User Research in Product Design

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ABSTRACT

Ergonomics contributes to product design through provision of generally applicable data and through study of user-research methods that can be used within the design process. However, the application of research outcomes relies upon the adoption of relevant information and methods by product designers.

In this study, industrial designers were asked how and where they get information about users of the things they are designing, and about their perceptions of the role and value of user research. The study made use of group discussions with nine design companies followed by a questionnaire distributed to industrial design consultancy firms throughout Australia.

Results showed that designers used many of the methods familiar to human factors researchers but often in a cut-down form, due to cost and time constraints. For example, there was widespread use of work colleagues and family members as test subjects. The challenges faced by designers included getting information in a manner that is timely and cost effective, and in a form that supports decisions about design concepts and details.

Further study is needed of user-research methods that are used or could be used by designers, with a focus on usefulness and cost effectiveness within the design process. There are opportunities to develop a better “toolkit” of methods for designers.

1. INTRODUCTION

The stated aim of human factors / ergonomics is to develop knowledge about people for the purpose of improving the design of things and systems that people use. For example, the International Ergonomics Association describes ergonomics (or human factors) as, “...the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design”, IEA (2000). Ergonomics is largely applied to the design of things through the transfer of knowledge to designers including engineers, architects, software designers and industrial designers. This occurs, for example, through education, collaboration between designers and ergonomists and through published research and guidelines.

The focus of this study is industrial designers and their methods for getting information about users of the things they are designing. Industrial designers give form to a wide range of manufactured products used in homes, workplaces and public areas. A description of industrial design from the Design Institute of Australia begins with the statement, “Industrial designers develop and prepare products for manufacture with particular emphasis on those aspects that relate to human usage and behaviour.”, DIA (2004). The description goes on to say that designers consider functional and aesthetic aspects and pay particular attention to ergonomics. As part of their work industrial designers (hereafter simply referred to as designers) prepare drawings, illustrations, models and prototypes to assist in decision making, and to demonstrate or test their designs. The knowledge areas required of designers include materials, history and theory, manufacturing processes, business and marketing, and computer aided design systems. Designers also need to know about the people they are designing for in order to have confidence that the products they are designing will meet needs, be easy and safe to use, and fit the users’ lifestyles and aspirations.

Knowledge required about people can include information and methods contributed by ergonomics. This has been recognised by the inclusion of ergonomics in industrial design education. All but 2 of the 11 undergraduate programs in industrial design offered by Australian universities include at least
one course in ergonomics. Other disciplines such as marketing and social sciences also provide methods that have been adapted to user research in design.

Despite the obvious connection between ergonomics and design, there are also apparent barriers to the use of ergonomics information and methods by designers. The differences in modes of thinking between ergonomists (science based) and designers (arts based) have been identified as part of the problem by Green and Jordan (1999). Rouse and Boff (1998) have argued that information intended for use by designers should be presented in a form that relates to the decisions that have to be made, and preferably embedded in the tools used by designers.

User-centred design requires the application of known data and the discovery of new information through the testing of ideas within the design process, ideally with involvement of users. Models and illustrations routinely produced by designers can be used as tools in this process. The need to get information quickly and inexpensively has been recognised by some researchers who have shown ways of reducing time and cost of evaluation methods while still producing worthwhile results. Thomas (1996), for example, discusses the use of “quick and dirty” testing that often involves small samples and relatively primitive simulations of the product.

Recent ergonomics and product development literature shows exploration of a number of innovative approaches to user research in design, such as adaptations of focus groups (eg, Langford and McDonagh (2003)), ethnography or observational research (eg, Kumar and Whitney (2003), Sanders (2002)) and scenario modelling (eg, Fulton Suri and Marsh (2000)). At the same time there are indications that the scope of ergonomics in product design is extending beyond function and usability to include the ways in which products meet emotional needs and provide pleasure to users.

However, there is relatively little published about the ways in which designers themselves undertake user research in the normal course of their work. One exception is a study by Hasdogan (1996) of designers in 55 companies in the UK to find out how they represented users in the design process. She reported that designers formed “user models” informed by a variety of inputs including published information (empirical models) and their own tests (experimental models), but they also relied on their general experience to construct imagined scenarios of product-user interactions (scenario based models). Hasdogan raised the question of how well the designers’ model represents real future users, noting that a mismatch between the designers’ predictions and actual user behaviour could result in errors, accidents and dissatisfaction with the product.

