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Ecodesign tools for Designers: Defining the Requirements

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Abstract

This paper presents the findings from a research project which set out to understand the type of requirements that industrial designers have of ecodesign tools, through the use of a web based prototype. Through qualitative data collection and analysis a number of important criteria for ecodesign tools were identified. The conclusions recognise the importance of developing holistic tools for industrial designers, identifying that a combination of guidance, education and information, along with well considered content, appropriate presentation and easy access, are all critical to their success. A framework for ecodesign tools for industrial designers is presented along with the evolution of 'Information/Inspiration' into a fully working web-based tool.

Keywords

Ecodesign, Industrial Design, Product design, Tools

1 Introduction

This paper presents the findings from a three year collaborative research project with Electrolux [1] and a subsequent 18-month continuation project with Huntleigh Healthcare Ltd.. During the research project a series of data collection and analysis activities identified a range of problems with existing ecodesign tools and a number of criteria on which to base the design of more appropriate tools for industrial designers. These findings were used to develop a prototype tool which was tested, refined and retested on designers to generate a more detailed understanding of their requirements when it comes to ecodesign. As a result of this, a framework (or brief) for Industrial Design focused ecodesign tools was developed. In the continuation project the framework was used to develop the prototype into 'Information/Inspiration' the first ecodesign tool specifically aimed at the needs of designers. This paper outlines the development process and reports on the main findings to emerge from the study.

2 Methodology

Within the research project two studies were undertaken to identify the types of problems faced by designers involved in ecodesign and the type of support they need to make the process of integrating ecodesign easier. During the pilot study a wide range of data was collected via an in-depth case study of Electrolux and four broad surveys which drew on a variety of sources, including; designers in large multinationals, novice designers, design consultants with little experience in ecodesign,

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ecodesign experts and environmental affairs personnel. Qualitative data was collected via techniques, such as semi-structured interviews, active and passive observation, and literature and web surveys [1]. The findings were used to build a prototype version of 'Information/Inspiration'. During the main study this prototype was used to obtain feedback from twenty one different cases in order to test the accuracy of the data collected and the appropriateness of the way in which these findings have been translated into reality. Data was collected via mechanisms such as 'web-based feedback', open ended interviews and observation [1]. The data was analysed using a coding and clustering approach, common in qualitative research [2-4]. The emergent findings were used to build up a rich picture of the type of support that industrial designers require to enable them to engage in ecodesign projects.

During the continuation project the framework was used to develop the 'Information/Inspiration' prototype into a fully functioning tool. Throughout this phase the tool was freely available on the internet for public use, as well as being used by employees of Huntleigh Technology and undergraduate Industrial Design and Technology BA/BSc students at Loughborough University within their Sustainable Design module. Within this eighteen month period the design of the tool passed through a continuous loop of design iterations in recognition of the fact that with every iteration that a design passes through, new insight is gained and the product is improved [5].

3 Misalignments between existing ecodesign tools and design requirements

Codesign literature shows that many existing tools fail because they do not focus on design, but instead are aimed at strategic management or retrospective analysis of existing products [6]. In addition to this it has also been recognised that they do not take into account the culture of Industrial Design and the fact that these designers have 'their own way' of carrying out ecodesign [7]. The fact that many ecodesign tools are unsuitable for Industrial Designers was further consolidated by the early empirical work carried out with design teams during the pilot study, when many of the designers indicated that they did not have the right sort of tools to support them in carrying out ecodesign. Some of the designers involved in the pilot study had experienced a number of different introductions to ecodesign via one or more of the following; information provided by their Environmental affairs department [8], the LiDS wheel [9], the solar-cyclic-safe approach developed by Biothinking International [10], the EcoReDesign programme [11] and a creativity driven ecodesign concept pilot project [7]. Analysis of the empirical data collected and analysed during the pilot study provided a better understanding of the reasons why certain tools are inappropriate to or not used by Industrial Design. The findings also helped to identify a number of criteria that would help to make ecodesign tools more appropriate to industrial designers. The main issues identified are described below within five categories; service, content, time, style and culture.

3.1 A reflection on the type of service required

The designers who had previously experienced ecodesign tools felt they failed on a number of accounts. They felt the tools did not recognise that ecodesign is not a priority issue but is one of a number of things that designers have to contend with, an issue which had also been highlighted by a previous research project [12]. Ecodesign checklists were found by some to be too general, and by others to be an overwhelming list of requirements to be added to an already taxing design brief. Many of the designers complained that the tools available did not show them how to *do* ecodesign. Although tools such as the LiDS wheel [9] did help them to highlight the issues they needed to consider, there was no support provided to help them take these issues further. In addition to this nearly all the designers in the study were unaware of where to look for ecodesign information and felt there were no resources that pulled together relevant issue for industrial designers. This issue is also recognised by Tischner and Charter [13] who report that ecodesign material is often widely dispersed making it time consuming to collect. Some of the designers who had used the LiDS wheel [9] and the EcoReDesign programme [11] said they felt alienated and overwhelmed by them as they were asked to consider issues which were irrelevant to their work. Although it emerged that this had occurred because the tools were not being used in their correct context, it showed that asking designers to consider irrelevant issues (such as the environmental impact of the extraction of selected materials) can put designers off of ecodesign [14]

