DEVELOPING A FRAMEWORK FOR ACCESSIBLE USER-CENTRIC DESIGN

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ABSTRACT
The purpose of a user-centric design approach to product development is to improve the applicability and acceptance of the end design. There is much literature to suggest that developing a thorough knowledge of the end-user will help to protect the product from failure in the market. By reviewing the literature on user-centric design and through a subsequent analysis of a case study of commercial user-centric design practice, this paper proposes a new framework for user research. The main aim of the development of the new framework for user-research in product development is to create an accessible model. That is, to create an approach to user-centric design research that is suitable for use with resource constrained smaller companies.

INTRODUCTION
This paper develops and analyses a case study of user-centred product concept development in order to generate a framework for the management of cost effective user-led product design. The analysis references the research material generated by practicing designers contracted for new product idea generation by a multi-national retail organisation and includes: video and audio data from focus groups; user-questionnaire responses; project files detailing secondary research undertaken; client presentation material; and, final chosen concepts.

The purpose of the analysis is to assess the effectiveness of the process and understand the benefits this commercial design research brought to the project. This article is not about the insights gained for the client per se, but rather, is about assessing the process that was undertaken in order to improve future design research. In this respect, there will be some consideration of the ‘insights’ but only from the perspective of what might have been achieved had a more rigorous research design been employed. Therefore, a framework for the management and delivery of user-centric design research services suitable for the designers’ wider SME client base is created.

In her review of the state of design research, Sanders (2006) asserts that ‘The market driven era is finally giving way to the people-centred era.’ Sanders argues such change in focus is due to business recognition that products have to be useful to be successful, possibly a reaction to the failed products of the dot-com era. The issue of usefulness is further expanded by Utterback et al. (2006, p.154) who write of successful companies’ aspirations to ‘create an emotional link between the product and the consumer.’ Almquist and Lupton (2010) further describe a transition in design research from a ‘study of things to a study of people.’ However, despite much having been written about the need for User-Centric Design (UCD), and the various methods to capture user behaviour, there is little reporting of empirical enquiry into user-led design practice and the particular benefits user research brings to industrial application.
BACKGROUND
The purpose of a UCD approach to product development is to improve the applicability and acceptance of the end design. Therefore, from a management perspective UCD has the potential to reduce development risk. UCD has been described as multidisciplinary (Mao et al., 2005), value adding (Boztepe, 2007) and inclusive (Steen et al., 2007). It is multidisciplinary as it requires experts from various disciplines to examine, analyse, interpret and synthesise user needs and behaviours and translate these to designed artefacts, often in an iterative process. It is potentially value-adding both in terms of improved design output (leading to greater commercial success) and in considering the overall experience of product interaction for the user. And, it is inclusive in so much as it provides a mechanism for the end-user to influence the creation of the artefacts that they might invite into their lives.

Functionality and experience
In acknowledging the user centric aspect of contemporary design practice and research, Almquist and Lupton (2010) critique the literature produced by both the supporters and detractors of the user focussed approach. Their critique is used to argue for new methodologies that draw on methods from both social sciences and humanities; that is, considering both the ideas of affordances and the meanings of material things. The argument presented by Almquist and Lupton echoes that of You and Chen (2007) that clarifies the differences between affordances (action capabilities based on product and environmental conditions) and semantics (meaning construed in the user’s mind) and the need for considering both. Affordances have strong links to the traditional usability aspect of product design, and their consideration as advocated by Norman (1999) has led designers to move towards the contemplation of usefulness when creating new products. The humanist approach to product design leads to the understanding of product interaction as more than usability or usefulness, but rather as an experience. Boztepe (2007) argues that user value is linked to the experience that someone has with a product, and that this experience is a product of both the activities performed and a reflective evaluation of the consequences of those activities.

