodesign. Other research from the UK, based on surveys, conducted in the mid-1990s, showed little ecodesign awareness and praxis amongst ID practitioners (Sherwin, 2000). They survey of Ueda et al (2003) among Japanese industrial designers, mostly employed in product design departments of manufacturing firms (and some working in ID consultancies), identified a gap between the designer's personal attitude towards ecodesign, described as proactive, and their actual actions, classified as reactive, to the strong Japanese guidelines. Furthermore the Japanese designers showed little awareness of ecodesign sub-strategies expressed in the literature. Tools like LCA (life cycle assessment) did not find broad application. Japanese industrial designers focused on "operational decisions such as production, material and disposal, yet no strategic decisions" (Ueda, et al., 2003). The most prominent drivers for ecodesign identified in this study are feelings of social responsibility towards the environment and market opportunities.

No study was found specifically considering the role of the ID consultancy as different to the role of employed industrial designers. Specifically for Australia there was no research found that attempts to quantify the extent of ecodesign praxis in ID consultancies.

Research Aims & Methods

This paper aims to clarify the extent to which Australian ID consultancies practice and promote ecodesign. It will also investigate the role that industrial designers have within the product development process in general as well as in implementing ecodesign.

To achieve these aims the contents of the commercial websites of Australian ID consultancies were analysed in depth and interpreted. This involved firstly compiling the web addresses of the ID consultancies from Google searches and from international and Australian databases as www.core77.com, www.yellowpages.com.au, www.dia.org.au and www.australiandesign.org.au. ID consultancies without a website and companies not focused on product development services were excluded. Ninety-six websites were considered valid for the study.

Commercial websites are a key vehicle for communicating the corporate profile (Capriotti & Moreno, 2007). These give insight into the services that the design consultancy offers and the arguments used for advertising these services. A limitation of the website based approach is that the website is not the only way for ID consultancies to advertise their services. Portfolio presentations by consultancy representatives are likely to deliver a more complete picture. However, as Capriotti and Moreno (2007) point out, companies usually extensively communicate corporate responsibility issues such as environmental action on their website.

It has been discussed earlier that the activities conducted by industrial designers can be seen to fall in two major phases of the product development process (Roozenburg & Eekels, 1995). These phases served as the framework for this paper. To locate the role of the ID consultancy in this process, the services described on the websites were compared with this framework. Building on the terminology introduced by Bakker (1995), consultancies offering services for the product planning phase are labelled as strategic and those who engage during the strict development phase are termed operational. For those consultancies that offer services in both phases, the terminology holistic is used.

To identify the involvement of the ID consultancies in ecodesign, their websites were checked for 7 criteria, summed up in Table 2. Application of the various ecodesign strategies and sub-strategies [Table 1] outlined by Brezet and Van Hemel (1997) were noted in the work examples displayed on the websites, as well as in consultancy's statement of capabilities. Moreover, affiliation with any environmentally conscious designers' coalitions was noted.

Table 2: Checklist for ecodesign involvement

Criteria	Measure
Indication of awareness about ecological sustainability	Yes / No
Explicit mention of ecodesign strategies as a capability	Yes (Specify which) / No
Examples of work that have been designed using ecodesign strategies	Yes (Specify which) / No
Ratio of ecodesign examples to overall products shown in portfolio	Ratio
Support/tools used for practising ecodesign	Yes (Specify which) / No
Affiliation in environmental conscious associations for designers	Yes / No
Arguments for promoting ecodesign	Yes (Specify which) / No

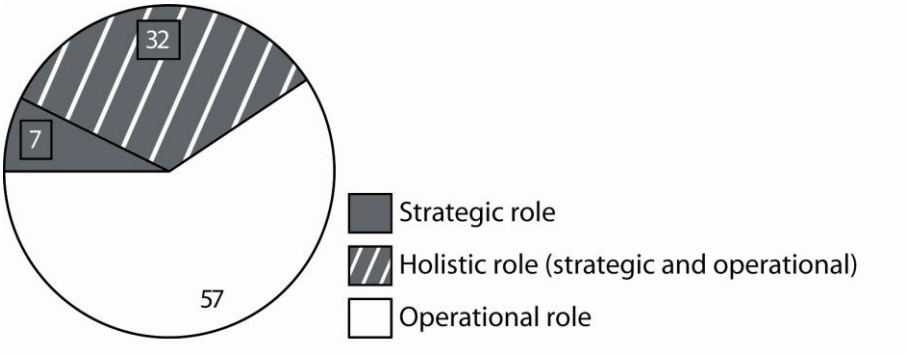
Findings

Not all the links to Australian ID consultancies found in the online databases were usable for the data collection. Sometimes ID consultancies were registered several times, and in some cases the website no longer exists. Out of 160 entries at www.core77.com only 56 websites were acceptable. In total 96 valid websites of ID consultancies were found.

