THE TRADITIONAL DESIGN PROCESS VERSUS A NEW DESIGN METHODOLOGY

A COMPARATIVE CASE STUDY OF A RAPIDLY DESIGNED INFORMATION APPLIANCE

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Abstract: This paper reports on the results of an exercise held at the National Centre for\ Product Design Research (PDR) which is based at the University of Wales Institute, Cardiff (UWIC) in partnership with Nottingham Trent University, and two UK Top Ten design consultancies, Alloy Product Design and PDD. The event was sponsored by the Audi Design Foundation and set out to cover the ground from briefing document to the full design and prototyping of an Information Appliance within 24 hours. The exercise was undertaken by two teams, one based in London at PDD's headquarters and comprising staff from PDD and Nottingham Trent, and another comprising staff from UWIC and Alloy Product Design, based in Cardiff. The latter team had access to an interface development methodology described in the paper while the former did not. This paper will initially concentrate on the activities of the interface design team based in Cardiff, their design strategies and, in particular, their use of the prototyping methodologies developed at UWIC. The paper reports on the structure of the "day", negotiations between the various teams, the consequent concessions and the integration of GUI and hardware aspects of the interface design process. It then examines the results of the Nottingham Trent/PDD team's efforts and compares the approaches and the results. In conclusion it examines the UWIC interface development methodology process's strengths and weaknesses, particularly through comparison with the more traditional design approach undertaken by the other team.

Key words: Interaction, Design, Information Appliance.

A. Sloane (ed.), *Home-Oriented Informatics and Telematics*

1. INTRODUCTION

The concept of designing and prototyping a product in twenty-four hours belongs to Roger Griffiths, a member of the product design programme at *UWIC*. The concept and management are described in Griffiths (2004).

The exercise was undertaken with *Nottingham Trent University*, *Alloy Total Product Design*, *PDD* and *PDR*. When agreement had been reached regarding the goals of the exercise, an approach was made to the *Audi Design Foundation* for funding.

The aim of the exercise was threefold:

1. An educational exercise for product design students to test the creative process, time management and organisational limits of the design process
2. A test of the fast and flexible interface design and prototyping methodologies developed at *UWIC* in response to the challenge laid down by Margolin (1998), Branham (2000) and others
3. A comparison of the approaches of two design teams working on an identical brief within a very short time frame

2. THE PROCESS EMPLOYED AT CARDIFF

The project team was divided into four groups covering Product Design, Interface Design, Computer Aided Design (CAD) work and prototyping/modelmaking.

The twenty-four hours are detailed below. Interface Design and prototyping matters are given precedence because one of the major aims of the exercise was to test *UWIC*'s design and prototyping methodology which seeks to accommodate the types of design thinking advocated by Sharpe and Stenton (2002), Houde and Hill (1997) and Buchenau and Suri (2000). Its underlying philosophies are described in greater detail in Gill (2003).

Audi briefed the team to design a "blue sky" communications device for use by design-aware 18 - 25 year olds interested in extreme outdoor pursuits.

2.1 Mind Mapping

The first priority for the team following the briefing was to rapidly arrive at a series of concepts. Creative Problem Solving technique (CPS), (Van Gundy, 1988)) and De Bono's Six Hats idea evaluation sessions (De Bono (1990)) were run simultaneously to answer this requirement. The teams discussed the way in which any resulting product might work, the social and technological preferences of the target user and how any product would

service these. Materials and technology research & interviews with target user group were undertaken by a third sub-team and the results were fed to the two mind mapping groups. Intriguingly the conclusions of both groups were dramatically similar. There were three main conclusions:

1. A "safety product" would not appeal to our intended user.
2. The product should have a competitive element.
3. The product should have a social element.

2.2 Review of creative processes and research data

The two concept generation teams were merged to discuss their conclusions, and more detailed discussions took place informed by reports from the research team regarding new materials plus the information gleaned from the target user group. A large part of the discussion revolved around the functions of the product and the wishes and habits of the user. Some details of control inputs were discussed at this stage but the overall look of the product was not.

2.3 Concept design phase

The chosen concept sketch is shown in *Figure 1*. It includes features agreed by the concept development team including a single-use "panic button" and a wrap-around Light Emitting Polymer (LEP) touch screen that can be removed from the product and attached to the user's body.

