Designers' use of the artefact in human-centred design

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Chapter 1

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Introduction

This paper highlights how artefacts can be used as an effective tool to understand users and encourage dialogue. The paper will reflect on how the role of the designer is evolving, some limitations of user-centred design and how a more holistic 'human-centred' design approach may be more productive. The nature and applications of artefacts in understanding users will be considered. Finally three case studies will illustrate how artefacts have been used to enable human-centred design.

The authors work within the Art & Design Research Centre at Sheffield Hallam University (SHU). South Yorkshire has a world wide tradition in the heavy industries of steel and coal but has witnessed its workforce in these industries decline by over 70% since the late eighties – there are now no deep mines in the region. The Art & Design Research Centre has played a significant role via collaborations with local industry to take help regenerate, redefine and reinforce industry within the region. The authors are design researchers who through fundamental and then applied research programmes are making a considerable contribution to industrial product development. Previous projects such as the use of waste glass (Roddis & Chamberlain, 1999) and the following case studies demonstrate how the design researchers have 'joined forces'; establishing collaborative alliances between designers, clients/manufacturers, users, and 'other stakeholders', and provide examples of the designer as the 'mobiliser' of new solutions. Key to this approach is the multi-disciplinary nature of the research undertaken. Prof. Rachel Cooper, Editorial Chair of the internationally refereed Design Journal, recently referred to a paper based on a case study of their work (Chamberlain & Roddis, 2003). She says, "If we are to consider the future of

design methodology, this is a good example of the trend of design leading research in collaboration with social and scientific disciplines".

The Role of the Designer

Designing is not an insular activity, designers need to engage with users and specialists from other disciplines. Design, unlike many disciplines, is not governed or restricted by context. However some perceptions about the role of the designer in new product development need re-evaluating. The relationships between designers, users and other stakeholders are evolving.

Beyond Styling

There is increasing literature on new product development (NPD) processes which aims to provide models of practice and identify factors that account for success. A shortcoming of most of this literature is that it assumes design to be a functional resource directed by management strategically to enhance the NPD process. Much of this literature is produced to educate business managers, it is hardly surprising that it conceptualises NPD as a corporate-driven process which employs the services of design.

Design is often seen as a resource to embellish products towards the end of the research and development process. Once the science has been established and the engineering proven, designers are brought in to add visual value to a product. A traditional view of the industrial design profession is that it tends to be preoccupied with *visual* appearance, at the expense of other factors. In the USA, the first industrial designers were known as 'stylists' since their chief concern was the cosmetic appearance of products (Margolin, 1997, Rothstein, 2000).

However, Jevnaker does provide different models of 'design alliances', one of which – entrepreneurial mobilisation – considers the role of the designer as a "dialectical, knowledge-intensive, source of innovation" who can take on an entrepreneurial role in the process (Jevnaker, 1998). Despite high profile examples of design as 'entrepreneurial mobilisation', such as Sir Terence Conran or James Dyson, there are few analytical case studies available.

User-centred Design

'User-centred' design methods have been widely discussed, within product design discourse, and also in the disciplines of human computer interaction (HCI), human factors engineering and ergonomics. McDonagh-Philp suggests the following definition of user-centred design (1998):

> *"User-centred design is a design methodology that utilises the target product users as a designing resource to increase the understanding of the design practitioner."*

Many business models will assume an understanding can be established through marketing techniques and questionnaires. However there has to be a clear understanding of users' needs and wants. Henry Ford is attributed to have said: "If I had asked people what they wanted, they would have said faster horses". Questionnaires can confirm past prejudices and breed mediocrity and dullness. Would the Wright brothers have invented the aeroplane based on a questionnaire, or Edison the light bulb?

If the aim is to improve the usability of products, it is essential that designers acquire knowledge of product use that is derived from first hand experience. In some cases, such as when designing familiar consumer products, designers can draw on their own 'real-life' experience of using these products. It is therefore necessary for designers to build close collaborative relationships with product users and, where possible, to take part in user activities themselves:

> *"I have washed clothes, cooked, driven a tractor, run a Diesel locomotive, spread manure, vacuumed rugs, and ridden in an armoured tank. I have operated a sewing machine, a telephone switchboard, a corn picker, a lift truck, a turret lathe, and a linotype machine. [..] We ride in submarines and jet planes. All this in the name of research."*
>
> (Dreyfuss, 1955 p62)

However, this approach becomes difficult when designing products outside the designers' or users' experience; products with unfamiliar contexts, applications or enabling technologies; users with different capabilities and impairments or where users safety may be at risk.

Human-centred Design

In certain situations it is difficult to define who the 'user' is. For example who are the users of assistive technology? The patient; the carer; the patient's family; the therapist; the teacher; the local community; the healthcare trust?