The role of Australian ID consultancies

A little over half of the investigated ID consultancies (n=57) only offer services for the strict development phase and are therefore classified as working in an operational role. Thirty nine ID consultancies who offer services in the product planning phase were found. Seven of those do not offer services for the strict development phase and are hence classified as working in a strategic role. The other 32, who offer services for both product development phases are classified as holistic [see Figure 1].

Figure 1: Roles taken by industrial designers in consultancies



Ecodesign praxis

Almost half of the ID consultancies (43/96 = 45%) indicate some aspects of promoting their environmental awareness. Three of them also communicated their engagement in social sustainability. How the ID consultancies expressed their environmental awareness is indicated in Figure 2. Nineteen showed examples of their ecodesign projects in their portfolio, but do not specifically point out ecodesign as one of their company's capabilities. A further thirteen showed ecodesign examples as well as explicitly mentioned ecodesign strategies in their service offerings. Notably the ecodesign strategies from the capability statements do not always match the ones applied in the examples. Nine consultancies alluded to ecodesign strategies in their capability statement but do not show any examples. Two companies highlighted their environmental awareness, without showing evidence of environmental projects in their portfolio or mentioning ecodesign strategies in their capability statement. One of those two claims to be

carbon-neutral. Among those who showed ecodesign examples in their portfolios, the average ratio of conventional products to ecologically designed products is 25:3.

Figure 2: Indication of environmental awareness in websites

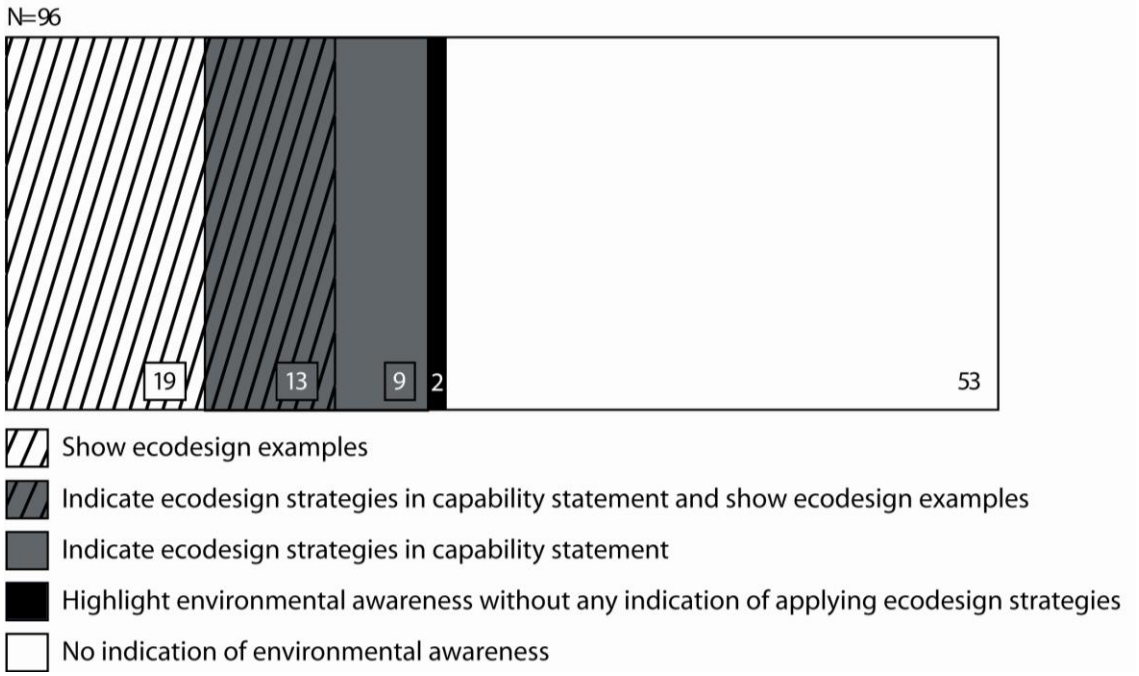


Figure 3 shows the number of ID consultancies that advertise and/or apply a specific ecodesign strategy, as indicated by the overall bar lengths. The structure in the bar gives insight on how evidence for them was found on the websites:

- The dark grey section indicates those only showing examples of a particular ecodesign strategy.
- The white section represents those who advertise each ecodesign strategy in their capability statement
- The light grey section denotes those that advertise a certain ecodesign strategy and actually apply it in an example exhibited in their portfolio.