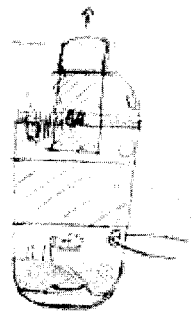

Figure 1. The Cardiff team's chosen concept

2.4 Interface Design

The user interface team consisted of four designers. At 11:00 it separated itself from the other teams and set about conceiving an interface that would

deliver to the user the functionality conceived by the design team as a whole. Early on in their discussions it was agreed that the major control input device should be in the form of a rotary dial, because a glance at the position of the dial would make it easy to see the current interface state. This had important implications for the product's design but the interface team felt strongly the importance of this type of control input. A representative from the interface team negotiated changes in the design with the product design team. Further communications were required, to decide on the number of functions and their sequence on the dial. The designs of symbols also required negotiation and discussion between the two teams.

When the basic functions of the product were decided and the negotiations between product and interface design teams satisfactorily completed, the interface design team began detailed design work. The first step in this process was the production of a state transition chart, which effectively became the design specification of the interface prototype. Landay and Myers (2001) report on a similar integration of state transition diagrams in the design development of websites.

The system is described in more detail in Gill (2003) but briefly it involves sketching each state of the product on a *Post-It* note, then numbering each one (see *Figure 2*).

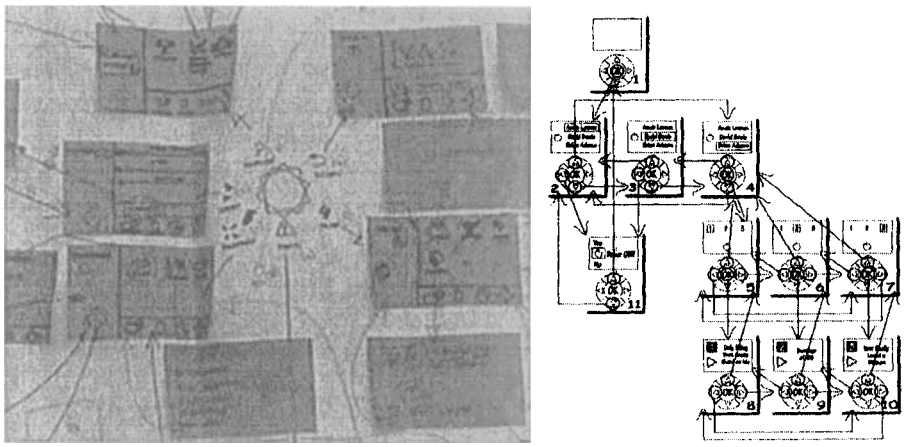

Figure 2. Post-It state transition diagram of the Cardiff Team's interface (left) and a diagram showing how a typical Post-It state transition diagram is laid out

The use of *Post-It* notes allows the designer to change the diagram quickly and easily so that the design is able to evolve as new ideas are inputted to the process.

2.5 GUI Prototyping

When the state transition diagram is complete each numbered *Post-It* is reproduced as a *PowerPoint* slide. Within each of these states there is frequently other work to be completed in the *PowerPoint* prototype that would not have been possible on the state transition diagram, for instance speech to text, text to speech, animations or sound (see *Figure 3*). All states of the GUI are prototyped individually before work commences linking them and detailing the GUI "skeleton".

Using *PowerPoint*'s embedded language, *Visual Basic for Applications (VBA)*, hyperlinks are made linking each of the "states" of the interface together. The control inputs triggering each of these changes in state are effected by a QWERTY keyboard press. The end result of this element of the prototyping work is a PC-based simulation of the GUI where transitions between states are effected by keyboard presses.

2.6 CAD data

With the external surfaces of the product fully detailed the interactive prototype designers and makers could start work. Their job was to create a model which would link up to the GUI prototype allowing potential users to gain a good feel for how the completed product would be in actual use. Sharp (1998) demonstrated that virtual prototyping of touch-screen GUIs could be effective this way. The product in Sharp's study however was a microwave oven with a flat vertical surface. Users interacted with it in the way they would a touch-screen, so a 3D product was not in effect tested. Pering (2002) describes a bespoke method called "the Buck System" used at *Handspring* where an existing product was used to trigger a PC programme. As she points out, however, flexibility remained a serious problem with this method. The *UWIC* method described below is designed to circumvent both these problems.