Human-centred design is a broader concept; a holistic approach that explores the relationships between the designer, the various end-users, and the other 'stakeholders' within the system of production and consumption. This may include those who manufacture, transport, sell, carry out maintenance, or dispose of the product or system at the end of its useful working life. The role of the designer becomes that of 'advocate' within a system of production and consumption that is socially and ethically responsible (Papanek, 1971).

A challenge to this approach is establishing communication methods that provide a clear understanding between the potentially diverse users and stakeholders involved. Enabling the communication of information and ideas, sometimes unusual or challenging, between specialisms and between specialists and non-specialists via a common language. A designer must understand the technical, commercial and personal 'jargon' of the users and stakeholders to both develop the questions and then appreciate and understand what the answers mean.

The Role of the Artefact

The Oxford English Dictionary defines an artefact as "an object made by a human being" (2002). The variety of manufacturable 'objects' means that artefacts are not restricted to physical but may also take virtual forms – as electronic media and interactive experiences. Artefacts reflect the knowledge, intent and ideas of their maker(s). Thus artefacts can be effective vehicles for communication: to make statements, encapsulate ideas and illustrate knowledge.

Dunne (1999) suggests "conceptual design objects" as a way of expressing unusual ideas and challenging technology's roles and applications. The objects are not intended as practical prototypes but rather "encourage complex and meaningful reflection" (1999, p109) of the hypotheses they represent. Gaver and Martin apply such artefacts as a way of "mapping the design space" (2000), exploring the territory where future solutions could be positioned.

Gaver *et al.* (1999) use artefacts as "Cultural Probes" to gather information. Users are presented with a miscellany of artefacts with which to record their views and experiences. The design and selection of these probes pose deliberately ambiguous questions prompting rich subjective interaction and identification of needs.

Rust (2004) discusses the concept of 'tacit knowledge' – knowledge that is fundamentally embedded in action and may not be readily explained by explicit reasoning, for example a craftsperson's 'feel' for shaping wood. Interaction with artefacts provides an environment in which users' tacit knowledge can be revealed. Rust suggests that creating artefacts "can give us access to tacit knowledge, and can stimulate people to employ their tacit knowledge to form new ideas" (2004, p84).

Design provides ways of thinking and skills that can deliver artefacts as tools for creating new scenarios of the world we live in. These scenarios can simulate unfamiliar experiences and allow users to make imaginative extensions into unfamiliar areas. Thus designers can create new 'contexts' for others to experience and explore as part of human-centred design.

Case Studies

Multi-sensory Design: Tac-tile Sounds System™

This project was concerned with the design and development of sensory equipment for people with profound sensory disability and its therapeutic, educational and recreational benefits. It was conducted through the Art & Design Research Centre's collaborative initiatives with clinicians, musicians, technologists and latterly Rompa – one of the leading suppliers of products and equipment for special needs teaching and sensory environments. Design-led research projects resulted in product outcomes that were subsequently adopted by Rompa and have since

achieved major design awards (Design Council, 2000). The relationship with the company has led to the establishment of a sensory research centre within the University.

Early stages of research and development involved a process of collaboration and communication between the design team directed by Paul Chamberlain, a team of clinical and educational specialists and the end-users, which in the main were deaf children and in some cases, deaf-blind. In short, the problem was that the design team was faced with the challenges of understanding highly specialised fields of clinical and educational practice, and the end-users literally could not hear what the designers and the clinicians were trying to achieve. Somehow the designers had to develop methods of communication that went beyond words. It was through quite literally 'feelings and vibrations' that artefacts provided that the research team gained the knowledge necessary to develop the product. The artefacts became the vehicle for communication between the designers, end-users and specialists.

Figure 1.1. *tac-tile sounds system™*

An early development from this research was a versatile vibro-acoustic modular system that tries to convey the emotions of music and meaningful sounds to people who cannot hear in the usual way. The product, now manufactured and marketed as the *tac-tile sounds system™*, (Rompa) is a system that delivers sound to a series of resonating surfaces where they are converted into mechanical vibrations which can be felt by people who cannot hear sounds in the usual way. The system has a wide range of uses in clinical, rehabilitation, educational and domestic settings.

It is interesting to note that 'key partners' in the sensory research were initially clinicians, Derbyshire Health Authority's Ashgreen Centre, a residential and special day care centre and Russ Palmer, a Music therapist who himself was deaf/blind. These key partners provided access to other important specialists and users to input useful information to the project. The Design team liaised with technical specialists to inform the project and the Music Department at the

University of Sheffield to compose 'low frequency' music for the system. The manufacturer, Rompa, were a 'sub partner' who only engaged in the research at the latter stages of realisation when the work had been trialed and tested.

As our research has progressed Rompa have become a 'key partner' and have now formally 'joined forces' with the Art & Design Research Centre at Sheffield Hallam University. The *Everysense* system multi-sensory environment (Rompa) is a product of this ongoing research collaboration.