User-centric design methods
There is much written about the approaches to gathering and usage of user data to inform product development, including the impact on designed output, established methods, novel and experimental methods, and, case studies for specific classifications of products. Most of this work talks of the potential benefits of varying degrees of user involvement in design projects (Bruseberg & McDonagh-Philp, 2002; Kristensson et al., 2002; Brandt, 2007; Visser et al., 2007), though there are warnings of some of the potential pitfalls. For example, Redström (2006) warns that the way in which designers focus on the ‘potential’ user during the design process might lead to the creation of products that are overly restrictive, preventing the user from interpreting new uses.
Steen et al. (2007) present a useful overview of user-centric methods, identifying six common approaches and providing advice on where each may be appropriate to different types of project. Although six methods are described, Steen et al. acknowledge that there are two key differences amongst the methods: those placing the user as the expert; and, those placing the researcher/designer as the expert. Additionally, these methods tend to be either nearer participatory design (users
involved in the envisioning of design solutions) or ethnography inspired (researchers/designers drawing solutions from the observation of users).

**Participatory and ethnography inspired design**

As described above, participatory design is an approach to gaining knowledge of users by involving them in the design process. The rationale fits with that of all approaches to UCD which, as Redström points out, perceives product failure in the market to be ‘a matter of insufficient knowledge about people, their capacities, needs and desires’. Although participatory design began in the 1970’s as a reaction to automation in the workplace and an attempt to harmonise the technological interaction with the needs of users (Steen et al., 2007), more recent work has considered the refinement of the process for better results or for specialised applications. For example, Béguin (2003) explores mechanisms for designers and users to learn from each other in system design; Brant and Grunnet (2000) and Mehto (2006) explore how drama tools can assist the development of user empathy in designers; and, Bate and Robert (2007) report on the effectiveness of co-designing with users in organisation development.

The discussion regarding ethnographic approaches to the gathering of user-data for design has been more controversial due to the tensions regarding the differences between the distinct disciplines of anthropology and design. Grudin and Grinter (1995) describe designers’ frustrations of ethnographers’ bias against intervention and the potential disruption caused when the results of behavioural observation lead to the creation of new artefacts. A decade later, van Veggel (2005) still reports tensions due to the inter-disciplinary nature of ethnographic enquiry for design; however, his article describes an environment that has become much more used to such interdisciplinarity and mainly reports tensions surrounding communication and developing appropriate research designs.

It seems that in the design space, design research, whether by participatory or ethnographic approaches, whether undertaken by designers as researchers or as collaboration between researchers and designers, has become a tool-kit of ideas, each appropriate to different requirements.

**Theory in practice**

Norman’s (1999) ‘The Design of Everyday Things’ demonstrates where all too often the human interaction aspect of product engagement has been ill-conceived. The designers of these artefacts have usually considered the functionality of such products in fine detail, but have not effectively designed the user interaction. Users and products create a dependent relationship; there is little point in a product having latent functionality that the user fails to access. However, although Norman’s work calls for better, more user-focussed design, it does not present mechanisms for achieving such an aim. More recent works have explored user-engagement beyond the activities made possible by a product to include consideration of user experience and value. Additionally, the discourse has expanded beyond usability to incorporate usefulness, has presented different approaches for gaining insights into user needs and behaviours, and, has warned of the dangers of restricting user interpretation and producing over specialised products.

From a practical standpoint, it must be recognised that user-centric enquiry has to fit into a design process where the aim is to create commercially viable output. The potential errors resulting from insufficient user consideration must be mitigated in a cost-effective manner; something that is rarely discussed in the available literature.
Ideally, user interaction should be explored early in the development process, so that the usage habits of the user can be used to inform product development; to ensure that the most appropriate designs and solutions are identified. A difficulty in obtaining such data in a reliable fashion exists as many of the factors influencing the knowledge associated with a product, and many of the potential operating errors are heavily influenced by the environment in which the object is situated.

Despite the design community’s increasing awareness of the importance of UCD, manufacturers typically lack the knowledge, expertise and resources to effectively implement such design principles (Walters et al., 2008). Additionally, there is a lacuna of research to assist user-centric design implementation by way of translation from theory to practice (Weng et al., 2007; Boztepe, 2007). In an attempt to begin to address this gap, this paper critiques a case study of user-research in consumer product design and presents a concept framework to guide future user-research.

