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This paper explores the adoption process of user-participative interaction design tools in manufacturing organisations in which they have not historically been used in the development of consumer product interfaces. Three case studies are presented describing the adoption of user-participative design tools at different stages of implementation. The studies reveal an interesting ambivalence towards innovation. There is willingness within design groups to adopt new design tools and motivation to produce novel and innovative products from them. Manufacturers are also willing to sponsor innovative product development methods and products but problems occur at the interface between the design group and other functionally related or dependent groups. The paper concludes by suggesting that a broad contextual frame of inquiry is required, where a deeper organisational understanding of the design and manufacture decision making should form an integral part of interaction design research.

## **Introduction**

Consumer product manufacturers continually seek innovation in product development. Low-cost display and digital processing technologies now provide additional opportunities for product manufacturers to explore novel interface interaction styles using ‘computer-based’ interfaces. The purpose of this research study was to explore how user-participative interaction design methods could be used in manufacturing organisations which had not previously addressed these interface design issues. Interviews and workshops were carried out to address two questions. How were user-participative methods being introduced (or how could they be adopted) and what perceptions did the designers’ have of their power to influence the introduction of new interaction design methods and the adoption of innovative interface design solutions? At the time of this study (around 1994-6) interaction design tools for consumer product interfaces were only beginning to emerge. This is in contrast to today, when user participative methods are more readily available, for example (Beyer and Holtzblatt 1998; Preece, Rogers et al. 2002; Rosson and Carroll 2002) and user interface design issues for consumer products are also available (Bergman 2000).

## **Case studies**

Three case studies are presented; the first, case-study A, describes a small ‘interaction design’ group working on novel control devices within a manufacturer of programmers, time switches and automatic controls for control and regulation of residential and non residential heating systems. Case-study B provides an account of a small industrial design group based in a large manufacturer of domestic appliances. Current design practice is described first, followed by a very brief description of the industrial designers’ reactions to using a bespoke set of user participative design tools. While case-study C describes

feedback provided by a user-centred design group, which was part of a telecommunications company, to potentially adopting the same design tools offered in case-study B.

### **Domestic process control manufacturer (A)**

*During the interview period*, the design team was exploring the possibility of using TV-type remote controls on some of their products and the use of 'smart' service tools for client organisations. Design activity usually began with extensive fieldwork before undertaking a series of workshops to incrementally improve the interaction design problem by involving both participants and designers. The design tools included: rich character descriptions to facilitate discussion about how future products might be used; descriptive task maps that were built up using post-it notes; drama-based activities to enact interaction scenarios; and the use of mock-ups and prototypes to articulate user requirements. Much of the design team's work centred on event planning and analysing findings from the workshops. Significant or important design activity was conducted within the workshops where participants took a proactive role in design decision making. Substantiating design proposals and design detailing was conducted between workshops. Interviewees defined the design process as 'empathy driven'.

Workshops were not usually written-up formally as it was argued that formalising evidence on paper could force subtle and complex user requirements to be misinterpreted. When it was suggested that other documentation methods could be used, the designers argued that design solutions should remain 'embedded' in the workshops and they should retain their informality. The benefits of this approach were the emergence of unexpected solutions, the implicit and tacit knowledge gained through the workshops, plus frequent iterative developments and changes to the design tools. These were seen as strengths of the process. However, some of the design team did admit that controlling the granularity of the design problem could be difficult and found it difficult to articulate exact procedures and define clear workshops objectives and tangible outcomes. Nevertheless, the design team expressed enthusiasm for using this design approach.

The team leader deliberately wanted to create a radical design process within the organisation and admitted that their approach was sometimes treated with scepticism, but this was reducing over time. He negotiated with other departments to secure design projects but only accepted them if the participative methods could be used, although he did recognise that the long term future of the design group was dependent upon more conventional design projects that might not require participative design tools. The group enjoyed support from senior management who were keen to promote the innovative design methods outside the organisation.