As well as identifying the negative aspects of existing tools, the pilot study also provided the opportunity to investigate what positive attributes designers were looking for in ecodesign tools. Through the interviews it became clear that the designers were asking for guidance. They were looking for 'short and punchy' lists of issues that they could use as a basis for their ecodesign work, and simple targets to reduce the amount of things that they need to think about. The findings also indicated that industrial designers need tools which pull together relevant ecodesign issues making the process easier and quicker. To summarise, it appeared that the designers were looking for ecodesign tools that combine guidance, information and education

3.2 A reflection on the type of content required

During the an early stages of the project one group of designers continually asked for examples of ecodesign, to help them 'see' what others were achieving through ecodesign. These examples appeared inspire the designers and boost their confidence by demonstrating how design teams can and have tackled ecodesign challenges. The designers were keen to have a wide range of ecodesign examples from a variety of industry sectors as inspiration material for their work. These examples seem to help broaden their understanding of the types of issues which can be considered under the banner of

ecodesign. Though this need for examples and images is typical of the way many industrial designers work, it is not something which has previously been recognised in the development of ecodesign tools.

In contrast to the need for inspiration, every group of designers interviewed expressed a need for specific information on areas such as materials and construction techniques to help them become more easily involved in ecodesign projects. The feedback also indicated that it was important for the information to be appropriate. Although the Environmental Affairs departments in the large companies had vast databases of environmental data, interviews with designers showed they do not use it, as they found it too technical and scientific and more appropriate to the requirements of production and design engineers rather than industrial design. The findings from the pilot study strongly suggested that industrial designers need content which is specific to design and design issues rather than general environmental information. They need specific information, with a similar content to that which they would use in regular design projects (i.e. materials, fixings, and general advice) but with an ecodesign focus. Both the literature [15] and the findings from the pilot study showed that information requirements are project dependent and may vary considerably. In addition to this neither ecodesign information nor guidance as to where designers might source this type of information is currently provided by mainstream design magazines, such as Design Week, or in many cases by design education.

3.3 A reflection on the time requirements of designers

Another common complaint from the designers who were familiar with ecodesign tools was that they were too time consuming to be carried out on a regular basis. For example, many of the established ecodesign tools available, such as the LIDS wheel [9] and the EcoReDesign programme [11] require the whole production team to spend a day together to map out the ecodesign process and plan future directions for the project. In general, this is incongruous with the way in which design teams often work. The findings suggest that in order to compliment their way of working, designers need ecodesign support mechanisms that can be used by individuals on a less formal basis, as and when required. Ideally they should fit into their daily practices.

3.4 A reflection on the style requirements of designers

As with any information design, ecodesign information needs to be presented in a style that is appropriate for the user. One of the biggest problems with existing ecodesign tools, was the way in which the information was being presented. At one of the companies involved in the study it was common practice for Environmental Affairs to provide ecodesign information to design teams in lengthy technical documents full of graphs and wordy, technical explanations [8]. However, both the literature and empirical evidence demonstrate that designers spend little time reading and generally only read things they are interested in or are appropriate to the project that they are working on [15]. As such, evidence shows that designers do not react well to

manuals and often 'file' them, rather than use them. Instead designers are motivated by visual communication and like information to be presented with maximum use of graphics (pictures and colour) and minimal text. Industrial designers also need ecodesign information presenting in a language that they understand. The findings from the pilot study showed that many designers favoured a non technical approach and on a number of occasions they asked for 'nuggets' of information (short pieces of text) that can be easily digested.

3.5 A reflection on the cultural requirements of designers

The dynamic nature of design projects limits the types of tool that are appropriate for designers. Hands-on workshops to facilitate learning, appear to be the most appropriate approach in terms of the culture of Industrial Design but the time restrictions generally mean they are not a suitable way of integrating ecodesign into product development. Learning mechanisms need to compliment designers' ways of working and findings indicate that to do this ecodesign tools need to support on the job learning. The designers were looking for a tool that takes up little time, and can be referred to as and when required.

4 The Prototype tool

The findings collected in the pilot study were used to develop the prototype version of 'Information/Inspiration' that was used to collect data in the main study. The tool became known as 'Information/Inspiration' for two reasons. Primarily, the name described the unusual combination of content provided by the tool. Secondly, it was felt that using a new and unusual name that placed more emphasis on the creative nature of the tool, would reduce the likelihood of the designers prejudging it as 'another one of *those*' ecodesign tool.