1.1 Definitions

In this study, user research refers to ways in which designers intentionally gather relevant information about anticipated product users. It includes, but is not limited to:

- Locating published information
- Observation of users
- Interviews with users
- User testing
- Seeking expert advice

The term, user, means people who use or interact with the product. In this study, users are not only the “end-users” but also those who interact with the product in other ways, such as during installation or maintenance.

2. AIMS OF THIS STUDY

The aim of this study was to find out how Australian industrial designers currently do user research in their day to day practice. Two questions are addressed in this paper:

1. How and where do designers get information about users?
2. How do designers perceive the role of user research in design practice?

The study was approached without pre-determined views of what should be happening in design practice and thus the purpose was to describe rather than evaluate.
3. METHODS

Group interviews and an on-line questionnaire were used in this study to ask designers about their practices and attitudes. Interviews were conducted first and the results informed the development of the questionnaire. The combination of a mainly qualitative approach (interviews) and a mainly quantitative approach (the questionnaire) sought to discover: a) what designers do and think and, b) how common are particular practices and attitudes.

3.1 Group Interviews

Group interviews were conducted in Sydney during 2005 with nine design teams, two of which were design teams within larger manufacturing organisations and the other seven were design consultancy firms. The interviews were held at the workplace of each group to make participation as convenient as possible. A series of questions was used to guide the discussion and cover a range of issues including how designers described user groups, sources of information, methods used to collect information and how knowledge of the user is incorporated into the design process.

Audio recordings of interviews were made and transcribed, and a brief questionnaire form was used to get some details to establish a profile of the participants. A total of 45 participants were interviewed in groups varying in size from three to eight people plus the facilitator. The average length of the recorded interviews was 45 minutes and the transcripts averaged about 6,500 words.

Analysis of the transcripts was done by transferring the text to a spreadsheet, with a row containing the text of each question or response and columns with codes to identify the source of the comment and the question or topic it was associated with. Thus it was possible to separate and sort comments for analysis while retaining the ability to locate each comment in its original context. Sorted groups of comments were then copied to new spreadsheets according to codes. Standard spreadsheet functions were used for sorting, filtering and searching during analysis. The method was essentially an electronic version of the “long table” approach described by Krueger and Casey (2000) for analysis of focus group results. The long table refers to a work area where paper copies of transcripts are cut up and the pieces assembled into groups. In this way responses to particular questions and themes that emerged from the discussions could be identified for review and reporting.

3.2 Questionnaire

An on-line questionnaire was developed with mainly closed questions to elicit standardised and quantifiable responses to issues identified in the group interviews. An email, with links to the questionnaire and a project web-page, was sent to 47 industrial design consultancy firms throughout Australia to invite participation. Thirty six questionnaire responses were received, estimated to represent about 12% of designers in the companies contacted, assuming and average of 6 designers per company as reported by Robertson (2005). Analysis of the responses shows that at least 15 companies were represented among the respondents.

4. RESULTS

4.1 Profile of Respondents

The role descriptions and years of experience of group interview participants and questionnaire respondents are shown in Figures 1 and 2. In both figures the numbers are expressed as percentages of the 45 interview participants and the 36 questionnaire respondents. There is some overlap between the two groups as 11 of the interview participants also responded to the questionnaire. The higher proportion of design managers, compared with industrial designers, among the questionnaire respondents has probably resulted from managers who received the recruiting email and responded to the questionnaire but did not forward the email to their staff.

Responses to other questions revealed that the design work done by both interview participants and questionnaire respondents was mainly product design, including consumer products and products designed for use in workplaces. To a lesser degree some other types of design such as visual communication, packaging and interior design were also done by some groups.
Interview participants and questionnaire respondents had similar distributions of experience and, overall, about 90% of designers in the study had at least two years of experience in design.

4.2 Getting Information about users

The questionnaire asked which methods of “getting information about users” had been used during the last year. Respondents selected answers from a list. The results are shown in Figure 3.
Another question asked if 2D or 3D representations of designs had been used during the last year in getting feedback before a real product was available. 2D representations included “any form of illustration, whether hand drawn or computer generated”; 3D representations were described as “all types of physical models from simple representations of size and shape to realistic prototypes”. The results of this question are shown in Figure 4.

Figure 4 – Showing how many of the 34 respondents who answered this question claimed to have used 2D and 3D representations in particular types of user evaluation during the last year.

### 4.3 Attitudes towards user research

Attitudes towards user research in design were surveyed by asking for responses to 11 statements that represented views expressed in the group interviews. The question asked for ratings on a 5-point scale from strongly agree to strongly disagree. Results of this question are shown in Table 1.