### **Consumer 'white goods' manufacturer (B)**

*Semi-structured interviews were carried out within one of the industrial design groups in the organisation. The group regarded themselves as an internal design consultancy, negotiating projects with different parts of the organisation. Interface design work depended upon the type of product and brief given; typically, most design projects were 'facelifts' where an existing design is modified mainly in visual appearance. Innovative interaction design was generally not part of the design group's remit and typically they worked with conventional control and display technology. Each phase of design solutions had to be 'sold' to the sponsoring group to continue funding. Most of the innovative design work was carried out by another design group within the organisation, but nevertheless, they were beginning to receive more 'conceptual' development work such as providing design concepts based on commissioned external marketing consultancy reports, competitor analysis reports or through 'trend mapping'. Final decisions on design proposals were made by external groups, usually marketing management, or through product planning groups or steering committees.*

Contact with users was rare and they were not involved during product or interface development. This was due to the organisation's perception of the design group's role which did not include user requirements capture, which was regarded as a marketing function. If user requirements needed to be considered, this would be achieved by working through a list of 'factors of influence', a checklist of psycho-social factors

that affect product perception. Users were only consulted during 'clinic research' undertaken by marketing divisions with existing or 'near-to-market' products. Products were assessed against competitor products but purely on visual impressions; users did not interact with the products. The design group were very willing to involve users in design activity but thought management approval would be difficult.

However, through this project we did gain approval to carry out innovative interaction design work using a set of user-participative design tools specifically developed for this purpose. Two design tools were proposed, which were based on 'card sorting' games (Muller, Tudor et al. 1995) and scenario design techniques (Carroll 1995). Both design tools were adapted to satisfy project design constraints, in particular the designers' lack of experience in using these methods. The introduction of the design tools had a powerful impact on the designers' perception of their role and influence within the organisation. The trial of the design tools contributed to their frustration at not being able to affect key product development decision making.

We also carried out extensive usability trials of some prototype interfaces produced from the user-participative workshops and measured usability dimensions such as user preferences and performance. An example is provided in Figures 1 – washing programs are created by dragging and dropping washing functions into a series of washing baskets.



**Figure 1. Prototype touch-display washing machine interface**

The usability results from one of the other prototype interfaces, an auditory display, revealed contradictory results. Users enjoyed using the auditory display and found it engaging but at the same time programming accuracy was weak. Because, overall, the usability studies did not present clear 'winners', this led to a sense of unease from the marketing department, who were co-sponsors of this research, about how to develop these proposals further. Despite the local success of the design tools and the willingness of the organisation to fund innovation, the design tools and the innovative solutions created from them ultimately did not fit with manufacturing processes, design procedures or expectations, see (Bonner 2007 ) for a more detailed analysis. Clearly the design tools were successful at the implementation level but their use and outputs created from them created uncertainties in other parts of the organisation. We needed to understand more deeply what type of factors affected the organisational survival of the design tools.

Telecommunications supplier (C)

*An opportunity arose where 'organisational survival' could be examined further. A discussion group session was set up with members of the User-Centred Design Group at a telecommunications company*

where the feasibility of introducing the design tools produced in case-study B, could be considered. Members of the group were invited to a one and a half-day workshop. Focus was placed on how best the design tools could effectively be generated within their organisational context and fitting them into their organisational culture. A design case study, a hand-held testing device used by field engineers, was used as an exemplar around which to discuss the design tools. The group were asked to draw up a list of important critical success factors to facilitate implementation of the design tools and to increase involvement of end-users in the design process. In general, they suggested the tools must be acceptable to many different stakeholders by integrating existing human factors and user-centred skills, while also permitting other non-design disciplines to be involved in the process. Furthermore, the tools must be seen as viable and acceptable to senior management, particularly marketing groups. The outcomes of the design tools must translate naturally into tangible design specifications and should focus on retaining links between inquiry objectives (what type of design data is being elicited) and outcomes (how interaction design issues raised by the design tools could best support design objectives).

During the discussion, other issues were identified that might impede survival. Most of the designers worked closely with human factors specialists and traditionally user requirements capture was regarded more as a human factors role. The designers needed to feel confident about using alternative design methods, which they perceived as belonging to the human factors group, before exposing their design methods to external criticism. Concern was also expressed about being able to gain access to users for workshop sessions. Designers were usually co-opted onto observation sessions and focus group meetings organised by other sections of the organisation. The group rarely organised participative sessions themselves. User-centred design methods were more commonly found in the human factors group, than in the User-Centred Design Group!