The study did not find a single ID consultancy that covers all the 8 ecodesign strategies in its capability statement. Keywords related to the strategy "new concept development" to reduce the environmental impact – such as dematerialization, shared use, functional integration or optimization – were never mentioned. However, examples on four websites show new product concepts to fulfil a consumer's need in a less environmental harmful way. Adding the ecodesign strategies applied in examples and those advertised in the capability statements, only one ID consultancy was found to communicate coverage of all ecodesign strategies. The most popular ecodesign strategy is "selection of low impact material". The other widely used strategies are: "reduction of impact during use", "optimization of end-of-life system" and "optimization of initial life time". A selection of the descriptive statements used to communicate these prevalent strategies is shown in Table 3.

Figure 3: Application of ecodesign strategies

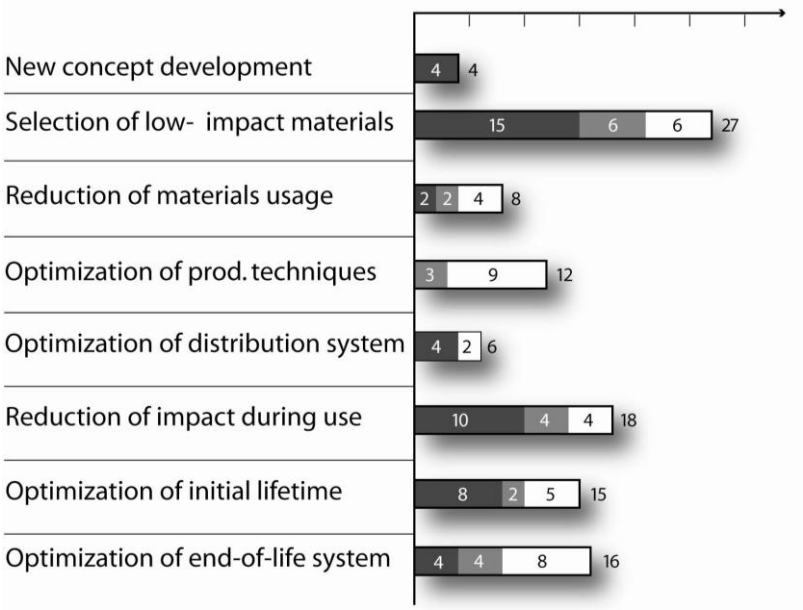


Table 3: Language used to communicate use of ecodesign strategies

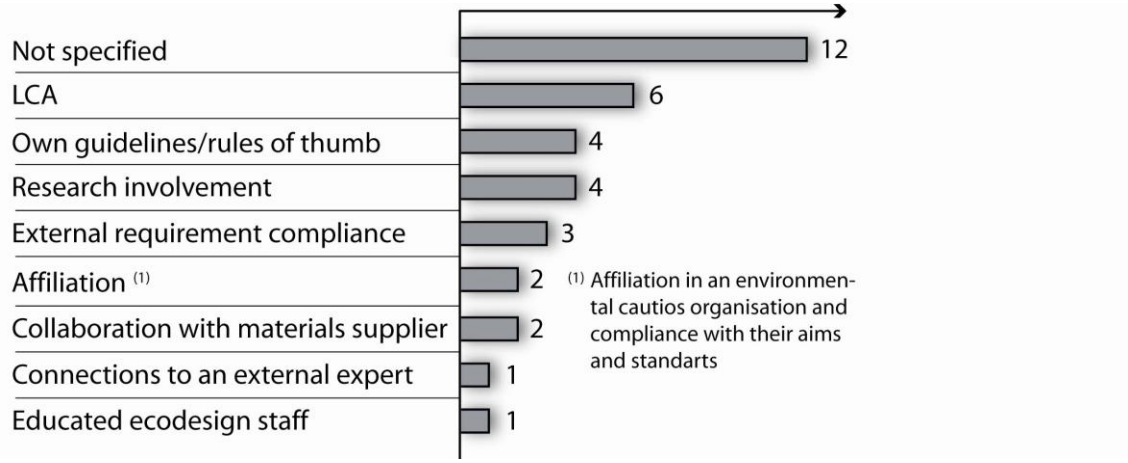
Ecodesign strategy	Examples of quotations
Selection of low impact material	"made of bioplastics from a variety of renewable resources" "made from virgin and recycled wool" "made from 100% recyclable polymer" "created from 100% post consumer recycled content" "made from recycled cardboard"
Reduction of impact during use	"solar powered LED light" "inbuilt solar panel for extraordinary battery life" "uses an energy efficient fuel cell" "uses a halogen energy saver" "the burner was designed to burn efficiently"
Optimization of end-of-life system	"designed for disassembly" "will degrade once you put it on a landfill" "can be broken down into raw materials for recycling quickly and efficiently" "made from 100% recyclable polymer" "using high quality poly carbonate makes the glasses... 100% recyclable"
Optimization of initial life time	"stainless steel, being a durable material" "components are repairable rather than replaceable" "scratch resistant" "physically durable" "personalising ... would encourage people to 'own' and re-use"