<table>
<thead>
<tr>
<th>No</th>
<th>Statement</th>
<th>Ratings used to calculate mean</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
<th>Mean rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Our clients (or other business units) provide us with the information we need about the users of the things we design.</td>
<td>4</td>
<td>9</td>
<td>11</td>
<td>11</td>
<td>0</td>
<td>3.2</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>A lot of research about users and their preferences can inhibit the design process.</td>
<td>2</td>
<td>10</td>
<td>3</td>
<td>20</td>
<td>0</td>
<td>2.8</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Ergonomics data can be usefully applied in most design projects.</td>
<td>8</td>
<td>18</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>3.8</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>User preferences and needs can be largely derived from review of existing products.</td>
<td>0</td>
<td>9</td>
<td>7</td>
<td>16</td>
<td>3</td>
<td>2.6</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Systematic research of user requirements is a necessary part of product design.</td>
<td>9</td>
<td>17</td>
<td>5</td>
<td>4</td>
<td>0</td>
<td>3.9</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Knowledge and experience of a wide range of people is important for product designers.</td>
<td>16</td>
<td>13</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>4.1</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Designers are not expected to carry out user research as part of the design process.</td>
<td>1</td>
<td>2</td>
<td>7</td>
<td>18</td>
<td>7</td>
<td>2.2</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Industrial design is more about solving technical problems than researching user needs.</td>
<td>0</td>
<td>6</td>
<td>6</td>
<td>16</td>
<td>7</td>
<td>2.3</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Trying to meet the needs of all kinds of users results in an unsatisfactory compromise.</td>
<td>1</td>
<td>11</td>
<td>8</td>
<td>13</td>
<td>2</td>
<td>2.9</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Product evaluation involving users is best done by someone other than the designer.</td>
<td>3</td>
<td>9</td>
<td>9</td>
<td>10</td>
<td>4</td>
<td>2.9</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>In the future designers will need a stronger capability in user research.</td>
<td>3</td>
<td>19</td>
<td>9</td>
<td>4</td>
<td>0</td>
<td>3.6</td>
<td></td>
</tr>
</tbody>
</table>

Table 1 – Responses, on a 5-point rating from Strongly Agree to Strongly Disagree, to the statements shown. Thirty-five respondents answered all parts of this question.
5. DISCUSSION

The questionnaire response rate, at about 12% of the targeted population of Australian industrial designers working in consultancies, is acknowledged to be too low to generalise the results to all industrial designers. Instead, in the discussion below, the data collected in the questionnaire is considered together with the qualitative findings of the group interviews. More attention has been paid to the relative ranking of responses in the quantitative data than to the actual numerical value.

In the discussion below, quotes from the group interview transcripts are shown in italics.

5.1 Getting Information

The most common method of getting information about users, according to questionnaire responses (Figure 3), was talking to someone familiar with the user group. The person the designer talked to was often their client, or people involved in selling the product.

“We have demonstrators who are demonstrating our products all over the country, and through those demonstrators we can get a lot of knowledge as well.”

The attraction of this method is cost effectiveness compared with surveys of individual users. A discussion with the right person could be a rich source of mostly qualitative information, typically in the form of anecdotes and opinions. The obvious disadvantage is that, without validation, the designer cannot know how accurately the opinions given reflect the views of the user population.

The second most common method of getting information about users (as shown in Figure 3) was observation of users with existing products. Comments in the group interviews emphasised the importance of seeing people use things. There were examples of designers trying to observe behaviours in public areas without being noticed, and occasions where the designer would speak to a subject as well as watch what they do (usually in a work environment). Recording observations with a camera and notebook was mentioned in one group. Observation of people handling products in a focus group setting was also mentioned. One of the interview groups used videotapes of focus groups to bring information back to the design team.

“So as soon as we saw the video, the way they picked it up, it was great for us because we saw the distance between the fingers and whether they picked it up left or right-handed…”

Observation also played an important role in evaluation of design concepts represented as models, often in combination with talking to the subject.

“.quite often I’ll give someone a prototype and go and show them how to use it, or not show them how to use it, depending on what I’m trying to ascertain from it, and sometimes I’ll take photographs and things like that”

Looking up reference books was the third most common method of getting information among the questionnaire respondents (Figure 3). Responses to a related statement in the questionnaire showed a relatively high level of agreement that “ergonomics data could be usefully applied in most design projects” (statement 3 in Table 1). Interview comments suggested that the participants were mainly referring to anthropometric data when they talked about ergonomics information. While there was general agreement that this type of data was important, there were also comments that emphasised the difficulties in using the data, such as when there was a mismatch between the data available and the design problem to be solved, or when the designer needed to know how much tolerance would be acceptable if other design requirements were in conflict with ergonomics guidelines.

