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ADAPTING ECO-INNOVATION TOOLS TO THE NEEDS OF THE COMPANY: A CASE STUDY

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ABSTRACT
In this paper we consider the problem of the lack of industry uptake of eco-design and eco-innovation tools. We take a change management perspective on this problem and focus on eco-innovation tool selection and implementation activities. We introduce a systematic process for these activities which emphasises the development of contextual tool criteria and the adaptation of the tool to meet both company and design-team requirements. The process is tested by applying it to the '9-Windows' tool with six manufacturers of electrical or electronic equipment. The preliminary results suggest that the proposed process is effective in producing successful tool adaptations but that further evidence is required to validate the process. We conclude that: the development of contextual tool criteria is effective in gaining design team 'buy-in'; the design team can be a useful source of ideas for tool adaptation ideas; eco-innovation tools, more so than other types of design tool, must be easy to learn and use; and that eco-innovation tool adaptations must take into account the business need that the tool fulfils, and the language preferences and knowledge of the design team.

Keywords: Eco-innovation, eco-design, design tools, change management

1 INTRODUCTION
It has long been recognized that the environmental impact of satisfying our needs for food, shelter, energy, transport and products has reached a level which is unsustainable in the long term [1]. Experts have suggested that, if we are to continue improving the standards of living for our rapidly increasing global population, we must develop new technologies and ways of meeting our needs and desires that will allow us to double wealth whilst halving resource consumption [2]. In recent years the environmental imperative for action on this issue has been significantly strengthened by a growth in more immediate pressures that are impacting engineering companies. Legislation, the cost and security of supply of raw materials and the cost of oil and energy are some of the most frequently discussed business drivers that are leading companies such as Wal-Mart, Nike and Sun MicroSystems to integrate environmental considerations into their business and product strategies.

Producers of Electrical and Electronic Equipment (EEE) face particularly strong drivers to improve the environmental performance of their products most notably from legislation which is affecting many aspects of the design of their products, such as:

- the use of hazardous substances (EU RoHS Directive, 'China RoHS', Norwegian PoHS);
- the End-of-Life strategy for the product (EU WEEE Directive);
- the use of chemicals (EU REACH Directive, California Green Chemistry Initiative);
- the use of batteries (EU Batteries Directive); and,
- the lifecycle energy consumption of the product (EU EuP Directive).

Recognising the potential impact of such legislation on how companies design and develop their products, the academic community has responded by producing a vast collection of 'eco-design' and 'eco-innovation' tools to assist designers to meet these new requirements. So with large industries facing legislative and other forms of pressure to improve environmental performance on the one hand, and academics boasting a bulging toolbox for eco-design and eco-innovation on the other, one might expect to see many glittering examples of such tools being whole-heartedly adopted and integrated into industrial practice. Unfortunately, this is not the case. In this paper we look at the problem of poor uptake of eco-innovation tools and propose that their adaptation to better meet the requirements of companies and their designers is the key to success. We present a process for the adaptation of eco-

innovation tools and use evidence from the application of this process to an established innovation tool in six EEE producing companies to qualify the efficacy of the process.
In the following section we begin by considering the academic literature on improving the selection and implementation of eco-design and eco-innovation tools before justifying our change-management-based approach to the selection and implementation of tools. In Section 3 we introduce the '9-Windows' innovation tool and explain the first adaptations made to it . Section 4 explains the detail of our iterative, workshop-based activities and methodology. The findings from each of the six companies are presented and discussed in Section 5. We finish with conclusions and a summary of our future work in Section 6.

2 ADAPTING ECO-INNOVATION TOOLS

Before discussing why or how they can be adapted, we begin here by providing some insight into what we consider to be the nature and purpose of eco-innovation tools. According to James [3], 'eco-innovation aims to develop new products and processes which provide customer and business value but significantly decrease environmental impact.' Eco-innovation differs from other forms of 'Design for Environment' both in terms of the focus of innovation and the organisational resources required to execute it, as represented in Figure 1.
The current authors' view is that tools for eco-innovation should guide and influence companies at the very earliest stages of a project; from R & D and pre-development activities through to the formulation of the product brief and a requirements specification. Due to the long term nature of eco-innovation projects and the fact that they may require significant commitment and investment it will be essential for eco-innovation to be aligned with a company's business and product strategy. It is suggested that if a company can implement eco-innovation adhering to these two principles then they will be more able to spot opportunities for products that both increase value and reduce environmental impacts. The outputs from an eco-innovation project should be a proven technology or prototype accompanied by a requirements specification for a product that is both significantly better than existing products in terms of its environmental performance and represents an attractive, strategically aligned and feasible opportunity for the company to exploit.