2.7 Interactive and facsimile models

Once the CAD work for the interactive prototype was completed the files were sent to a CNC machine which began to manufacture the shapes from solid blocks of model board.

In order for the interactive prototype to connect to the PC-based GUI prototype, switches had to be embedded in it. In this case these are simple micro switches attached to a ribbon cable and tested before they are mounted within the model. When wired to a product called an *IE Unit* (Gill 2003) they allow the PC to receive keyboard inputs via the model (see *Figure 3*).

Thus when a user activates a switch in the model, the PC behaves as if it has received a keyboard input so the GUI prototype responds accordingly.

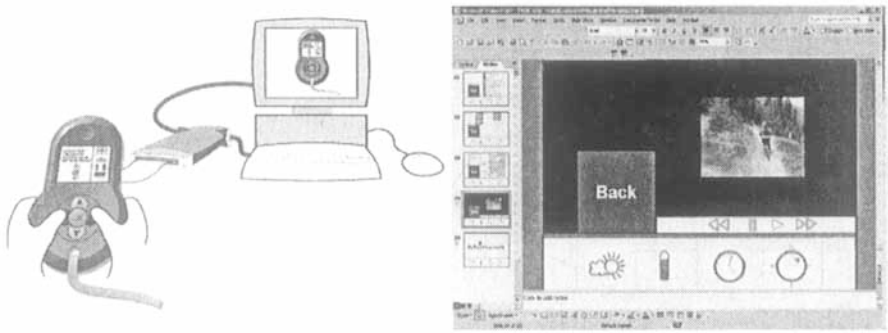

Figure 3. Illustration on the left shows the UWIC IE Unit linking a prototype to a P.C. Illustration on the right shows a single state of the UWIC/Alloy design including graphics, video and sound

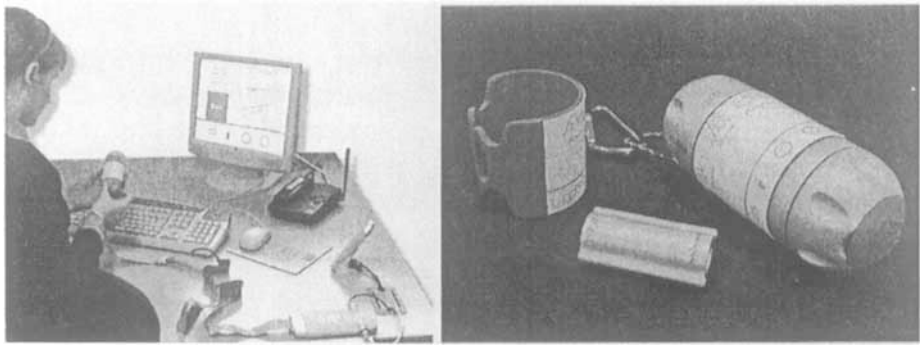

Figure 4. The Mohawk in working prototype and facsimile model forms

2.8 Presentation to user group

The Cardiff team's answer to the brief was *Mohawk (*see *figure 4),* a device for extreme sports enthusiasts of the "*PlayStation* Generation". The device would allow users to record their performance in a "real world" activity (in this case mountain biking), publish it to the internet, keep track of their "tribal" and world rankings, and challenge and meet others from their "tribe". Users could even race "virtually" because the device would have the ability to "ghost" an image of a competitor's experience on top of their own.

Similar approaches to the use of social enabling technology can be found in Vogiazou et al. (2004), Frohlich (2004) and Reid (2003).

3. THE PROCESS EMPLOYED IN LONDON

The methodology and outputs of the two teams varied significantly. Many of *PDD*'s commercial techniques such as "culture hunt", user profile generation, creative brainstorming, brand intelligence, commerciality investigation and focus group reviews were utilised. These were employed to reduce the risks of the product development process and identify product opportunities, understand the needs of consumers and create a brand identity. They are briefly described below.

3.1 Market research via Culture Hunt (thirty minutes)

This activity was carried out by talking to members of the general public to identify the target market for a communications device.