## Discussion

**The design groups in the first two case studies shared similar ambitions about increasing their influence within their respective organisation. In case study A this was through the use of innovative design methods to create new innovative product solutions. The key vision of the group was to persuade the organisation to widely adopt these design tools and** to begin to influence more mainstream product development decision making. While in case study B the objective was to attract more creative, conceptual development projects. By adopting the user-participatory design tools, the industrial designers hoped to increase organisational awareness of their competency to be more creative. However, they began to face similar problems to case study A once they began to use the new design tools. They quickly recognised the need for external positive endorsements to gain approval for product proposals produced from the design tools. Common across all the case studies was an awareness of having to compete against other functionally-related groups within their respective organisations. This created a degree of cautiousness about adopting or using innovative design tools. The tools needed to provide clear tangible demonstrations of their capability in terms of problem solving, usability, adaptability, robustness (against scrutiny from other sectors of the host organisation), and to provide organisationally relevant outcomes that map easily to organisational reporting structures. In case study A the team leader was acutely aware of this problem and ensured that influential and senior management were regularly invited to observe workshop sessions. New design methods maybe supported at senior level but are nevertheless disruptive at the interface between the design group using user-participatory methods and other functionally-related and dependent groups. Acceptance is only likely when the outputs of the design tools provide a seamless integration with other parts of the organisation. This problem of user-participative design tool acceptance is further compounded, as the case studies illustrate, when the responsibility for user involvement varies from marketing to human factors departments. Design tools need to be tailored to fit into different functional groups while at the same time offering common touch points for a diverse range of needs across an organisation. Designers do not hold autonomous control over interaction design decision making either with indigenous or adopted design tools, but need to constantly negotiate design parameters

and constraints with project sponsors.

So far, innovation has been discussed within the context of user-participative design methods, but organisational resistance was also found with the innovative products produced from the tools. In the first two case studies, both approaches were bound together: innovative design methods were used to produce innovative interface design solutions. While the organisational acceptance of new design methods was the major preoccupation of the design groups, evidence was also found that the innovation solutions they produced also caused resistance. For example, the degree of innovation and creativity in some of the suggested interface design proposals in case study B was very high, for example, replacing mechanical control devices with touch sensitive displays. This technology would have required a very different design, manufacture and procurement process compared to the existing manufacturing process with probably only a marginal gain in profitability and this contributed significantly to the prototype proposals not being investigated further.

Together, these case studies reveal an interesting ambivalence towards innovation. There is willingness within design groups to adopt new design methods and motivation to produce novel and innovative products. Manufacturers are also willing to sponsor innovative product development methods and products but problems occur at the interface between the design group and other functionally related or dependent groups. This prevents innovative design methods from diffusing easily throughout an organisation. The organisations, in which the studies were conducted, did not have inter-group cooperation or agility to support innovation even when at a corporate strategic level they recognise its importance; this ambivalence is not uncommon in other manufacturing organisations (Christensen 1997).

Innovation ambivalence will not disappear and it is an organisational phenomenon that interaction design researchers with an interest in implementing new interaction design methods or novel interaction styles may have to be mindful of. We need to go further than research outputs that contributes to a corpus of design knowledge, produces creative interactive solutions or supports 'designers' in making decisions. There is a greater need for research activity that integrates interaction design knowledge with specific organisational and innovation practice. Real-world design activity is precarious and there are many hurdles to any form of innovation being accepted, as McDonnell (1997 p473) states, 'the form and nature of design decision making cannot be gained otherwise than by studying the designing in the context of professional practice'. As researchers, we probably retain a rather simplistic notion of how design decision making in large manufacturing organisations is carried out. These case studies illustrate the importance of empirically grounding interaction design research in professional practice in order to contribute to managing innovation in manufacturing organisations.

## Conclusions

These case studies reveal tension between the use of innovation within manufacturing design groups and other parts of an organisation. Both manifestations of design innovation illustrated, process and product, carry high levels of risk not just in terms of direct commercial or manufacturing viability, but also internal risks to the credibility of the design team itself. By using this understanding, it is possible to recognise a number of implications for interaction design research that involves the use of innovative design methods or user-product interaction styles. In order to gain any tangible impact on product interaction design a broad contextual frame of inquiry is required, beyond the contextual use of consumer products to also developing a priori understanding of the design and manufacture decision making processes from which new consumer products may emerge. Therefore, further bridging studies between research and practice are of paramount importance for the development of effective interaction design tools.

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