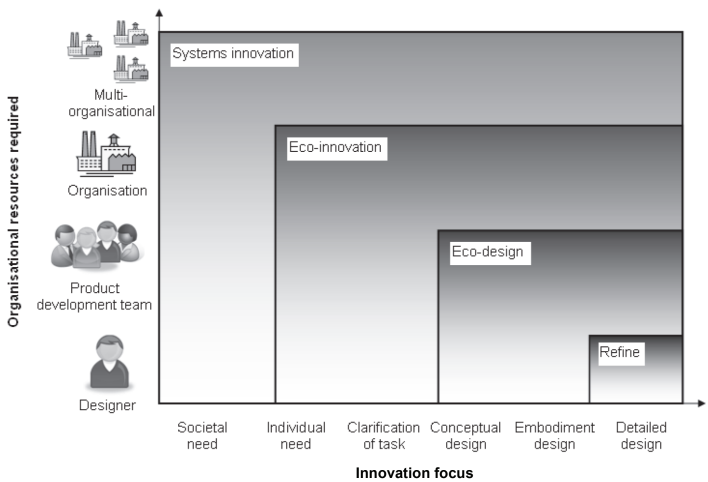

Figure 1. Scope of eco-innovation relative to other levels of Design for Environment

2.1 Causes of poor industrial uptake of eco-innovation tools

Several authors have raised concerns over the lack of uptake of eco-design and eco-innovation tools within industry [4] [5] [6]. Some of the possible causes of the lack of eco-design tool adoption previously highlighted within the academic literature include:
No demand – If there are no environmental criteria in the product requirements specification then quite simply there is no need for eco-design tools [7] [8].

No time - Environmental impacts are just one of many constraints a designer must consider during product development and hence only a very limited amount of time and effort can be spent on them [7]
Designers' requirements not considered – Tool developers have lacked a thorough understanding of how designers use tools and their main considerations when choosing whether or not to use a tool [9]
Too many tools – The vast multitude of tools now available makes the process selecting an appropriate tool an extremely complicated and time-consuming task. Designers do not have time to go through such a process and so end up using inappropriate tools, or none at all [10].
Poor integration – When eco-design activities are treated as a separate stream of activity, distinct from the mainstream product development activities, they struggle to gain acceptance and quickly become marginalised [11]
Tool not adapted to the specific application – There are many variations in product development activities between companies related to organisational, cultural, process and product differences. These differences may require the tool to be adapted to the specific application but this is not normally considered [12].
No systematic implementation process – Tools are often implemented without any formal analysis of the need that the tool is intended to fulfil, with choices about the type of tool and how and when it should be implemented often done on an ad-hoc basis [12].
Research has begun investigating ways to overcome some of these issues. We now have some idea of the success factors for the integration of environmental considerations into the product development activities [8] [4]; a better understanding of designers' requirements of eco-design tools; methods for selecting eco-design tools based on product, company and context-related criteria [10]; case studies of the implementation and customisation of eco-design heuristics [7]; and a systematic approach for the selection and implementation of eco-design tools [12]. Unfortunately, we are still lacking in evidence of the industrial application of these approaches and hence it remains difficult to draw conclusions on the efficacy of them.

2.3 A process for eco-innovation tool selection and implementation

Ritzén and Lindahl [12] have previously proposed processes both for design tool selection and for implementation based upon the principles of change management. It is our belief that of the approaches highlighted in the previous section, this type of change management view approach is the most likely to yield significant improvement in the industrial uptake of eco-innovation tools. This is because when we are trying to introduce eco-innovation into a company we are introducing change in the form of new tools and new types of product requirement. In taking a change management perspective on the problem we benefit from being able to draw upon the extensive body of knowledge within this field to guide our efforts.
The selection and implementation processes proposed by Ritzén and Lindahl were intended to be applicable to any form of design tool, not just eco-design or eco-innovation. In Figure 2. we propose a simplified process that draws upon elements of both the aforementioned processes. The key difference with the processes described by Ritzén and Lindahl is that the current process model includes tool adaptation as a key activity whereas Ritzén and Lindahl imply that the tool is used in its original 'off-the-shelf' format.