3.2 Profile Generation exercise

Various tools were used to examine the product's user. As a PDD employee stated: "Don't forget we are designing something for a future target market. We are not ourselves the market, and we can't ask those who are now in their pre-teens the relevant questions."

In order to create a profile, a lot of information about the target market was required, e.g. their tastes in music and fashion and their aspirations and interests. Each Product Profile generation team had different age ranges to consider and paperwork with basic headings was distributed to each group to facilitate discussion.

In PDD's estimation the exercise failed to garner enough useful data principally because it did not gather the views of a wide enough cross-section of the target market. Furthermore, what was identified were aspirations rather than needs. They stated: "This represents a very small part of the population. The only learning we can take from this exercise is that we do not know our target market."

3.3 Facilitated Concept Brainstorming Six Hats & Needs Review

One of the advantages of the *Six Hats* method (De Bono (1990)) is that it democratises the design process and prevents dominant personalities from controlling it. Accordingly, the contributions of all members of the team are granted equal status. The process briefly involves participants being asked to think about a given subject from six different viewpoints (thus the reference to six "hats").

The primary aim of the process is to "undo" the way in which the brain is conditioned to think and thereby generate unusual ideas. Each idea generated is recorded on a *Post-It* note. The members of the group review the *Post-It* notes and share their ideas before separating to develop these further on an individual basis. (see *figure 5*).

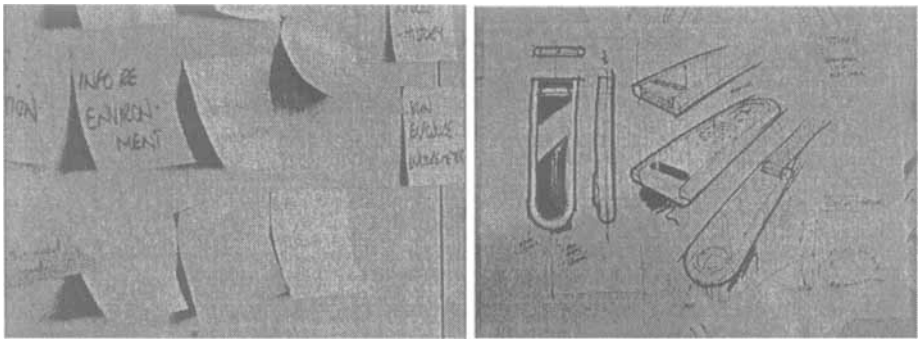

Figure 5. Six Hats & Needs Review and Concept sketch

Members of the team then voted on each others' ideas and rated them by allocating a number of stars. The highest scoring ideas were selected and the authors asked to explain their ideas more fully, resulting in six concepts. Each person on the team was then given two votes and by 12:00 noon the choice had narrowed to three concepts.

3.4 Concept "work up"

Three hours were allocated for three teams to produce a full product design specification, in visual form, of each of the potential ideas. Deliverables included rough 2D visuals and a specification of materials, finish and functionality. In essence these were used as feasibility studies of external form, internal components, interface, interaction and key features.

3.5 Teams present and agree final product

The final stage of the concept selection process involved the three teams making presentations for debate and discussion to each other, the *PDD* technicians, and administrative and marketing staff. The final design was selected by this group as a whole.

3.6 Product detailing

Once a concept had been selected, the design process employed was similar in several ways to that followed in Cardiff. One notable exception to this was the interface design which was tackled with very different methods. Following the selection of the final concept the main design team was split into a series of sub-teams, each of which was set the task of detailing various aspects of the product's design. Interface design issues were dealt with during this phase with each sub-team producing interface concepts as part of the detailing process. These were presented in the form of storyboards which, as well as illustrating the concept's interface proposals, also contextualised its use. Storyboards were presented to the team as a whole and critiques were held which served to "debug" the concepts.

Form and scale were evaluated through the production of foam models and were subjected to design review by a focus group. Once the form and detailing had been agreed upon, the work of producing the finished product was handed to the CAD team for modelling. CAD data was sent for CNC machining. Once this was complete model makers produced a facsimile model of the design that was presented at the project's conclusion. There were some additional processes employed in London however, including packaging design, brand intelligence, storyboarding, commerciality checks and photography. Some of these are described in more detail below.