Ecodesign support/tools

The ID consultancies that only showed ecodesign examples on their websites do not specify the support/tools they use for practising ecodesign. Therefore the data about the support/tools was collected only from the 22 ID consultancies who explicitly mention ecodesign as one of their capabilities in their service offering statements. The number of Australian ID consultancies using various support/tools is indicated in Figure 4. The majority do not give evidence of any support/tool. The most popular tool, mentioned by 6 consultancies, is LCA (life cycle assessment). One design office works with an external expert for its LCA needs. Two ID consultancies use the Greenfly LCA tool (www.greenflyonline.org) developed by the Centre for Design at RMIT. Ten consultancies are members of the Designers Accord (www.designersaccord.org), an international agreement among designers, educators and business leaders to catalyse innovative and sustainable problem solving throughout the creative community. Two of them

point out that their concordance with the Designers Accord principles helps their efforts in ecodesign. Involvement in academic research, as a way of fostering ecodesign, was mentioned by 4 ID consultancies. Three of them specify RMIT as their academic partner. Four ID consultancies have developed their own guidelines or rules of thumb.

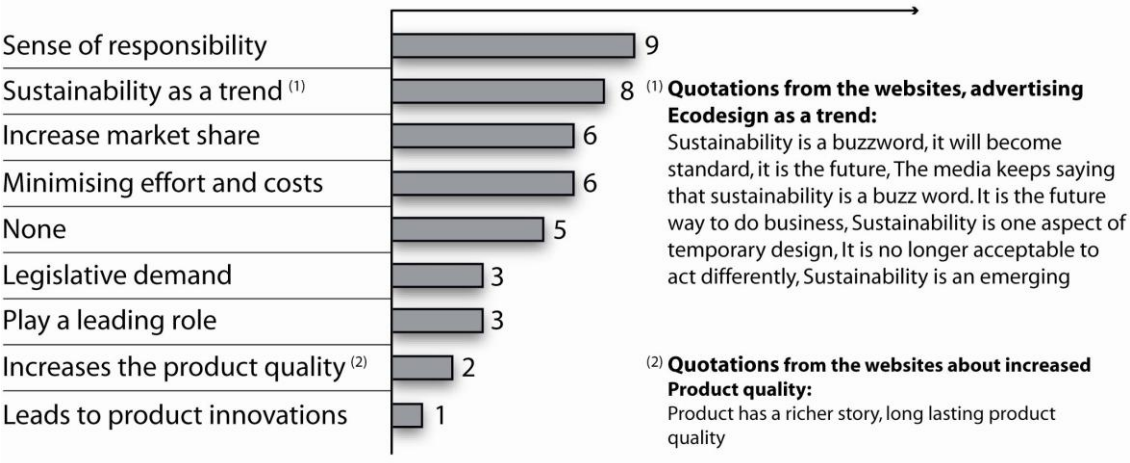
Figure 4: Ecodesign support/tools in capability statements (n= 22)



Arguments for Ecodesign

The information about the arguments used by ID consultancies to promote ecodesign was drawn from the 22 websites that explicitly mention ecodesign as a capability of the consultancy. How many thereby use which arguments is indicated in Figure 5. The most popular argument for ecodesign is "sense of responsibility" towards the environment and future generations, closely followed by highlighting (ecological) "sustainability as a trend". This trend and its implications do not get specified further (see quotations). Legislative demand, playing a leading role, product quality enrichment, and sparking product innovations also surfaced as drivers for pursuing ecodesign activities.