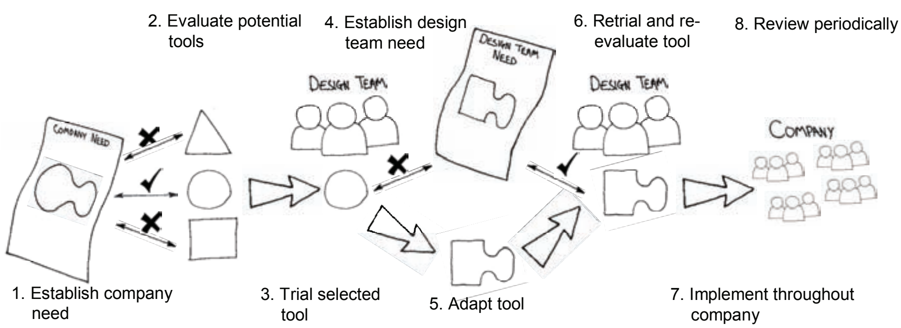

Figure 2. A process for the selection and implementation of eco-innovation tools

Whilst previous authors have advocated tool adaptation and customisation [7] there are limitations to such an approach. Tool adaptations are feasible for relatively simple, workshop-based tools (as we shall show in later sections). However, when a tool is more complex, or is implemented through third-party software, it will become more difficult to go through the fast iterations in the tool which are a feature of the approach. The tool adaptation process we describe here is therefore mainly relevant for relatively simple tools. Given that eco-innovation will often involve simple tools that can be applied during the very early stages of a project, this is not a significant problem.

The process can be described as follows:

1. Establish company need – this will be determined to a large extent by the overall company strategy, but will be influenced by other factors such as: the requirements of environmental legislation; types of tools currently used; level of innovation performance etc. The aim is to establish what the company is trying to achieve and how implementing a new tool may help to reach this goal.
2. Evaluate potential tools – this can be achieved through short 'taster' sessions to apply a variety of potentially relevant tools. There should be significant representation from management at this stage as they must judge if any of the tools are likely to meet the company need. This activity should therefore conclude with an evaluation and the selection of one or two tools to take forward for in-depth trials.
3. Trial selected tool – tool trials should involve key stakeholders including design team members, and marketing staff. Input from management is less critical at this stage as the focus of the activity is for the design team to learn about the tool and to begin to highlight problem areas for the application of the tool.
4. Establish design team need – individual interviews with participants from the initial tool trial should be used to gain feedback about the tool, to discuss possible tool adaptations and to establish a set of criteria that reflect the needs of the design team – referred to by Ritzén and Lindahl as 'contextual tool criteria' [12]. The criteria should be validated by the design team before being used in stage 6.
5. Adapt tool – using both the feedback comments from the first trial and the contextual tool criteria as a guide, the tool should be adapted so as to eliminate weak points and reinforce strengths. The initial company need should be borne in mind when making such adaptations.
6. Retrial and re-evaluate – In order to make a fair assessment of the tool it should be applied at this stage to real, live projects. The contextual tool criteria should be used to evaluate the tool. Management input should be sought again at this stage so that they can decide whether or not to implement the tool across the company.
7. Implement throughout the company – this phase should begin with an assessment of the drivers and barriers to the implementation of the tool. Action can then be taken to reduce barriers and reinforce drivers before attempting to roll-out the tool across the company. Careful planning of the training and support requirements should also be completed and the necessary long-term funding secured before commencing the tool roll-out.
8. Review periodically – Once one real project has been completed with the aid of the tool a review should be completed to assess the contribution of the tool both to the project and to the underlying company need. Any problems encountered during the application of the tool should also be noted and corrective action taken where possible. Annual reviews may be appropriate to ensure that the tool continues to satisfy the company need and to assess the on-going utilisation of the tool.

3 THE 9-WINDOWS TOOL

The '9-Windows Operator' is one of many tools developed by the Russian 'TRIZ' community. TRIZ has been described as, 'a human-orientated, knowledge-based, systematic methodology of inventive problem solving' [13]. The 9-Windows tool prompts problem solvers to consider their problem from multiple viewpoints. The tool suggests nine viewpoints that vary in both their temporal and systems level location. Figure 3 shows a typical 9-Windows diagram including the horizontal 'Time' and the vertical 'Systems Level' axes, which in this case has been completed for the problem of 'High energy use in mobile phone chargers.

Whilst the 9-Windows tool has been widely discussed within practitioner literature [14] there would appear to be no significant academic studies of the effectiveness of the 9-Windows Operator as a tool for problem solving and creativity in engineering design. However, it is claimed by the TRIZ community that the 9-Windows tool can aid innovation by helping problem solvers to overcome 'psychological inertia'. Psychological inertia is analogous to physical inertia which is the effort made by a system to preserve the current stable state or to resist change in that state. Complex problems often require the problem solver to change their view of the elements of a system in order to reach a new understanding of the system and subsequently find a solution. The 9-Windows tool is therefore claimed to reduce the time and effort required to generate problem solutions by assisting rapid shifts of viewpoint and thinking about a problem [14].