3.6.1 Brand Intelligence Workshop

The Brand Intelligence Workshop exercise was designed to ensure that the concept's branding created the right associations in the minds of potential users. The exercise was in two phases. The first involved placing 400 cards with images of known brands on them and asking members of the team to choose three cards which possessed the attributes they wished to have associated with the concept (e.g. "excitement" "quality" etc.). Each member laid their choices before the rest of the team and further "filtering" took place. The second exercise involved the team's leader choosing four words appropriate to the concept and writing them on a quadrant (see *Figure 6*). Team members were asked to place selected brand cards in the

quadrant that they felt best suited their attributes. Of particular interest were brands that crossed multiple boundaries.

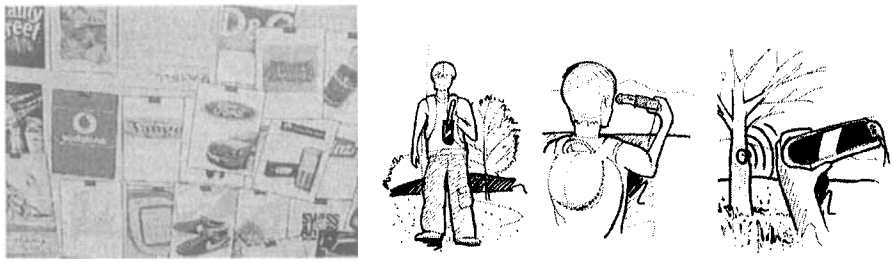

Figure 6. Brand Intelligence sorting grid & storyboarding of the chosen concept

The results of both exercises were then analysed in order to produce an appropriate brand for the chosen concept.

3.6.2 Storyboarding

As well as their role in the interface design development, storyboards were also used to explain and contextualise the way in which the concept worked at the final presentation (see *Figure 6*).

3.7 Touchstone

The London team's answer to the brief was called *Touchstone* (see *Figure 7*). The concept enables people to record a memory or experience onto a server located at points of geographical interest to be accessed by like-minded travellers in the future. Went (2004) describes the concept:

> The final product, Touchstone, was conceived as a digital version of a cairn. Instead of stones to mark and memorialise, Touchstone builds layers of digital experience. Personal memory and data pass between a static digital message-board and a personal handheld unit, allowing images and messages to be left on the Touchstone for others to see and hear. The durable alloy casing, dual display, GPS and short-range radio make Touchstone as useful in town as in the country. The product also includes a keypad interface integrated into an intelligent textile strap, augmented reality graphics, induction recharging, integral imaging and sound recording capability.