Figure 5: Reasons for pursuing ecodesign (n=22)



Discussion

The role of the Australian ID consultancies

ID consultancies in the United States are increasingly playing strategic roles in the product development process (Weiss, 2002). We did not find comparable data about this trend for Australia. Lofthouse (2004) identified that industrial designers employed in a manufacturing company typically spend 90% of their time focussing on the operational end of design. Our findings show 40% of the Australian ID consultancies represent themselves in a holistic or a strategic role. This can be seen as an indication that ID consultancies can take over a more strategic role in the product development process than industrial designers employed in manufacturing firms. One reason for this may be that the role of ID consultancies as external consultants differs from the one of internally employed industrial designers. Another explanation for this may be the fact that ID consultancies employ not only industrial designers but also specialists from other disciplines. This might give them the possibility to cover a broader range of product development services.

Ecodesign praxis among Australian ID consultancies

In their advertised projects and capability statements, the majority of Australian consultancies did not demonstrate evidence of the broad range of ecodesign strategies and sub-strategies that are discussed throughout the scientific literature. This is similar to another study that concluded that Japanese industrial designers mostly lack familiarity with ecodesign principles (Ueda, et al., 2003). The presence of own rules of thumbs and guidelines for ecodesign on the websites of the ID consultancies insinuate that ecodesign praxis appears disconnected from ecodesign theory. Interestingly the strategy "new concept development" is the most underrepresented ecodesign strategy and completely absent from all capability statements.

One reason for this can be that the new concepts could have been planned by the client without involving designers. It can be noted that of the 39 consultancies who took on strategic or holistic roles in product development – and who are in a good position to suggest new environmentally responsible concepts – more than half (n=23) advertise ecodesign. Some of them even state that reducing the environmental impact of the products they design is one of their core concerns. The absence of the strategy "new concept development" might suggest that they are not aware of their full ecodesign potential. Most ecodesign literature underlines that only those new concepts that fulfil our needs in less environmental harmful ways have the potential to significantly reduce impact (Sherwin, 2000).

Ecodesign theorists stress the importance of early integration of ecological considerations in the design process (Tischner, et al., 2000). By far the most popular ecodesign strategy among Australian ID consultancies is "selection of low-impact materials". Similar findings were obtained by studies covering other industries: Van Hemel and Cramer (2002) highlighted that among the most successful solutions in SMEs were "recycling of material" as well as "recycled material". However, since materials selection happens later in the product development process (Roozenburg & Eekels, 1995), it appears that the suggestion of early integration of ecodesign is rarely followed.

Especially regarding environmentally aware ID consultancies in an either strategic or holistic role this is interesting. It may indicate that their role is rather operational in the context of ecodesign, making it difficult for them to integrate ecodesign in earlier phases of the product development process. Similar findings in Japan show that industrial designers are personally aware of the need to develop new concepts but do not transfer this to praxis (Ueda, et al., 2003). Another explanation for that may be that ID consultancies are simply not familiar with other possible ecodesign strategies, and that the "selection of low-impact materials" is the most obvious to them. For applying this strategy, the use of either recycled or recyclable material was pointed out by most ID consultancies. As theoretically almost any material can be recycled with enough effort (Ayres, 1999), it is questionable how effectively this strategy gets applied.

Nowadays, many products end up in landfill before they actually reach the end of their useful life. To improve this unsustainable situation, ecodesign literature advocate designing for long-term emotional attachment between the user and the product (Chapman, 2005; Mugge, et al., 2008; Van Hinte, 1997). Anticipating and influencing the emotional functions of a product via its form and appearance may be considered as one of the core competencies of the ID profession. However, emotional attachment is only mentioned by two ID consultancies for the strategy "optimization of initial lifetime"; most point out

physical robustness and reparability of their products [Table 3]. Certainly durability attributes can be influenced industrial designers, but appear to be more a core competency of engineering disciplines.