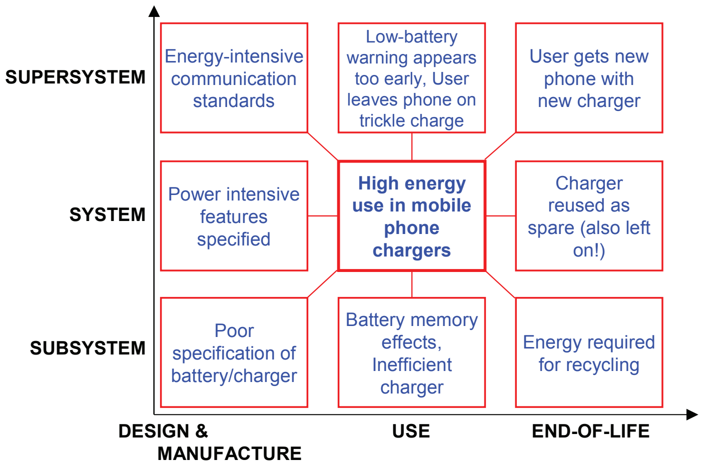

Figure 3. The 9-Windows tool in the form first presented within the industry trials

The 9-Windows tool was considered by the authors to be very relevant for eco-innovation projects as the design team will need to abandon any preconceived ideas of the type of product or service that will meet a need and to conduct as wide a search for ideas as possible. Furthermore, the time axis for the 9-Windows tool is often labelled as ‘Past, Present, Future’, but these labels can be substituted with, ‘Manufacture, Use, End of Life’ to encourage a greater focus of the tool on the environmental lifecycle of the product, as shown in Figure 3.

4 METHODOLOGY

The study described here forms part of a larger study whose aim was to develop a process to assist with the adaptation of general innovation tools into eco-innovation tools adapted to the particular needs of a company and its design teams. The methodology is described in the following sections in terms of the participants, the activities completed and the data collection methods.

4.1 Participants

The scope of the study was limited to EEE producers because they face particularly strong pressures to reduce the environmental impacts of their products, as outlined in Section 1. Companies were recruited into the project by various means: direct marketing, networking, tradeshow presentations etc. Only companies with significant influence over product design and design offices in Europe were accepted for the project. An overview of the participant companies is given in Table 1.

Table 1. Overview of the participant companies

Company	Description	Eco-design experience
A	Medium-sized company that design and manufacture low-volume, high-value industrial products	None
B	Large multinational company that design and manufacture complex, very high value healthcare products	Considerable
C	Medium-sized company that design high-volume, medium-value consumer products	Limited

D	Medium-sized company that design and manufacture high-value products for industrial applications	Limited
E	Small company, began life as an innovation hub to a large corporation, now focused on the design of high value healthcare products	None
F	Medium-sized company that design and manufacture a medium-value range of products for the household	Moderate

4.2 Activities and data collection methods

Table 2 summarises the workshops completed, the focus of the tool application and the level of tool adaptation. The last column offers an indication of the extent of the tool adaptations made for the Week 2 applications of the tools. Note that the participants in the one-day workshop were generally different to those participating in the Week 1 and Week 2 workshops. The '(2)' indicates that two workshops were completed during that week using different groups or applying the tool to different topics.

Table 2. Summary of the workshops completed and the focus of the tool application

Company	One-day workshop	Week 1	Week 2	Level of tool adaptation
A	Theoretical case	-	Theoretical case	None
B	Real, general issue	Real, general issue	Real, specific projects (2)	High
C	Theoretical case	Theoretical case (2)	Real, specific projects (2)	High
D	Theoretical case	-	-	-
E	Theoretical case	-	-	-
F	Theoretical case	-	Real, specific project	Moderate
Total	6	3	6	

For the workshops, the 'theoretical case' activity asked the participants to imagine that they were working for a large, well-known mobile telephone manufacturer. A graph showing the main lifecycle environmental impacts of a mobile telephone was presented before setting the brief, which was: 'Generate ideas for new features, products or services that will help tackle the problem of energy usage during the use phase of a mobile phone'. This type of product and brief were chosen as it is something that almost all people could quickly understand and draw upon their personal experience of mobile telephone use to inform the discussion. For the workshops based on 'real' issues and projects, the brief was developed through discussion between the researcher and the company contacts and related to either general environmental impacts such as water or energy consumption, or specific projects such as "eliminate the use of material 'x' from our products", or "generate ideas for a low-energy usage product for market segment 'x'".