'Information/Inspiration' was a *working prototype*, primarily developed as a mechanism for collecting data and *not a finished product*. This was a deliberate decision. It was felt that using a non-perfect prototype of an 'in-progress' nature would encourage discussion and enhance the development process [5]. Mock-ups of this nature are regularly used in design practice, and as such are something which industrial designers are familiar with. It was anticipated that this type of mechanism would produce a mixture of positive and negative feedback that would provide a rich insight into the designers' needs and benefit further development.

4.1 Suitable access

A web based format was chosen for 'Information/Inspiration' as it was felt this approach supported many of the requirements identified as important in the pilot study:

- providing the potential for the content to be presented in a highly visual and interactive way, making it very relevant to the designers' way of working.

- offering the opportunity for the amount of reading to be kept to a minimum.
- Recognising the time restrictions on design and supporting the opportunity for the user to access it on demand, thus enabling designers to integrate it easily into their daily practice.
- providing a good opportunity for the ecodesign information to be kept up to date.

The 'Information/Inspiration' website consists of two streams, one providing information ('Information') and the other providing inspiration ('Inspiration'), connected by a Homepage. The navigation structure in Figure 1 illustrates the tiered system that is used to keep text to minimum and allow users to delve into the site to an appropriate level. In addition to this, the arrow 'A' illustrates the links between the two sides of the site and the dotted box and line 'B', represents links to external web sites. From the Homepage the user can select either the 'Information' route, for specific detailed information, or the 'Inspiration' route for inspirational ideas on ecodesign. Navigation through the website is made logical through the implementation of a consistent graphical theme. Although the tool was not intended to be a perfect piece of web design, the fact that it was web based, meant it was important that the basics of the discipline, such as the use of style, user friendliness, navigation, and maintenance were understood. In order to achieve this web design literature was consulted and a wide range of company/organisation websites were referred too [1].

4.2 Content

The 'Information' provided by the tool was presented via six categories; 'general', 'materials', 'recycling', 'production', 'use' and 'packaging'. Within each category data was provided as 'nuggets' of information and illustrated with images wherever possible. For example, within 'recycling', data was broken down into bullet points and short lists of 'rules' were provided. Where appropriate each of these statements was linked with a hyperlink to another page, which provided more detailed information should the user require it. In addition to this, a series of questions such as "Who is going to disassemble it?" and "Can the disassembly rely on specialist tools?" were posed to encourage designers to think more holistically. Similar lists were provided in each section.

The aim of 'Inspiration' was to encourage, inspire and educate designers, by providing them with product examples of ecodesign work, to help them build up their tacit ecodesign knowledge, and/ or support idea generation at the beginning of an ecodesign project. The examples provided in 'Inspiration' were selected on an inclusive rather than exclusive basis, due to the fact that there are a limited number available and very few examples per industry sector. The creativity literature indicated that drawing stimulus from a variety of different places, not just ones own industries also enhances creativity [16,17]. In addition to this the pilot study also showed that industrial designers liked to refer to a wide variety of ecodesign

examples for inspiration (e.g. the edible lolly stick). With this in mind it was felt appropriate to provide a wide range of interesting examples. The key selection criteria were that examples should contain evidence of ecodesign, be relevant to Industrial Design (in the broad sense), and be visually interesting.

Within 'Inspiration' the product examples were organised within the six categories; 'materials', 'form', 'energy', 'function', 'parts', and 'packaging' and presented in a visual contents page that contains an illustrative icon and title for each section. Each of the icons takes the user to a page with a visual sub menu of the products within this category, for example within energy these include the Baygen wind up radio, a solar table, the Electrolux solar powered lawn mower and the NightStar Kinetic torch. Clicking on each of the images takes the user to an enlarged image of the product and a brief description of the product and its function. Wherever possible throughout the site product examples are linked to more detailed data within 'Information'. For example, the case study of the Sony loudspeaker cabinets made from Tectan (recycled Tetra-pak cartons) [18] is hyperlinked through to 'Information' where more information on the material is provided.

5 Criteria identified for design focused ecodesign tools

The prototype tool was used as a data collection device in the main study to further refine the understanding of the requirements of designers involved in ecodesign projects. Using the prototype, a more detailed understanding of the service, content, visual requirement, language and mode of access required were identified and a number of important criteria upon which to base ecodesign tools emerged. These criteria are outlined below.

5.1 Delivering a useful service

In the past, ecodesign tools have tended to focus on providing either guidance, or information, or education, but not a combination of all three. The feedback obtained during the main study confirmed that each of the individual elements provided in the tool has particular benefits to industrial designers.