Haptic Design: Medical Connectors

Paul Chamberlain is currently leading a research project funded by the Department of Health, with B.Braun Medical, a major international medical device company, to minimise medical misconnection errors through the design of a non interchangeable medical connector system. The project has produced generalizable knowledge about haptic affordances and a methodology for evaluating them, which may inform the design of other safety critical control systems.

The increasing complexity of medical interventions and the associated medical devices means that users are required to connect a multiplicity of external tubes to various types of diagnostic and therapeutic devices. A typical patient in a coronary care unit may have as many as 40 connectors. It is not surprising then that errors arise and recent incidents that have led to patient fatalities where drugs were administered intrathecally (via the spine) that should have been delivered intravenously (into the vein) has raised concern about the application of a single connector design to a number of incompatible applications. Our research brings together a multidisciplinary team to design and test a new system of medical connectors. There is now significant pressure for research and development into a system of medical connectors that will distinguish between the different routes of delivery, so that misconnections of this kind become physically impossible. The design of a non-interchangeable connector system will eliminate the possibility of misconnection, which has the potential for catastrophic results. Currently more people die through medical errors than in motor related accidents. An easily identifiable system should eliminate the common practice of customised labelling and reduce the time for clinical checking procedures. Clinical practice will benefit in terms of a safer, time saving system and should contribute to a less stressful working environment. The project will lead to a new range of innovative devices and could provide valuable new knowledge that will inform their future product development

The research brings together expertise in general and regional anaesthesia, critical care medicine (Bradford Royal Infirmary), Psychology and human factors (University of Leeds) and industrial design (Sheffield Hallam University) to develop an engineered design solution supported by a *novel* means of enhancing the discriminability of a new system of connectors through visual and tactile (haptic) cues. B.Braun Medical, a major international manufacturer and supplier to the health industry, provides technical expertise and will support the route to market.

Figure 1.1. CAD rendering of prototype medical connectors using shape and texture as a means of discrimination.

A key research challenge was to devise methods to evaluate visual and haptic discriminations and affordances. The concept of an affordance was coined by the perceptual psychologist James J. Gibson in his seminal book *The Ecological Approach to Visual Perception* (Gibson 1979*)*. According to Norman an affordance is the design aspect of an object which suggest how the object should be used; a visual clue to its function and use (Noramn 1988). How could the connectors' shape and texture aid identification and afford their use and method of connection? A varied set of connectors was designed and presented to users who were given timed tasks to identify their affordances (push or twist). CAD simulations were used to test visual affordances and physical prototypes were used to test and compare haptic affordances. These artefacts therefore simulated new user experiences for study. The research team realised "conducting user-based research in the setting of an intensive care ward was going to be an ethical and practical minefield" (Walters *et al.*, 2003), using simulated experiences allowed such problems to be avoided.

Ideation: Digital Photograph Collections

Simon Bowen's MA work investigated methods for involving users in the identification of new product opportunities for new technologies; how to make users key participants in the ideation process. The project produced a hypothetical methodology that he is investigating further via a PhD.

User groups representing older people and families with young children were chosen to explore the specific context of the roles and management of digital family photograph collections. The increasing number of digital photographs taken is creating an information management problem:

> *"Having thousands of photos on a hard disk or DVD-ROM is the equivalent of throwing [..] images into the air and letting them flutter to the ground"*
>
> (Weinberger, 2004 p149).

Rapidly developing digital technologies are becoming increasingly pervasive and offer numerous possibilities to enhance our lives. The social role technology occupies in our lives is changing. So how can new applications for these technologies be determined that accurately reflect users' wants and needs?

Early sessions using questionnaires, interviews and low-fidelity prototyping (after Ehn & Kyng, 1991) produced limited results. Users had difficulty articulating their needs or exploring new contexts in an unfamiliar territory – the application of new technologies, such as wireless networking and electronic ink displays, to photograph collections. Being biased by familiar experience users generally asked for 'faster horses'.

A more productive approach was to use a set of conceptual designs (after Dunne) in workshops with users. The artefacts were created to embody various (occasionally provocative) ideas, values and needs, and their presentation allowed the imaginative extension of users' experiences that could then be explored. Users' interaction with the artefacts provided rich, qualitative data. What was liked or disliked, what was appropriate or inappropriate. The artefacts proposed a position in the 'design space' of potential new products. This created a dialogue with users that intimated where the location of actual new products might be.

Figure 1.3. *Forget Me Not Frame* conceptual design

For example the *Forget Me Not Frame* concept displays a photograph that fades over time with a lever that can restore it. Users' strong dislike of this feature highlighted the need to feel in control of such emotive subject matter, users did not want the presence of personal photographs to be automated.