Feedback from the one-day workshops consisted of a simple feedback form, summarised in Table 3., which was completed collectively by the workshop participants after each tool activity. At the end of the day the group ranked the five tools in terms of the value they felt they could bring to the company. Audio recordings of the workshop activities and feedback sessions were made.

During the Week 1 activities, feedback was not collected during the workshop sessions themselves (although audio recordings were made). Instead interviews were held with a representative sample of individual participants from each workshop. During the interviews participants were asked to rate the performance of the tool against a number of generic design tool criteria, adapted from the work of Lindahl [11]. A five-point scale was used to score the tool and the participants were asked to comment on their score in order to encourage more open discussion of their requirements. Participants were also asked to rate the importance of the feedback criteria. So, for example, the participant would first rate the performance of the 9-Windows tool against the criterion of being 'Time efficient', and then would be asked to rate the importance of the criterion 'Time efficient' itself.

For each of the six workshops completed during the Week 2 activities a tool feedback form was completed. The form listed the five or six contextual tool criteria and the group used a five-point scale to state if they 'strongly agreed' or 'strongly disagreed' that the tool met each of the criteria. Within Company A the tool was applied to a theoretical case study in Week 2. This was because the tool was only introduced to the team in the second week of the study and it was agreed with the team that it would be better to run through the tool as a learning exercise than to try and apply it to a real project. In the remaining three companies the tool was applied to real projects or problems (the details of which can not be described for confidentiality reasons).

4.3 Adapting the tools and criteria

In the period between the first and second week of the implementation studies the contextual tool criteria were developed and adaptations were made to the tool. The contextual tool criteria were developed by analysing the scoring of the individual criterion and the associated comments, selecting the most important criteria, and adapting or combining the criteria to reflect the design teams' needs. Efforts were made to make the criteria more precise and relevant in their content and use of language. For example, rather than stating that the tool, 'Can be used during the early stages of New Product Development', the adapted criterion would be, 'Can be used prior to the Phase B project review'. The aim of this was to reduce ambiguity whilst making the criteria easier to communicate and more relevant for the design team

The tool adaptations were made by analysing the feedback scores, comments and audio from the individual interviews and comparing these to the desired performance, as given by the contextual tool criteria. So, if the feedback from Week 1 showed that the tool performed poorly against the generic criterion 'Easy to learn, use and understand', and 'Could easily be applied with other business units or suppliers in a one-off session' was one of the important contextual tool criteria, then the tool adaptation efforts would focus on making the tool easier and simpler to use with novices. Examples of how the tool was adapted are given in the following sections.

5 FINDINGS AND DISCUSSION

5.1 Limitations of findings

Before presenting our findings it is important to note some of the limitations of the study. First, the participating companies were essentially a self-selected sample of European-based, EEE producers. We would therefore expect the findings to be applicable to other European-based EEE producers that have an interest in eco-innovation but we cannot say if the findings will remain valid for companies that do not fit into this category. Secondly, in this paper we present the results from the application of one tool within six companies. This is a relatively small sample size and so any findings must be treated as 'work in progress' findings in need of further validation. The evidence for this will come from the results of similar activities undertaken for four other eco-innovation tools with the same six companies and will be presented in future publications. Thirdly, as we are considering the issue of tool adoption, we would ideally track the uptake of the tool within the participant companies over several years. However, this will not be possible due to the time limits of the project. Finally, it is reiterated here that eco-innovation has a number of peculiarities in terms of its focus, timing and tool requirements and so the findings may not be applicable to the adaptation of 'normal' design tools.

5.2 Findings from one-day workshops

Table 3 below summarises the feedback for the 9-Windows tool from the six one-day workshops. It is interesting to note that the companies found it fairly easy to understand the principle of the tool but relatively hard to apply the tool (with the exception of Company E). The workshop participants from Company E were mostly senior engineers with responsibilities for product architecture. This would suggest that they would be very comfortable with the principle of 'systems levels' both in theory and in practice. This might explain why they found the tool easier to use than the participants in the other companies.