5.1.1 Guidance

The findings from the pilot study suggested that simple guidance is an important element of ecodesign tools for industrial designers. The main study confirmed the designers wanted simple guidance to get them started, many of the users were new to the subject area and needed to be introduced to important issues. It was felt they needed a resource they could rely on when confronted with a project that required ecodesign principles to be considered. Their feedback clearly demonstrated a need for appropriate information, legislation and product examples. The general reaction of the participants was that the level of guidance provided was very useful. One designer explained that this type of tool was invaluable as it made ecodesign accessible. Another described it as a "doorway" through which it was possible to access ecodesign information [1]. It is worth noting however that some designers wanted more guidance than was provided in the prototype.

5.1.2 Information

The feedback from the main study illustrated that designers were looking for ecodesign information in the broadest sense. Many of the participants were observed using both 'Information' and 'Inspiration' as a 'database' from which to source specific data. When used in this capacity, designers referred to the content they were sourcing, as "information", whether it be a suppliers details, or an image of a particular product. In these circumstances designers were looking for specific "information" on a subject related to their current design project and they only referred to the tool when they needed to. In this capacity they used 'Information' to source a wide range of topics including packaging, recycled plastics, and fixings to facilitate disassembly. 'Inspiration' was also used as a database to search for more details on specific product examples that they had heard about previously.

5.1.3 Education

The feedback from the participants indicated that the tool had educational value in a number of ways. A number of designers liked the fact that the tool enabled them to see who was doing what in ecodesign. Not only was this interesting and useful, but it also raised their awareness and made them feel as though they weren't alone. Hence it provided a valuable, supportive role. The feedback from a number of the designers even suggested that the prototype could have had a stronger educational focus. One designer suggested that the 'shock factor' should be added.

5.1.4 The importance of combining the elements

The previous sections illustrated that on their own, the elements of the prototype tool had a valuable role to play in ecodesign tools. However, the real value lies in the combination of these three elements, as they contribute to a more holistic tool.

5.1.4.1 Information and Guidance

As was suggested earlier the designers saw the tool as a useful starting point for ecodesign. Much of the value of the tool appeared to lie in the fact that neither guidance nor information was provided in isolation. On a simple level, the participants found the tool useful because it provided an outline of the important issues which they needed to be aware of and then provided them with the opportunity to follow these issues up through links that led to more detailed, practical information. This combination provided them with the support that they needed to get started.

Interestingly, a number of the participants involved in the study commented on the usefulness of ecodesign checklists and even asked for more of them. This was quite different from the feedback obtained in the pilot study. However it appeared that within the context of this tool, checklists have a valuable role to play. It is believed that this change in level of acceptance came about because the checklists were not provided in isolation, but were linked to pages providing further information. For example, rather than simply being reminded to 'consider disassembly', 'use recycled materials where possible' and 'reduce energy consumption', they were provided with links to websites that provided useful information for

solving the particular problem. Linking together guiding questions and checklists with information sources that provided potential solutions, meant that the designers no longer saw them as a constraint but as an opportunity or potential source of inspiration.

5.1.4.2 Guidance and Education

Earlier feedback showed that the designers wanted simple guidance. However, the comments from some of the designers illustrated that they wanted more guidance than was provided by the tool (but that it should still be of a simple nature). One designer noted that 'Information/Inspiration' did not provide any indication of which strategies were the 'best' to tackle first, for example, whether it was better to reduce energy consumption or tackle recycling. This type of feedback illustrates that designers want to have the opportunity to learn how to take ecodesign further. A number of them asked for a simple, explicit hierarchy of approaches, so that they knew what to tackle first for an "easy win".

5.1.4.3 Education and Information

Whilst at times the participants used 'Information/Inspiration' as a database, they were also observed using both 'Inspiration' and 'Information' as they might a magazine. In much the same way as they do in regular design, they were using the tool to educate themselves about the state of the art in ecodesign. Looking for the latest on styling, new materials, and the new technologies that others have used to solve different problems. They saw it as a useful resource for keeping them abreast of what was happening in the field. They also liked the fact that it introduced them to new ideas that they had previously been unaware of. By referring to the tool in this way, they were in effect using it to build up a database of ecodesign knowledge in their heads, that they could then draw on at a later date. This finding was reinforced by a suggestion made by another designer, who wanted to be able to group and collate the examples he found interesting, so they could be printed out and referred back to. The feedback obtained during the main study demonstrated that the designers appreciated being given product examples to stimulate ideas and enhance their knowledge of current practice in ecodesign. This suggests that providing practical examples of ecodesign and detailed information on the products is a powerful way of educating designers.

5.1.5 Summary

The feedback presented in this section has illustrated that simple guidance, information and education each have an important role to play in the prototype tool, but that combining these elements provides a more holistic service and greater benefits than those afforded by the individual constituent parts, with the greatest benefits coming from combining 'information and guidance', and 'education and information'.

- Due to the combination of information and guidance, 'Information/Inspiration' was able to outline important topics for consideration and then direct the user as to where to find out more detail.