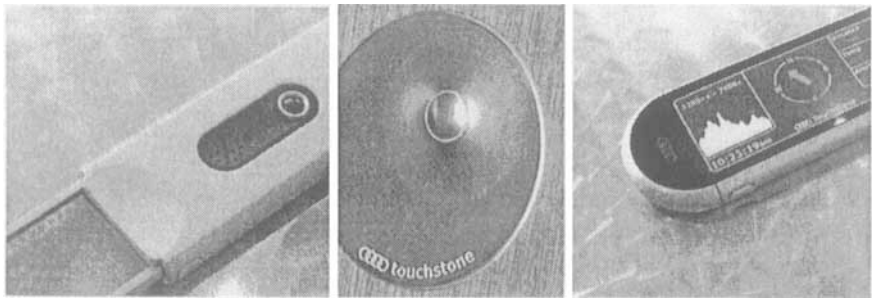

Figure 7. The Touchstone facsimile model

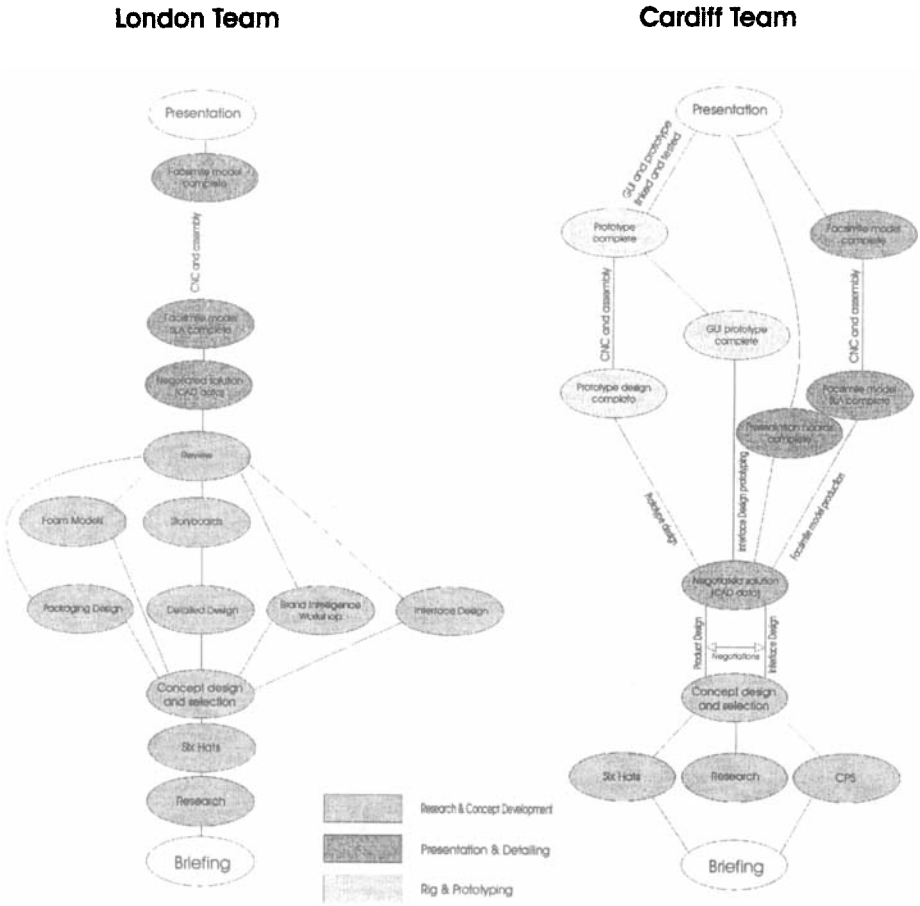

Figure 8. The Cardiff and London Team's Design Processes

4. COMPARISONS OF METHODOLOGY AND RESULTS

The two teams approached the same problem in different ways. There were a number of similarities, both used *Six Hats*, both divided their teams into sub teams to tackle specialist areas of operation and both used regular review meetings to manage and control this process. The main area of difference is that the team in Cardiff were driven from the beginning to deliver a working prototype. The team in London were not and this had important ramifications on the design process and outcome. *Figure 8* illustrates the two approaches.

The London-based team spent a much higher proportion of its time conceptualising and researching. This meant that the product development process was fuller and that considerations such as the end-user, tactility, weight and balance were given greater attention than was the case in Cardiff. Other areas that received more consideration were commercial concerns such as packaging, branding and product specification.

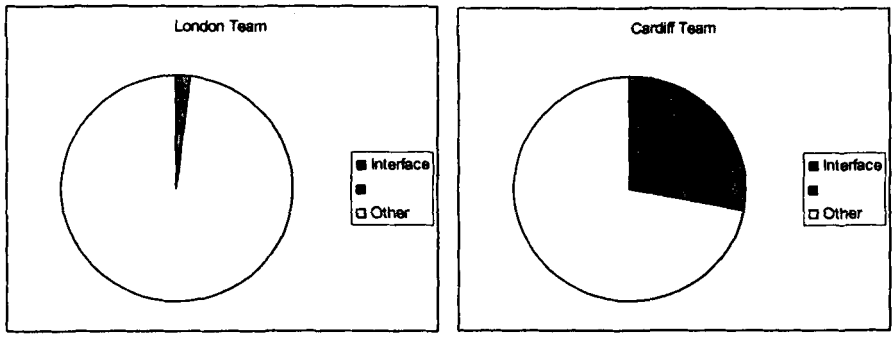

Figure 9. Proportion of team effort on interface design

The team in Cardiff committed to a specific concept and design aesthetic a full 21 hours before the deadline, meaning that this aspect was allocated only 12% of the total project time. The London team did not commit until 12 hours before the deadline meaning that they allocated a full 50% of their project time to conceptualisation, research and branding. In contrast the London team spent approximately 2 hours (8%) using 17% of the total team for that time on the interface design while the Cardiff Team spent a full 20 hours (83% of total time) with a full 34% of the project team committed to this aspect. *Figure 9* shows total team effort on interface design and prototyping by each of the two teams.