The question, 'Has any new thinking come out of the use of this tool?' was designed to capture both new product ideas and new ways of thinking. Most companies felt that the 9-Windows tool offered a new way of systematically breaking down a problem and so answered 'yes' to this question. The exception was the team from Company F who felt that the tool was similar to other tools they had used in the past. The last column of Table 3 summarises the feedback comments and offers some insights into why the teams found the tool difficult to apply. The difficulties appeared to be centered around the problem of clearly defining the contents of the windows e.g. is a mobile phone charger part of the supersystem of a mobile phone or part of the mobile phone system?

Table 3. Summary of the tool feedback from the one-day workshops

Company	Ease of principle (1: Easy – 5: Hard)	Ease of use (1: Easy – 5: Hard)	Any new thinking? (Yes/No)	Aspects of the tool they did not like?
A	2	3	Yes	Difficult to consider the 'Future' and 'Super system' windows
B	2	4	Yes	Difficult to differentiate between the systems levels
C	1	4	Yes	Placement of issues within windows too subjective
D	2	4	Yes	Difficult to decide in which window an issue should go
E	1	2	Yes	-
F	2	4	No	Just another way of brainstorming

In summary, the results of the one-day workshops show that the 9-Windows tool was perceived to be a simple and novel tool but that there was difficulty in applying the tool due to the problem of clearly defining the window categories. This was reassuring from a research perspective as it was hoped that with further adaptations it would be possible to make the tool easier to apply without sacrificing the novelty of the approach.

5.2 Findings from two-week studies

An example of company-specific eco-innovation tool metrics is shown in Figure 4. The selection of metrics developed for each company followed a broadly similar pattern and consisted of five or six metrics.

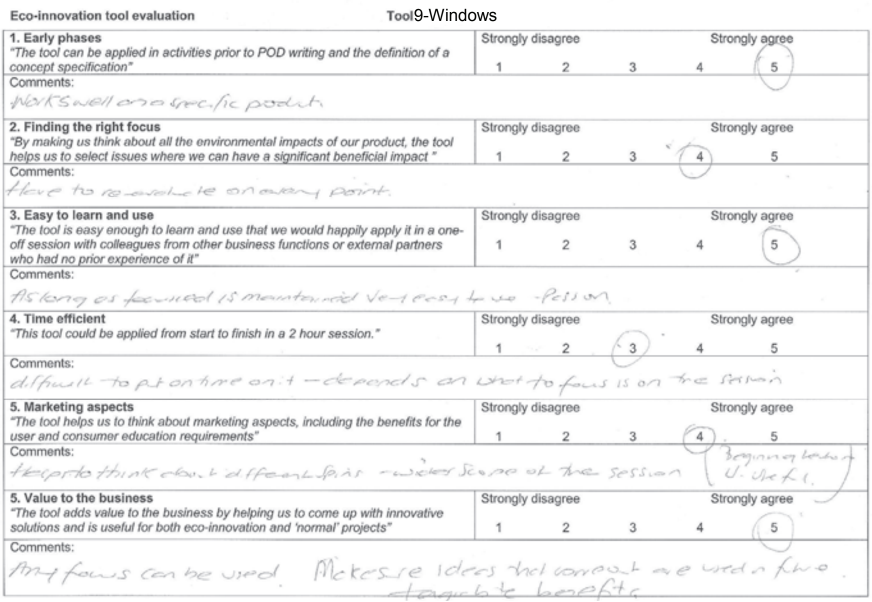

Figure 4. A completed eco-innovation tool feedback form showing the contextual tool criteria

The six main 'themes' that emerged from the development of the contextual tool criteria were:

1. Early phases – Participants were clear that eco-innovation tools need to be applicable during the early stages of product development for them to be of most use. This was generally not a problem for the 9-Windows tool as this was one of the key criteria used when searching for

potentially relevant tools at the beginning of the project.

2. Consideration of the environmental lifecycle – Participants were keen to explore the range of environmental impacts associated with their products and to have a structured method for this search and prioritisation process.
3. Easy to learn and use – This was consistently one of the key requirements for eco-innovation tools. Several reasons were found for the importance of ease of learning and use. First, if a tool is easy to learn and use it is more likely to gain widespread adoption. Secondly, as eco-innovation tools may only be used once or twice per year by any given team, they need to be easy to 'pick-up' again after a long absence from use. Finally, some companies were keen to be able to use the tools with suppliers or other business units and hence wanted to be able to use the tool in one-off sessions without wasting significant time explaining the function of the tool.
4. Time efficient – There was less emphasis on time efficiency than was expected as several participants noted that during the very early stages of a project there is generally less time pressure. In Company A for example, there was more interest in reducing the 'No Value Added' time associated with relearning a tool after a prolonged absence from sing the tool than in reducing the time spent actively using a tool in a session.
5. Marketing aspects – Cost, selling price and consumer education requirements were all considered to be important marketing aspects that should be incorporated into eco-innovation activities.
6. Value to the business – The quality of idea outputs from the tool and their eventual market or strategic value were aspects that were considered to bring value to the company from applying the tool. If the tool did not create any such value, then it was not worth the cost associated with learning and using the tool.