- Providing information to support ecodesign education enabled the designers to use the tool to build up tacit knowledge on ecodesign, that they could draw on at a later date.

This suggests that the provision of information is the key to a successful tool, but that this can not be realised unless the other two elements are included. Adding guidance to the mix ensures that the most relevant information can be identified and found. Combining information provision and education ensures that the designers have the opportunity to build up an understanding of the main principles of ecodesign, in a hands on way.

The findings have also provided the opportunity for a more detailed understanding of the nature of the guidance, information and education required from the tool, to be identified. For example, it has been seen that although industrial designers need simple guidance to provide direction and help them to become involved in ecodesign, some of the designers also wanted to know which issues to tackle first. This suggests that tools such as the LiDS wheel [9], would provide a valuable addition to a tool of this nature.

Finally, the feedback from the main study helped to provide a greater understanding of how designers want to use tools of this nature. It was seen that the designers used the tool either in the capacity of a magazine, or as a database. The approach that they chose reflected the nature of the information they were looking for. Whilst using the tool as a magazine the participants were looking for interesting ideas, images, colours, styles, technologies, looking at examples across industries to support ideation and to build up tacit knowledge. However, when they used the tool as a database they were looking for specific information which was relevant to their current project. The findings show that industrial designers used the tool to source a wide variety of ecodesign focused information, reflecting the approach that industrial designers have when sourcing information in regular design [15].

5.2 Content

The pilot study identified that ecodesign tools need to contain two different types of content; information and stimuli and that these two types of content need to be intrinsically linked so designers can benefit from information that is relevant and examples which are based in reality. The feedback from the main study recognised that although 'Information' and 'Inspiration' were useful types of content in their own right, there were even greater benefits to be had from combining the two elements. It was recognised that case study examples bring ecodesign information 'alive' illustrating a practical application of how it can be applied, whilst providing specific, detailed ecodesign information helps to make the examples more credible.

The feedback from the main study helped to provide a more detailed understanding of the type of information that industrial designers need from ecodesign tools. During the development of the prototype, the researcher only had a limited understanding of what constituted 'relevant' information, as this was not something which had previously been identified in ecodesign literature. In response to this dilemma, existing ecodesign information (of a similar nature to that provided to Design Engineering) was simplified into 'nuggets' of information and 'translated' into a language that it was felt industrial designers would understand (i.e. non scientific and non technical, as identified through the Pilot Study). Although this was well received, and 'translating' traditional existing information into appropriate language was useful, it was also recognised a whole range of ecodesign information specifically focusing on design, needs to be generated. Industrial designers are looking for information on different applications for materials; how parts were joined; styling examples from similar/other industries; information on how products work and how they have been designed to be used; information on how products are manufactured; and links to where products can be bought, so that they could take them apart themselves. In other words, although the content provided by 'Information/Inspiration' was well received, and the fact that ecodesign information was linked to the case studies, added to the usefulness of the tool, it was felt that the level of information provided was only the 'tip of the iceberg'.

The feedback from the designers also confirmed that the ecodesign examples provided in 'Inspiration' were very well received. All of the designers highlighted the examples that they liked, and/or were useful and their comments illustrated that the examples were a useful aid for the generation of mood boards and in the support of brainstorming. A number of suggestions for how to further improve the site were suggested. One designer felt it would be useful to provide patent drawings of the product examples in 'Inspiration', within the 'Information' part of the tool. The sentiments reflecting a need for these types of drawings were common amongst a number of designers who felt they would help make examples more credible and enable users to better understand the products which would support the transfer of appropriate technologies. Another couple of designers remarked that short animations of how the products worked, would be a useful addition to the website. The comments arising from several other designers reinforced the important of credibility in a resource such as this. On a number of occasions, designers commented that it was difficult to identify whether products were conceptual or not, from the level of information provided. Although conceptual products were considered to be useful, it was felt that they should be kept apart from the 'real' products, as these provided more practical information. Finally a number of the designers liked the fact that links were provided to other web sites and further information and asked for more links of this nature. These links supported the designers' usual way of sourcing detailed information, i.e. that of referring to experts for detailed information. Providing this type of information, such as phone numbers and contact details, performed a similar

function to the company literature/web sites that they would refer to in regular design and enabled them to follow up interesting leads quickly and easily.

5.3 Visual

The presentation style of 'Information/Inspiration' was heavily influenced by Bakker [19] and Sherwin's [7] findings which both recognised that ecodesign information should be presented visually using case studies and examples. These findings combined with observations and experience of Industrial Design culture, contributed to the design of the prototype tool and the provision of a wide range of ecodesign examples, such as the example depicted in Figure 3.