THE RESEARCH QUESTIONS

Although there exists design-industry wide recognition that UCD research can aid effective product development, a review of the literature has revealed relatively little information on how to translate user-centric theory to practice. Responding to the call for increased user-research, the commercial team at The National Centre for Product Design and Development Research (PDR) took the opportunity of a concept creation contract to explore user research-mechanisms. This paper examines the approach that the commercial team used in order to develop a framework for future user-research that more effectively draws on UCD theory and therefore presents a step towards relating theory to practice. The research questions developed to guide this are:

- How effective was the ‘ad hoc’ user-centric design research undertaken by PDR?
- How can the experience be used to formalise and improve user-centric design research for commercial product development?

Each of these questions is set against a backdrop that attempts to recognise the resource issues associated with contracted commercial practice.

METHOD

In order to address the research questions it was necessary to create a case study of the process that PDR took for gaining user knowledge and to understand how that knowledge related to the concepts presented to the client. The case study was generated through a review of the project files and an interview with the lead researcher in order to understand:

- What did the project intend to achieve?
- How was the research undertaken?
- Why was the particular approach chosen?
- What were the results of the exercise?

The case study provided concise documentation of the project in order that the results could be assessed against the benefits of various forms of user enquiry as reported in the available literature. This empirical research allows consideration of how the project influenced the further commitment to design research from both the designers and the client; and subsequently of how design research theory can be applied to improve future performance in capturing user needs for product development.
**CASE STUDY**

The design team at PDR were commissioned by a multi-national retail company to generate new concepts for their own-brand range of baby products. There was no guidance on how this should be approached by the client; however, the design team were aware of the ongoing dialogue in the design industry of the merit of UCD approaches. Most of the design team were not parents, and so they recognised this contract as an opportunity to explore the value of user-centric investigation. However, as this was an initial exploration of needs, not directly bought into by the client, there was only a limited budget with which to resource the research.

The planning of the study was based on the materials provided by the client (competing products sold at their outlets) and the identification of typical user-groups (identified by the client). However, there was no formal referencing of the literature on different approaches to gaining ‘user insight’. Rather the lead researcher (a design professional, not a research professional) drew on his personal experience in ideation techniques and broad reading of professional design publications.

Recruitment for the user-study was undertaken through advertisements placed at a local mother and baby group. The participants that replied and agreed to partake were split into two groups based on ‘expert’ users or a match to the typical purchaser profile as described by the client. Expert users were identified as those with multiple children or being childcare professionals. It was perceived that the expert group would have strong opinions based on increased experience with the classification of product.

The day was organised as a structured focus group, with the lead researcher inviting comments about how the products fitted into participants’ daily routines. Each of the products was then introduced to the group, where the key features were explained and critiqued by the participants.

The sessions were video-taped; additionally, one of the design team took notes on the comments and interactions of the participants with the products, and, another designer made sketches of potential design options based on what he was observing. The process of analysis was simply a review of all the material by the lead researcher, highlighting interesting observations that might guide product development. A long list of points was fed back to the conceptual designer, and the video was used as evidence of these interesting points to help justify the resultant new concepts to the client.

Overall, the design team felt that the research had helped them to create better concepts, providing them with a better understanding of:

- How the participants tested and compared quality in the products;
- An assessment of the most important features based on the reaction of the participants;
- An understanding of how the parents justified their expenditure on such products;
- A deeper understanding of the impact of particular aesthetic options;
- And, a better understanding of how the product fits into family life.

The client also seemed to be impressed with the knowledge gained and the impact that such research might have on product development programmes. This was evidenced by a further commitment to commission such research-based concept development with the design team, and in taking some of the concepts through to the next stage of development.
DISCUSSION AND PROPOSED FRAMEWORK

Critique of the case study

That the investigation was undertaken without an informed research framework opens up the case study to criticism regarding the validity of the results; however, as a professional investigation to gain material for ideation and new concepts the process was successful. The purpose of this paper is to critique the process that was followed and suggest improved ways of undertaking contracted research that draws on the available theory. In addition, the new advice should recognise that the needs and resources in professional practice are not always an exact match to the ideals of the theoretical underpinnings. Table 1 below presents the positive points that were observed in the case study, matched to criticisms that could lead to an improved user-research data gathering framework.