These themes are closely aligned with the findings of a study by Lindahl that investigated designer's generic requirements for eco-design tools [11]. This is not surprising given that the feedback questionnaire used as a guide to the individual interviews during the Week 1 activities was based on the findings of Lindahl's study.

The value of developing this type of contextual tool criteria was twofold. First, it helped to guide the tool adaptation efforts towards the issues that were most important to the design team. Secondly, it helped to gain 'buy-in' and legitimacy from the design team as they felt that they were having an input to the decision making process and the development of the tools. High levels of design team buy-in to the study were particularly apparent in Company C where several design team members said that they would be happy to lead sessions using the tool and went on to describe how they would further adapt the tool for their particular applications.

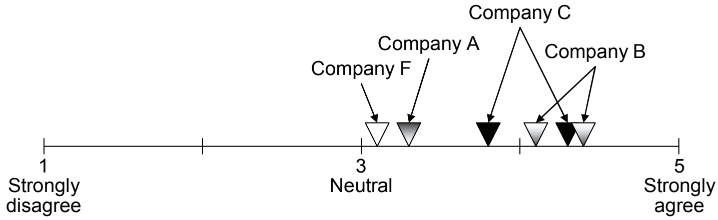

Figure 5. Mean feedback scores from the final applications of the tool

Figure 5 was compiled by taking the mean score from all of the metrics in each tool workshop. Despite the aggregation of the scores and the differences in metrics it is still useful to plot and compare the scores from the four companies on one scale as in each case the metrics represent the eco-innovation tool requirements of the design team. Whatever those metrics are, if the design team 'strongly agrees' that the tool meets those requirements then we can conclude that the tool adaptation has been successful.

From this we can say that the tool adaptation was more successful in companies B and C than it was in companies A and F. This finding is reinforced by qualitative data from the individual interviews where we found that design team members that we interviewed from companies B and C were much more positive about the effectiveness of the tools and the likelihood of them using the tools again in their work than interviewees from companies A and F.

Considering first why the tool adaptations at companies A and F were less successful, it is suggested that this can be explained by the fact that companies A and F did not go through the full tool adaptation process with the 9-Windows tool. With these companies, for various reasons, the 9-Windows tool was not applied during the first week of the study and was only introduced during the second week. The minor modifications made to the tool in these cases were based only on the researchers' understanding of the design team's general eco-innovation tool requirements. We therefore lacked the specific feedback from the design team about the tool that was available in the cases of Companies B and C.

Reflecting on why the tool adaptations at companies B and C were successful, it was noted that in both cases the successful tool adaptations were based on suggestions made by members of the design team. In Company C for example a number of the design team members noted that the team had struggled both with the terminology ('subsystem', 'supersystem' etc.). This led one marketeer to suggest that the tool should be simplified to a 3-stage process of 'Before use', During use' and 'After use' and that less emphasis on the differentiation of the systems levels (although it was agreed that looking at a problem from different systems levels was important – it was just the terminology which was distracting). This idea was implemented, reducing the nine windows down to five and pre-specifying the window titles. The titles chosen for those windows were:

- Contemplation – 5 minutes before use
- Product in use
- Product features and components in use
- Household environment and user behaviour
- Completion, conclusion – 5 minutes after use

Comparing this to the original 9-Windows tool shown in Figure 3. we can see that the 'Contemplation' window has replaced the three windows in the 'Past' column; 'Household environment and user behaviour' replaces the 'Present-Supersystem' window; 'Product in use' replaces 'Present-System'; 'Product features and components in use' replaces 'Present-Subsystem'; and the 'Completion, conclusion' window replaces the three windows in the 'Future' column.