The importance of using a visual interface was highlighted on a wide number of occasions, and the fact that the tool should look as though it had been designed for industrial designers was reinforced. All of the designers said that they found the images useful, interesting and stimulating and their comments clearly demonstrated that they preferred having information displayed visually rather than in a written format. A number of the designers gave the impression that they wanted to be entertained as well as informed, as has been previously mentioned a number of designers suggested that animations would be a useful addition.

The findings helped to identify a more detailed understanding of the way in which examples contribute to the 'education and empowerment' [7] of industrial designers, by establishing a better understanding of the role that they play in ecodesign. The feedback obtained during the main study illustrated that the usefulness of the images went beyond attracting the designer's attention, raising awareness and motivation as Sherwin [7] suggests. Images also have the potential to play a much more practical role, as a mechanism through which designers can learn how the product works, how the product was manufactured, how it was used and what it was made from. This was demonstrated on a number of occasions, by designers asking for working drawings as suggested earlier and by designers who felt that more detail should be provided by high-resolution images and animations

5.4 Language

Findings from the pilot study suggested that in order to compliment the culture of Industrial Design, the content provided in ecodesign tools needs to be presented in the form of 'nuggets' of information rather than large quantities of text, and be presented in an appropriate language for industrial designers, avoiding technical/scientific jargon and an academic framework. In response to this, the data presented within 'Information/Inspiration' consisted of existing ecodesign information, that had been translated into simple 'nuggets' of information for industrial designers. Feedback from the designers confirmed that they liked the fact that complex information was reduced into small sound bites of data that

represented the bare essentials, as opposed to longwinded complex documents. They also liked the simple style of presentation used in the tool and the use of more suitable language. These findings clearly proved the value of using appropriate communication, demonstrating the importance of considering the user's requirements within the design of anything.

5.5 Access

The findings from the pilot study stated that ecodesign tools need to fit into design practice for two reasons. First of all, ecodesign is not a priority issue and is therefore subject to time constraints. Secondly, because industrial designers have a dynamic way of working that is not suited to planned, workshop based programmes but more to an integrated approach. In response to these findings, 'Information/Inspiration' was designed to be a web site that users could access as and when they needed to. The feedback from the designers indicated that the web approach was sympathetic to their time constraints and as such it was well received. The feedback also showed that the designers felt this approach had great potential as a timesaving device for ecodesign projects. The designers were appreciative of any mechanisms that helped them to get to the information that they needed in the shortest possible time.

The feedback from the designers confirmed that they liked being able to use the tool as and when they wanted to, dipping into it for information and interesting ideas as and when they were needed. They liked being able to refer back to it for more detail as and when required, or to follow up different avenues. Many of the participants had either revisited the tool or felt that they would go back to it in the future, in order to delve for more detailed information, to follow up links within the site or to link to company web sites. In order to support this, it was recognised that the data would need to be kept up to date and new examples would need to be added. It was suggested that an email alert service which informed interested parties when new examples and information were added to the web site, would be a useful provision.

In addition to this, the findings also highlighted another reason why this type of approach was well received - that industrial designers have little patience with things that don't grab their attention. The web approach allowed designers to quickly assess the usefulness of the different bits of information in relation to their current project, enabling them to easily dismiss inappropriate content and 'surf' the rest of the site to look for interesting examples and relevant data. This was recognised as an important function of the tool, in the light of the fact that industrial designers will potentially have the need to source very different types of information for the different projects that they work on.

5.6 Conclusions

The rich data obtained from the participants during the main study helped to further develop and refine an understanding of industrial designers requirements of ecodesign tools. It has been seen that industrial designers involved in the design and development of consumer products need ecodesign tools that combine guidance, education and information, and provide inspiring examples which are reinforced by product focused information, and presented in a format which is highly visual, uses minimal text and allows for instant access. The findings suggest that without tools of this nature, industrial designers do not have the time or knowledge (in terms of where to start) to be able to look for 'specialist ecodesign' information, nor are they likely to be aware that these issues are important enough to spend time researching them further.

6 The framework

The findings from the main study provided new insights into the types of issues that need to be considered when designing ecodesign tools for industrial designers. In order to benefit future research in this area, these findings were translated into the holistic framework illustrated in Figure 2. The framework is in effect a design brief for Industrial Design focused ecodesign tools. It combines all of the elements which need to be embodied in tools of this nature, providing a simple and quick reference tool to highlight the main findings of this research and support the development of tools based on these findings. Its strength lies in the combination of the different elements, and therefore tools which aim to be more appropriate for industrial designers should not be developed on a 'pick and mix' basis but instead should embody all elements. The main features of the framework can be described in terms of four levels of interconnectivity.

6.1 Unique focus

The combination of all the different elements of the framework provide its unique focus, specifically aimed at supporting the activity of designing and the culture of Industrial Design. The framework recognises that Industrial Design is a unique and complex discipline with a distinctive approach to problem solving, learning styles and working practices [20-22], that sets it apart from both art and engineering and as such, tools for industrial designers must be developed with this in mind, if cognitive dissonance is to be minimised.