<table>
<thead>
<tr>
<th>Positive case study actions</th>
<th>Criticism or limitations of the approach</th>
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<tbody>
<tr>
<td>Direct observation with users</td>
<td>Little formal structure: research guided by ease of implementation rather than a review of needs</td>
</tr>
<tr>
<td>Interaction with products</td>
<td>Guided interaction with product features: users not left to discover features</td>
</tr>
<tr>
<td>Video analysis to capture ‘interesting’ points</td>
<td>Analysis undertaken by designers not trained in research</td>
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<tr>
<td></td>
<td>No research question developed to guide analysis</td>
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<td></td>
<td>No analytic strategy to explore anything other than ‘interesting’ behaviour or statements</td>
</tr>
<tr>
<td>Design team involved in research data gathering</td>
<td>No research professionals involved in research design, data gathering or analysis</td>
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Table 1. Merits and limitations of the research design employed in the case study

Although this was a contract for a large multi-national company, it was noted that the research aspect had a limited budget. This resource limitation allows the case study to be viewed as a parallel to the resource constraints likely to form a part of any contract with smaller companies (Larsen & Lewis, 2006). One of the aims of the development of a new framework for user-research in product development is to create an accessible model. That is, to create an approach to user-centric design research that is suitable for use with resource constrained smaller companies.

Recruitment for the study was undertaken via advertisement at a single venue; however, efforts were made to match the applicants to the profile supplied by the client, and, to group the participants based on their experience with the products. The use of recruitment agencies was not considered due to the budgetary constraints. Such a compromise, which necessarily removes sophisticated filtering, e.g. geographic or socio-economic filtering is likely to be a feature of any user-study conducted on a limited budget.

The lead researcher undertook video analysis and presented his findings back to the design team; however, one of the design team had been present during the research data gathering and spent that time creating sketches. It might be considered that by undertaking sketch development in parallel to the research data gathering, the designer was ‘shortcutting’ the design process (Carroll, 2002). Indeed, this study presents some validity to such a viewpoint, as the sketch output captured many of the ‘interesting’ observations deduced from the video analysis. It is outside the scope of this paper to analyse the effectiveness of such shortcutting; however, it might provide a potentially interesting aspect of future research into increasing the rapidity of design research and its synthesis to practice.
Parallels with current theory
The way in which the project studies both the functionality of the products and how they fit into the lives of the participants does present an exploration of use, usefulness and value. Functionality is explored both in terms of the features of presented products and in the dialogue of what users want and get from this class of product. The focus group type interaction with users generates a retrospective dialogue, and so fits with Boztepe’s (2007) notion of value based on reflective evaluation. The research process undertaken is similar to the Empathic Design approach, in so much as it is a move by the designers to get close to the end-user to find inspiration (Steen et al., 2007). However, Empathic Design usually has an ethnographic element to observe users with existing products and to consider how users might interact with potential product solutions. The approach used is based on the designers being experts, and so is divergent from the Participatory Design type methods, further suggesting that an ethnomethodological approach would be most suitable. It is interesting to note that despite being unaware of academic literature surrounding user-centric design research, the design team finished the project feeling that the project would have benefited from in-use observation.

The proposed framework
Figure 1 presents the proposed framework for accessible user-centric design. The framework is described as accessible, as it is designed to be implementable even in situations of limited resource. However, it also aims to achieve rigor in the evaluation of potential product user behaviour in order to be an effective tool for improving the empathy of a design team when creating new products. The major deviations of the framework to the approach taken by the design team of the case study are the addition of an ethnography inspired user observation round and an emphasis on creating a structured and robust coding scheme for the subsequent video analysis. A further stipulation of the new framework is the inclusion of research trained individuals in setting up the research questions, study design and video analysis. It could be argued that the insistence on the use of such researchers inhibits the accessibility aspect of the model, as a lack of available expertise has been cited as a barrier to design usage in the wider literature on product development (Larsen & Lewis, 2006). However, this framework is intended to be used by design professionals that provide services to industry rather than for implementation within companies. Therefore, the accessibility (as in low entry costs) aspect is derived from the speed with which the study can be undertaken and the analysis fed back to designers. Attached to the User Observation box of the framework is a question regarding the simulation of environments. It is envisioned that many product interactions do not have to be observed in situ in order to be accurate. This might be a controversial issue, especially in terms of the tensions already shown to exist between anthropologists and designers regarding the way the design industry has modified ethnomethodology for its own purposes. However, if a simulated or quasi-contextual environment can provide some accurate notion of product interaction then such a strategy has the potential to reduce observation cost. Because of the contentious nature of this proposition, the observation has been labelled ‘ethnography inspired’ to demonstrate that there is no claim of this model providing a true ethnographic enquiry.
Fig. 1. Proposed framework for accessible user-centric product design
The focus group style interaction used in the case study appeared to be an effective way of gaining insight into how the class of product fitted into the participants daily routines. Further, such understanding of the daily usage provided information on how participants valued the products, that is, the use of the product beyond its functionality. Therefore, a focus group routine has been included in the new framework. However, as the focus group uses the same participants as the observation phase, the outcomes of the focus group can be used to contextualise user behaviour and to compare the things people say with the things that they do.