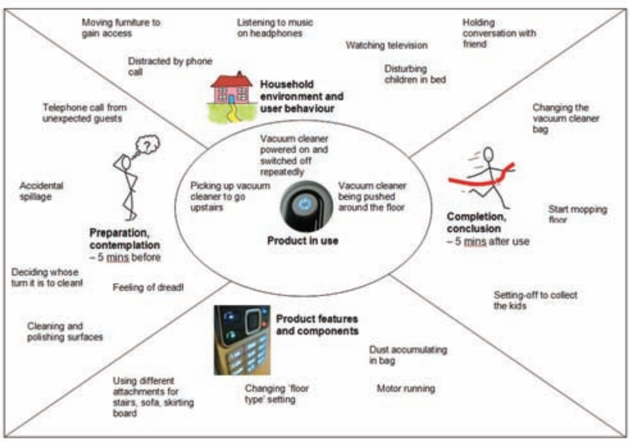

Figure 6. The final version of the 9-Windows tool adapted for Company C completed for the example of a vacuum cleaner

The window titles were chosen by the researchers but were designed to reflect the interests, requirements and language of the design team and the company. For example, it was mentioned during one of the workshops that the marketing team had previously held brainstorming session to think about what a user would be doing immediately before commencing use of the product – hence the '5 minutes before use' window. Also, the Innovation Director at the company noted that they had recently received the results of a large piece of market research which highlighted some of the main user profiles for Company C-type products. They were therefore very keen to understand how thinking about the *experiences* of these different types of user when interacting with the product could become a stimulus for innovation. The window titles therefore reflect this strong interest of Company C in user behaviour and the activities surrounding the use of the product.

The final adaptation to the tool was the inclusion of small pictures to represent each of the different windows. This adaptation stemmed from comments made by two of the product designers who thought the tool should be more visual. It was hoped that the inclusion of the pictures would act as a visual reinforcement and thus help the design team to remember the window titles. The final adapted tool is shown in Figure 6.

Some of the tool adaptations made for Company B were also attributable to suggestions made by the design team. For example, one designer commented that after the initial session with the 9-Windows tools he was thinking about how else the principle of the tool could be represented. He suggested placing a description of the problem on one face of a ‘paper box’. The task would then be to describe alternative views of the problem and write them on the remaining five faces. This idea had a number of advantages over the original format of the tool. First, the paper box would act as a physical manifestation of the principle of taking different viewpoints on a problem – the design team could now physically look at the different ‘faces’ or ‘windows’ of the problem. Secondly, by reducing the number of windows from nine to six, applying the tool was likely to be both simpler and quicker, both of which where important contextual tool criteria.

The paper box idea was complemented by once again pre-specifying titles for the six windows. These titles were:

- Materials extraction, manufacturing & assembly
- Design of system
- System in operation
- Components in operation
- User & operating environment
- End of useful life

Note that in this case the window titles emphasised the environmental lifecycle of the product, from materials extraction through to the end of the product’s useful life. This reflected the fact that Company B has significant experience of eco-design and hence the design team were comfortable using this type of environmental life cycle terminology. Furthermore, Company B is proactive in managing the environmental impacts of their supply chain and hence they were keen to consider issues such as materials extraction and the manufacture of bought-in components.

What these two successful tool adaptations cases have demonstrated is that to be effective tool adaptations need to reflect the strategy and interests of the business, as if a tool is not contributing to a business need then it will not be supported by management. On a lower level, the tool adaptations should be made to ensure that the language of the tool is familiar to the design team and that knowledge requirements of the tool are in line with the knowledge available within the design team. This will ensure that the tool can be applied effectively and efficiently.

6 CONCLUSIONS

This paper has presented some of the initial results from a study investigating the adaptation of innovation tools to meet the specific eco-innovation requirements of a company as a means of improving the adoption of such tools. By considering the case of the 9-Windows tool and its adaptation across six companies we have described a process of tool selection and implementation which proved successful when completed in full. Whilst the results presented in this paper are insufficient to conclude that the selection and implementation process described is ‘validated’, the initial findings are promising. In future publications we hope to add to the body of evidence to both support and improve this process. This evidence will come from the results of similar activities undertaken for four other eco-innovation tools with the same six companies.

In addition, it was found that:

- the development of contextual tool criteria was helpful both for guiding the tool adaptation efforts towards the issues that were most important to the design team, and in gaining ‘buy-in’ and legitimacy from the design team;
- design team feedback about the tools proved to be a good source of ideas for tool adaptations with several successful tool adaptations based directly on suggestions from design team members;

- eco-innovation tools, more so than eco-design or 'normal' design tools, should be easy to learn and use as they may be used with suppliers, consultants or other business units, and must be quick to re-learn as they may only be used once or twice per year;
- eco-innovation tools adaptations should take into account on one level, the strategy and interests of the business (such that they help to meet business needs); and on a lower level, the language preferences and knowledge of the design team (such that they can be used effectively and efficiently).

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