The project yielded several 'way marker' concepts indicating directions for further product development in the specific context. A more general methodology for using artefacts in the ideation process of user-centred product development also began to emerge. Simon is now developing this methodology via AHRC-funded doctoral research.

Conclusions

The role of designer has evolved considerably from adding 'styling' to products towards the end of their development. Designers can be the mobilisers of new solutions, advocates within multi-disciplinary teams and involved throughout the research and development process.

Traditional immersive user research techniques have limitations. It is difficult to understand users' needs and wants in scenarios that are outside their experience. Designers can use artefacts to create new contexts for study – enabling users to explore unfamiliar territory.

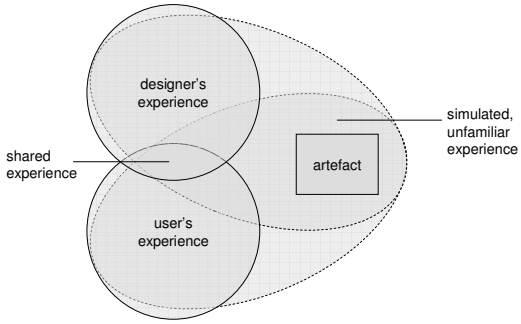

Figure 1.2. The artefact used to extend the designer's and user's experiences

The question of who is 'the user' covers an increasing number of roles. Human-centred design offers a more holistic approach considering all the diverse types of users and stakeholders of a product. Artefacts can be used as vehicles for communication in such situations where traditional methods may be inadequate.

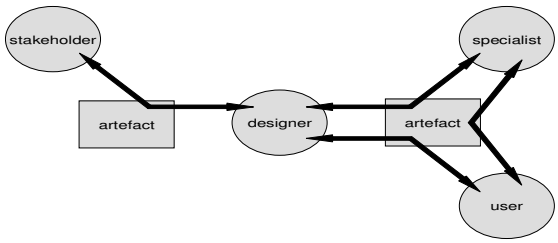

Figure 1.3. The artefact as a vehicle for communication in multi-disciplinary teams

References

Chamberlain, P. & Roddis, J. (2003). Making Sense: A case study in collaborative design-led new product development for the sensorial impaired in The Design Journal **6**(1) pp 40-51.

Design Council (2000). 'Millennium Products' – Tac-Tile Sounds System & Q. Chair http://tinyurl.com/9bose

Dreyfuss, H. (1955). Designing for People, Grossman Publishers, New York.

Dunne, A. (1999). Hertzian Tales - Electronic Products, Aesthetic Experience and Critical Design. RCA.

Ehn, P. Kyng, M. (1991). Cardboard Computers: Mocking-it-up or Hands-on the Future in Greenbaum, J. Kyng, M. (eds.) Design at Work: Cooperative Design of Computer Systems. Erlbaum.

Gaver, Bill & Martin, Heather (2000). Exploring Information Appliances through Conceptual Design Proposals in Proceedings of CHI 2000. ACM Press.

Gaver, B. Dunne, A. Pacenti, E. (1999). Cultural Probes in Interactions **6**(1) pp 21-29.

Gibson, James J. (1979): *The Ecological Approach to Visual Perception.* New Jersey, USA, Lawrence Erlbaum Associates

Jevnaker. B (1998) 'Absorbing or creating design ability :HAG, HAMAX and TOMRA' In Bruce & Jevnaker (1998).

Margolin (1997). Getting to know the user in Design Studies **18**(3) pp 227-236.

McDonagh-Philp (1998). Gender and Design: Towards an Appropriate Research Methodology in Proceedings of the 5th National Conference on Product Design Education, Glamorgan University, July 1998.

Norman, Donald A. (1988): *The Design of Everyday Things.* New York, Doubleday

Oxford University Press (2002). Concise Oxford English Dictionary. Oxford University Press.

Papanek (1971). Design for the Real World – Human Ecology and Social Change' Thames and Hudson, London.

Roddis J. & Chamberlain P. (1999) Furniture Design & the Environment, Innovation & Legislation. A case study of a design-led research programme investigating the use of waste glass in open-loop solutions, International Furniture Congress, Istanbul Technical University, Turkey

ROMPA. http://www.rompa.com/

Rothstein (2000) Ethnographic research: Teaching a young profession old tricks in Innovation, Winter 2000 pp33-38.

Rust, C. (2004). Design Enquiry: Tacit knowledge and invention Science Design Issues **20**(4) November 2004 p76-85.

Walters, Chamberlain & Press (2003). In Touch: an investigation of the benefits of tactile cues in safety- critical product applications in Proceedings of the Fifth European Academy of Design Conference, Barcelona University.

Weinberger, David (2004). Point. Shoot. Kiss It Good-Bye. in Wired **12**(10) p148-152