“its too simplistic, the figures they often give us, … we don’t design, say, computers or a keyboard for someone who’s definitely seated. Our products are generally used standing up, but at all sorts of bench heights and all sorts of things. I don’t think we could ever find a golden figure to solve our problem for us”

Another form of “published” data used by designers is existing products. Features of apparently successful products were used in some situations as a guide to user preferences and suitable dimensions. This was seen as a direct way of getting information applicable to some design
problems, although the response to statement 4 in Table 1 shows more disagreement than agreement with the statement that “user preferences can be largely derived from existing products”.

3D representations of models were used to collect feedback in a variety of ways (shown in Figure 4). Most common according to the questionnaire results was getting evaluation from or via a client. In the interviews several groups mentioned that a client would sometimes arrange user trials or focus groups to evaluate concepts rather than having this done by the designer. While it is understandable that the client might seek independent evaluation of the design, there were also benefits where the designer could be involved in the evaluation, even if only as an observer.

“… They came in and they conducted these interviews, and whenever we’re standing behind that two-way glass, you learn things you had no knowledge of. So, to read the reports of the market research is interesting and helpful, but to be there is just the best!”

Both the questionnaire responses (in Figure 4) and comments from the interview revealed that feedback was commonly sought from colleagues at work and family members. Although this may not be good research practice (non-representative sample) there is a clear benefit in speed and economy.

“When you’ve got a prototype […] we may give it to a number of people within the company, across the board in different departments to have a look at and to use, .. our families, including young children, an older grandma and grandpa, and all our friends….”

5.2 Perceptions of User Research in Design

Some of the responses in Table 1 provide information about the perceived value of user research and about the extent to which designers believe they should be directly involved in research. Opposing views were expressed on the first issue, as evidenced by the bimodal responses to statements 2 and 9 in Table 1. Although there were views expressed about the importance of user research there were also statements indicating that too much reliance on user research could impede the design process or result in less satisfactory outcomes. Surveys and interviews with users were felt to be potentially limiting because, it was claimed, users would only think about what was familiar to them rather than imagine future possibilities. Other comments, in contrast, stated that opportunities and new insights emerged from user research, particularly from watching what people do.

An overriding concern was the cost effectiveness of research. Design projects were undertaken within limited budgets and with time constraints. Some comments stated that the designers’ clients did not always allow resources for user research to be undertaken by the designers.

“. .. we’ve got very good clients that enable us to do some research, but we’ve got plenty of clients who don’t, and that’s still the biggest over-riding problem with research, it’s the client’s understanding of what’s got to be done to get a good result.

Some designers spoke of doing observation and getting feedback on designs as a non-chargeable “background” activity. There was about equal agreement and disagreement with the statement in the questionnaire (Table 1) that “product evaluation involving users was best done by someone other than the designer”. Views on both sides of this issue were also expressed in the group interviews. There were some who felt it was more cost effective for specialists to undertake research activities such as running focus groups. There were others who indicated they would do more research if the budget allowed. In any case there was a high level of agreement with the statement 11 in Table 1, that “in the future designers will need a stronger capability in user research”.

6. CONCLUSION

The study has served its purpose as a general “stock-take” on the practices and attitudes of Australian industrial designers with regard to user research in design, and from this base further research could be undertaken. It is clear that the designers studied used research methods without the rigour or theoretical understanding that would be expected of research in other fields. On the other hand, there was evidence that designers had found cost effective ways of getting information that, even if patchy, was perceived to be good enough to support design decisions. Some of the low cost methods already used by designers could be studied with a view to establishing better understanding of their effectiveness as design tools.
It would appear that there are opportunities to do things better. Further research could focus on factors that tend to produce successful integration of user research in design. For example, an action research approach could be taken in which a researcher and designer collaborate to introduce a user research method in the design process, and then evaluate the effect of the change.

Evidence of successful user research is ultimately in the products made, and the way they are perceived and used. As stated by Myerson (2005), “designers will not be judged on the research; they will be judged on what they design.”

7. REFERENCES


Sanders, E. (2002). "How "applied ethnography" can improve your NPD research process." Visions magazine(2).