After conducting the User Observations, Route 1 is followed, which advises: a short semi-structured interview to provide some context to the observation, e.g. to ask questions regarding which product or features the user preferred; a focus group to explore user values; and, the analysis of the captured data. The purpose of this route is to generate material for presentation to the design team with the aim of improving the designers’ empathy for the potential users and therefore leading to the generation of better product concepts. Mock-ups or prototypes of the new concepts can be used to repeat the User Observation phase and refine the product solutions. At this stage there is a choice of following either Route 1 or Route 2. Route 1 can be repeated if further analysis is required, or Route 2 moves the design on to further development. Of course, there remains the potential to repeat the ethnography inspired user observation throughout design development if required.

CONCLUSIONS, LIMITATIONS AND FURTHER RESEARCH

The literature on the various approaches to user-centric design provides a clear theoretical base on which to determine both the benefits and the drawbacks of involving/studying users in the design of new products. Additionally, the case study demonstrates how one design team approached UCD in a commercial setting and exemplifies some of the barriers, namely, resource constraints and a lack of available expertise. By considering both the theory and the experience of the design team at PDR, this paper set out to answer two research questions:

- How effective was the ‘ad hoc’ user-centric design research undertaken by PDR?
- How can the experience be used to formalise and improve user-centric design research for commercial product development?

That the ‘ad hoc’ design research was effective to some degree was demonstrated in the new concept ideas generated and in convincing the client to invest in further design research to be undertaken by PDR. However, the lack of structure to the research makes it difficult to determine the extent of the effectiveness. Interesting user behaviours were discovered by the lead researcher and these were translated into the new product concepts. However, had a more rigorous approach been taken then there may have been the opportunity to discover further interesting behaviours and to assess the relative importance of different behaviours.

The second research question was centred on an attempt to improve and formalise the UCD research for product design practice. By reviewing the user-centric theory it was recognised that the design team’s approach was analogous to the Empathic Design approach; however, it lacked an important ingredient – ethnography inspired observation of users interacting with products and design solutions. Therefore, a framework has been proposed that has the observation of users as its central theme.
Limitations and further research
The proposed framework is based around a typical product development contract, where there are existing products on the market that are perceived to be addressing current user needs. Of course, this is not always the case and sometimes more exploratory investigations are needed to define product opportunities. It may be that the framework can be adapted to cope with such exploration; therefore such adaptation to different circumstances is likely to form a future research avenue for the authors.
Additionally, the framework was developed from an identification of the aims of the design team and a proposal for improving the research design and analysis in line with those aims. That is, the retention of the designers as experts and therefore a leaning towards ethnography inspired methods. However, future projects might lead to different design aims, and therefore require a different research process. Taking the example of more exploratory design work above, there may be scope for adding a Participatory dimension to the framework, including the testing of the participatory output via User Observation.
Another interesting angle for further investigation is the notion of the designer’s observation of users’ interaction with products. In the case study the observation led directly to new concepts. It would be interesting to evaluate the effectiveness of such ‘shortcutting’ of the research analysis.
Despite these obvious avenues for further research, the next step for the authors is to begin to test the proposed framework in a commercial project. Fortunately for the authors, the client that commissioned the research undertaken in the case study has commissioned a second project that is likely to provide just such an opportunity.

REFERENCES