Regarding the examples for the strategy "reduction of impact during use", it is in many cases questionable how far the ID consultancy contributed to the product's reduced environmental impact. For this ecodesign strategy, many ID consultancies highlighted the low energy consumption of electrical components in their devices [Table 3]. Davis and White (2003) assert that industrial designers have little influence on the design of internal components like PCBs or electric motors. They may be able to choose from different components or to relocate their position in the product, but it is unlikely that they would actually design less energy-intensive electrical components. For this strategy and that of "optimization of initial lifetime", it again appears that consultancies are unable to seize the full potential that industrial designers can exert in ecodesign. A reduced impact during use can, in many cases, be achieved by positively influencing the product usage and behavioural patterns of the final consumers. The industrial designer can have a major role in planning how users would interact with their designed products, so it is somewhat surprising that this sub-strategy rarely gets mentioned.

Arguments for Ecodesign

The communication of supporting arguments for the consultancy's use of ecodesign appeared unstructured. None of the ID consultancies explicitly listed the drivers for ecodesign that could potentially make their services more attractive to clients. This contrasts with the ecodesign literature, where extensive lists of drivers for ecodesign can be found (Brezet & Van Hemel, 1997; Lewis, et al., 2001; Tischner, et al., 2000; Wimmer, et al., 2004).

Interestingly, the most popular argument used for promoting ecodesign is not minimising effort and costs but sense of responsibility. This matches findings in Japan, where sense of responsibility and market opportunities are listed as the most important motivators for ecodesign (Ueda, et al., 2003). In the United States, industrial designers identified cost analysis as the most effective information to convince clients about ecodesign attributes (Davis & White, 2003).

Compliance with legislative demands such as the WEEE (Waste Electrical and Electronic Equipment Directive) or the RoHS (Restriction of Hazardous Substances Directive) was rarely used to encourage client uptake of the consultancy's ecodesign capabilities. This may concur with Chris Ryan's (2003) assertions that the weak Australian legislative framework fails to support ecodesign. However the portfolios of Australian ID consultancies show many products designed for the global market. For these products, conforming with more rigid environmental legislation in Europe and the USA is an issue. It may be that the interventions possible by industrial designers do not have a significant enough impact on the product's properties that are targeted by the legislative frameworks. Especially for the RoHS this is highly likely. Industrial designers might have high influence over the plastic type that is used but low influence over the additives and flame retardants or toxics in electronic components (Davis & White, 2003).

Highlighting sustainability as an important trend is the second most popular argument used for fostering ecodesign. However, this is done in general, broad-sweeping statements and no tangible benefits of adopting this trend are expressed.

Conclusion

This paper contributes to clarifying the extent to which Australian ID consultancies practice and promote ecodesign.

There is awareness among almost half of Australian ID consultancies about the environmental impact of the products they design and the possibility to lessen this impact through ecodesign. Their approaches to ecodesign are mainly focussed on material selection and the integration of ecodesign appears to happen rather late in the product development process. Ecodesign appears far from being a priority for Australian ID consultancies: even the environmentally aware ID consultancies typically showed significantly more conventional products than ecologically designed ones. The sustainable design strategies are communicated in a rather unstructured way, as statements about capabilities in ecodesign often do not match the ecodesign examples shown on the same website.

We showed that almost 40% of Australian ID consultancies are in a role where they can influence the product planning phase. They therefore are in a good position to integrate ecodesign early in the product

development process or even suggest new concepts with a reduced environmental impact. In particular, ID consultancies do not seem to realize their full potential for ecodesign, as the "new concept development" for a significantly reduced environmental impact is the most underrepresented ecodesign strategy. Moreover environmentally aware ID consultancies with less influence on the product planning phase did not seem to fully embrace their possibilities for radically improving the sustainability of their solutions.

One barrier that may be hindering ID consultancies from fully integrating ecodesign in their practice may be the identified difficulty in defining and articulating to their clients the tangible benefits of engaging in more environmentally sustainable business approaches. Furthermore legislation appears to currently have a rather weak influence in pushing manufacturers and designers to strongly pursue ecological sustainability in their product development practices. Another barrier might be a lack of knowledge about ecodesign on behalf of ID consultancies and practitioners. Our findings indicate that they might not be aware of all the possibilities they have for ecodesign.

To clarify if the findings are Australian-specific or may be seen as representative for ID consultancies generally, further research in different countries is necessary. This will be covered through the ongoing Master's research thesis of the lead author of this paper.

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