6.2 Meeting the cultural requirements of designers

Through the framework the seven individual elements: guidance, information, inspiration, education, visual, non-scientific language, and dynamic access are combined. In the past all of these elements have been recognised as important and integrated into ecodesign tools separately, for example the O2 website [23] provides visual information, the LiDS wheel [9] provides guidance and the DEMI website [24] provides dynamic access, but no previous tools have provided this as a holistic package. This combination of elements has come about in response to the fact that a more detailed understanding of the cultural practices of industrial designers has been established. As such, the framework also reflects the usual working

practices of industrial designers (i.e. through the nature of the information they require, the use of images and diagrams, and the way they access information).

6.3 Content of the elements

The framework represents the importance of providing a combined service of (simple and focused) guidance, ecodesign education and design focused information, in a way which has not been seen before. It is the interaction of the three elements that provides the real value to the service provided by the tool. This interaction ensures that designers can identify the important issues to address in ecodesign, find associated cases to illustrate how others have met these needs, and then back this up with focused, specific product focused information. The framework also recognises the importance of a combined content, which pulls together inspiration (via cases), with information (both traditional ecodesign data and more detailed design focused information) to ensure that good examples are linked to detailed information, which transforms them from being interesting to being *really* useful and much more credible.

6.4 Interaction between the elements

The final feature of the framework is the interaction between the elements: guidance, information, inspiration, education, visual, non-scientific language, and dynamic access and how this leads to an improved service for the designers. The framework draws on the fact that detailed product focused information brings ecodesign examples alive and as such should be provided through visual working drawings. Although some tools provide product focused information in conjunction with their case studies, this is often limited to a brief description which may include materials information. None of the tools provided the detailed product focused ecodesign information (such as clip details, materials information) backed up by working drawings, identified within this study as being important to industrial designers. Although within the context of ecodesign tools providing information of this nature is seen as a new idea, it is something which is well practised in design and encouraged in ecodesign education. For example, to teach designers about disassembly students are often encouraged to take products apart [25]. Providing information of this nature might be considered to be the equivalent of providing hands-on experience or on-the-job learning. The framework recognises that traditional ecodesign information needs to be appropriate to Industrial Design and provided in a language that industrial designers understand, utilising images and minimal text. Feedback from the main study demonstrated that as long as the language was appropriate, and designers had the opportunity to ignore irrelevant information, the provision of information of this nature was useful. However, this information is not enough on its own and needs to be combined with a variety of well illustrated, design focused information.

7 The final stages of 'Information/Inspiration'

During the continuation project 'Information/Inspiration' was developed from a prototype into a fully working design tool. The basic format of the tool and the mode of navigation stayed the same but a number of changes have occurred in the light of the findings arising from the doctoral study and subsequent testing.

7.1 Information

The content within 'Information' is now presented via eight categories, some redundant sections have been removed and new sections have been added. The 'general' section has been removed along with the section on 'production' which was identified as being completely redundant to the designers and a range of new sections have been added. It was recognised that any designers coming to 'Information/Inspiration' for an introduction to ecodesign would need a section on 'where to start', this provides a quick step-by-step approach to getting started with links to professional help if necessary. There is also a section on 'tools' which links to existing tools such as the LiDS wheel [9], EcoWeb a simplified version and the PRé Consultants life cycle analysis tool [26]. It was recognised that there was no point in 'reinventing the wheel' and that the true value of 'Information/Inspiration' lay in its ability to be able to link together existing material. The biggest addition to 'Information' is 'strategies' which provides an extensive list of twenty four ecodesign strategies that designers can use to improve the environmental performance of the products that they design, these include design for disassembly, reduce transport, reuse and upgradeability. Each strategy is linked to more information and examples of products using those strategies found in 'Inspiration'. There is a new section on 'legislation' which contains information on the latest European legislation such as the Waste Electrical and Electronic Equipment Directive (WEEE), Restriction of Hazardous Substances Directive (RoHS), proposed Energy Using Product Directive (EuP) and Packaging and Packaging Waste Directive. 'Packaging' has been developed to provide more information on materials as well as information on issues such as labelling and branding. Finally in the light of an increased interest in 'end-of-life' due to the impact of the WEEE directive, a section dedicated to the different strategies for managing products at the end of their life has been added.

7.2 Inspiration

Within 'Inspiration' three main changes have occurred. Firstly, the case studies are now grouped according to product type; 'electrical products', 'white goods', 'packaging', 'textiles', alternate energy supplies' and 'furniture' with additional sections containing 'concepts' and examples of 'green design'. It was felt that this made it easier for designers to decide where to look and made it clearer that all of the examples provided were available in the market, except for those in the 'concepts' section. Secondly, many more examples have been added and the quality of the product descriptions have been improved and where possible links to company websites are provided. Finally for each of the case studies the ecodesign strategies which were used in the design of the product to improve the environmental performance are listed and linked to the

strategies section in 'Information'. The links to 'Information' for further detail have been retained, with more being added for the new product examples.