The necessity of producing a working prototype forced the Cardiff team to commit to key decisions at an earlier stage so that CAD data could be shared and used on two quite separate operations. From the time the data was "divided", changes to the design could only be made by negotiation between teams, effectively ending any design review opportunities as each team became committed to a particular course of action.

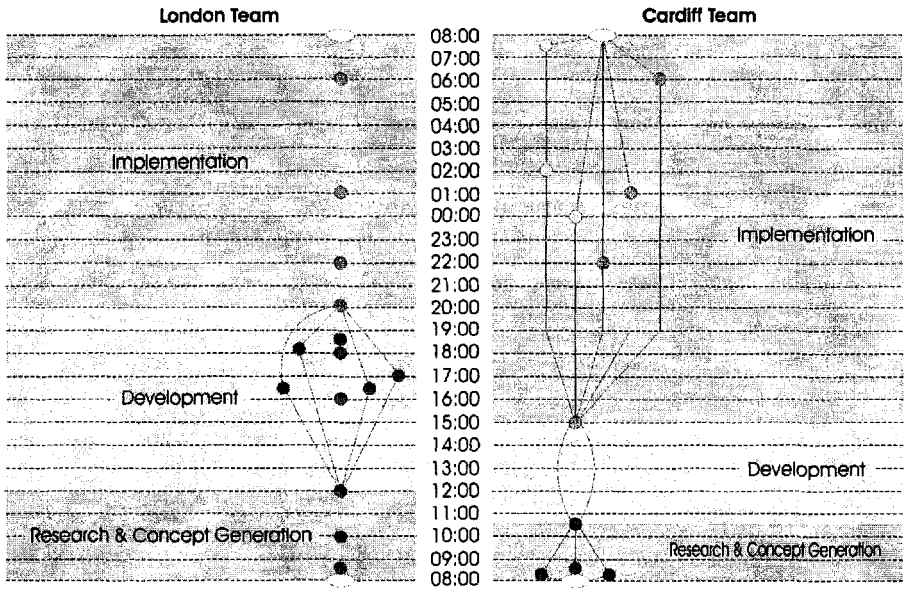

Figure 10. The Cardiff & London Team's workflow to scale against Time

The "trade off" is that the *Mohawk*'s interface design is better understood than that of the *Touchstone*, and this means that the interface and product design were in better equilibrium. However, one never gains without loss, and in terms of a complete, market-targeted package the *Touchstone* is the more complete of the two.

It is important to note that despite the significantly different approaches of the two teams, they arrived at some very similar conclusions. Like the team in Cardiff, the London team concluded that it was important for the product to be a social device that enhanced communication between groups with similar interests. Both teams in fact used similar terminology for this cultural aspect, *Tribe*.

5. CONCLUSIONS

The rapid interactive design and prototyping methodology developed at *UWIC* has been proven to be capable of being implemented within a very short timescale. The Cardiff team showed it was possible to conceive a product, develop its interface and create a three- dimensional prototype with a fully operational GUI inside twenty-four hours. The process influenced the product design process significantly and, while it enhanced some areas, it also forced decisions and resources to be committed earlier than was the case with the London team who considered more closely a number of subtle design matters including tactility, weight, packaging and branding. They were also able to devote more time to researching user needs and wants to ensure fitness for purpose at a conceptual level.

It would be fair to conclude that while the *Mohawk* demonstrated a better balance between product and interface, it lacked some of the simplicity and subtlety of *Touchstone,* arising from a more in-depth analysis of user and design issues.

It could further be extrapolated that the London Team deployed their resources more appropriately than the team in Cardiff. Given the timescale and desired outcome, it was more appropriate to concentrate on the thorough understanding of market placement and the development of the concept to a higher degree of "polish" than to move ahead to interface design issues before these were fully resolved.

In the end analysis, the interface design methodology was proven, but, perhaps, inappropriately applied.

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