8 Conclusions

Through this study a new, more holistic framework for developing ecodesign tools for Industrial Designers, has been identified. The approach used is more in keeping with the culture of Industrial Designers – fits their way of working better, communicates in a language that they understand, provides a resource of relevant, product specific ecodesign information and a starting point for ecodesign. As a result, 'Information/Inspiration' makes ecodesign much more accessible to designers who wish or need to consider ecodesign strategies within their design work. It offers a much more user friendly, design specific service to designers, providing them with guidance, education and information, allowing them to source specific data or browse for interesting ideas. The tool also appears to have helped in the development of designers' understanding regarding the types of issues they need to consider within ecodesign, with all of the participants in the project identifying that the tool in some way raised their awareness: through an introduction to the basic principles of ecodesign; by introducing and encouraging them to think about ecodesign issues; or by providing them with more detailed ecodesign information [1].

Discussions with professionals outside of Industrial Design have suggested that there are a number of transferable attributes within the makeup of the 'Information/Inspiration' that could benefit other disciplines involved in ecodesign and product development. A number of design engineers have commented favourably on the ease of accessibility, the lack of technical language, and the interesting examples provided, and shown an interest in being involved further in the development of the tool. In addition to this, on several occasions environmental scientists involved in evaluating the tool have recognised that approach used could be beneficial to them in their quest to communicate environmental information more effectively, to other elements of the design team.

'Information/Inspiration' is available on-line at www.informationinspiration.org.uk as a free resource for designers who are looking for ecodesign support. The site is actively integrated in both design and engineering undergraduate teaching at Loughborough University, as well as being an integral part of the A2 and AS level Sustainable Design Awards, run in the United Kingdom by Practical Action (ITDG). 'Information/Inspiration' is continually updated as part of the ongoing research carried out at Loughborough University.

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11 Vitae

Dr. Vicky Lofthouse is a trained industrial designer with practitioner experience. Since completing a PhD in the field of ecodesign she has managed and worked on a range of research projects in the field of sustainable design and taught the subject to designers at undergraduate and postgraduate level. Vicky currently works as a researcher in ecodesign at Loughborough University. In addition to this Vicky also provides ecodesign consultancy to support new product development

in manufacturing companies effected by the European WEEE directive. Vicky co-ordinates the internationally subscribed to Sustainable Design Network.

12 Figure caption

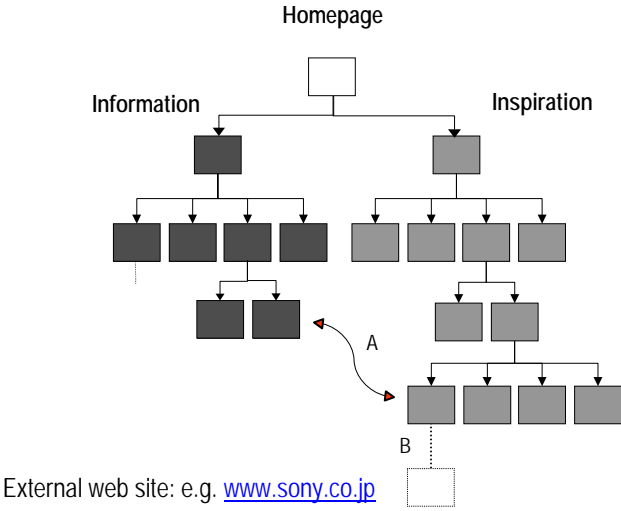


Figure 1 A schematic diagram of the navigation chart for 'Information/Inspiration'

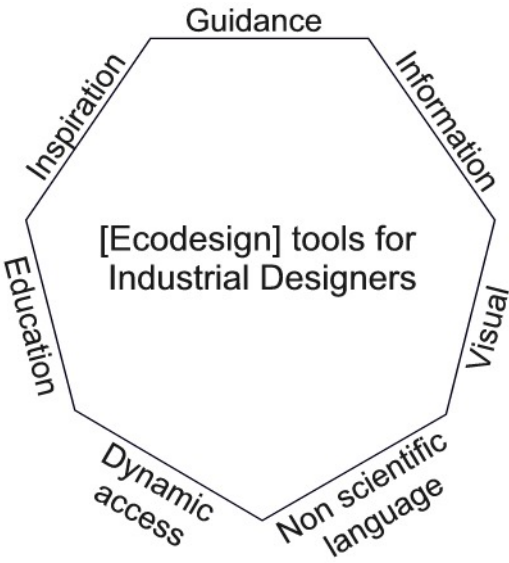


Figure 2 A holistic framework for Industrial Design focused ecodesign tools