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RAPID DEVELOPMENT OF INFORMATION APPLIANCES: FUTURE APPROACHES FOR DESIGNERS

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1. The demands of information appliance design and development

Understanding the lives and needs of users is one of the challenges designers face. There are numerous approaches that assist in this endeavour, including focus groups, user interviews, questionnaires, and user observation. These approaches are often appropriate to particular organisations and the markets in which they operate (Coughlan and Prokopoff 2004), (Brown 2005). This paper considers the particular development needs of information appliances. This market exhibits particular requirements that necessitate tailored development approaches to meet its ever changing needs.

One of the problems with rapid technological development is that it is so rapid, that at times it is simply not possible to get the right product to the right market in a form that consumers desire before it is superseded. Information Appliances suffer from this in a more acute form than many other types of products. This problem is compounded by the need to incorporate user needs and desires into this development process.

Who will ensure that those products are useable? At the stage of the design process where the designer would normally be exploring and trialling ideas with 'rigs' there is a chasm. First the technology the product is envisaged to use is still over the development horizon; and secondly, prototyping information appliance concepts requires an advanced level of electronics knowledge that most designers do not possess. Further; the process is unsympathetic to the designer's traditional experimental culture at what might be called the 'fast and fluid' stage of the conceptual process. Gill (2003) describes the problem arising from the clear division of labour between designers and electronic engineers, but there is a further division that has no less of an effect on commerce and the end user. Fig. 1 outlines a typical product design and development process.

The design process outlined in Fig.1 has limitations. It does not provide an integrated opportunity for consumer needs and potential future scenarios to be considered as a matter of course. In addition, the need to utilise an electrical designer/engineer to develop interactive prototypes greatly extends the development time. Further more it does not readily offer the designer with the opportunity to make on the spot changes to their proposal without entering additional refinement cycles. This paper outlines approaches that address these issues.

The community of information appliance design until now has rested upon a successful use of multidisciplinary user-centred design, often drawing on an ethnographic component. Much has been made of the need for a multidisciplinary team and of the difficulties of making good use of ethnographic outputs in such a team (Diggins & Tolmie 2002). Ethnography, multi disciplinary teams and extensive user testing are the order of the day - but there simply isn't the time to employ it.

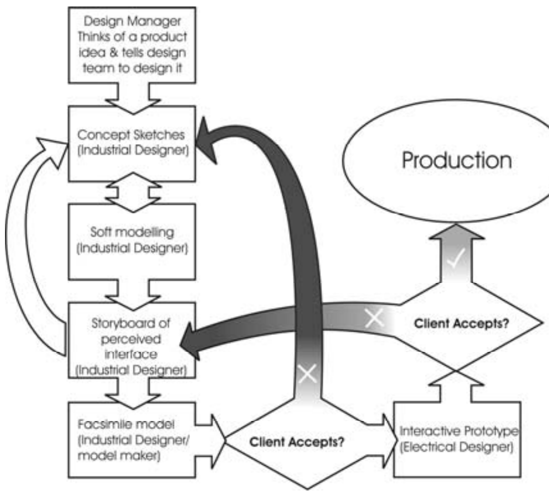

Figure 1. A common design process for digital interface appliances

The rate of technological change requires new design approaches that allow designers, and not extended development teams, to explore and refine proposals in an ever decreasing timeframe. It doesn't require this, it necessitates it. This development process needs to not only consider rapid technological change but importantly the demands and often unmet needs of the consumer. This often requires the design team to explore numerous future scenarios that incorporate both technological change and consumer needs. All of this needs to happen alongside a design and development that continues to encompass the multitude of design factors such as manufacturability, cost demands, marketing requirements, etc. that have always been demanded.

2. Understanding future scenarios and consumer trends

Before design activity commences, research undertakings are required to assist in the identification of potential future strategies. This allows a broad understanding of:

- Market research data
- Consumer needs, desires and prejudices
- Developments in technology and their implications
- Forecasting approaches
- Future scenarios that design undertakings may address

Market research is an integral element of marketing activities and as such has a central role in product development. It is frequently collected as quantitative information such as demographic, socioeconomic and geographical data. This helps the designer to understand the size of the market and the market segment defined for example. Qualitative market research data may also include forecasting in terms of trends in the market or identification of gaps in the market in terms of the product need. Designers can then turn those needs into tangible product or service offerings (Cooper and Press 1995).

Traditional market research produces valuable insights about users needs when the products and services provided to them are known and well defined. Going beyond this, innovators need to uncover new opportunities by exploring peoples unmet and unarticulated needs. Ethnographic observational research supports this type of inquiry well (Salvador et al 1999), (Kumar 2004). Ethnographic research methods provide information leading to questions. Designers are best placed to provide answers. Ethnography provides development teams with the knowledge of whom they are designing for and in turn what they value and desire (Feltham 2004). Helping clients (and designers) see the familiar in unfamiliar ways, ethnographic approaches place the user in a central role in the research undertaking and include approaches such as (Coughlan and Prokopoff 2004):

- *Mock Journeys* in which we simulate the experience of a customer, or someone else for whom we are designing
- *Shadowing* those involved in a process to note their everyday behaviours, use of tools, communication patterns, and so forth
- *Expert Walk-throughs* to quickly understand complex processes
- *Spatial Observations* to absorb the atmosphere of a location, observe behavioural patterns, and look for evidence of everyday workarounds or innovations that may indicate unmet needs
- *Day-in-the-Life Surveys* to get stakeholders to take note of their own surroundings and behaviour

The speed of development within the information appliances sector requires the designer to consider the implications of their design activity in a future context and, the implications of that future context upon their design activity. This consideration of the future can be broadly defined as futures thinking. Consisting of many approaches, it included: environmental scanning, trend forecasting, trend mapping, backcasting, scenarios planning and storytelling and assists in articulating possible futures. The possible drivers evident in these possible futures are also considered. Designers' capacity to envision and interpret possible social, cultural, technological and economic futures is crucial to the success of organisations.

Utilising a combination of forecasting methodologies and ethnographic observation, the authors contest that long term consumer trends can be identified. These 'mega-trends' can be used to inform the development activity of information appliances. If applied in an appropriate manner, they provide consumer insights that transcend the often unfeasibly short development cycles of information appliances.

3. Overview of the IE system

The invention of digital products with multi-functionality has meant the designer having to understand complex psychological issues relating to users' attitude to products and the ways they interact with them. Traditional methods of prototyping don't answer this challenge and as yet there are no new ones that allow industrial designers (as opposed to closely integrated industrial designer/engineering teams) to develop product prototypes with user interface emulations. This explains the all too common phenomenon of the oft. quoted video recorder that no one can programme (Norman 2002).

Gill has developed, at the University of Wales Institute Cardiff (UWIC), a new approach that circumvents the need for high level electronic expertise utilising what he calls the IE System. This approach discards complex multimedia software in favour of another product not designed to deal with this type of problem: Microsoft PowerPoint.

The design process is described in more detail in Gill (2003), and a case study utilising the process is described in more detail in Griffiths (2004), Gill (2005a) and Gill (2005b). The following summarises the design process utilising the IE system:

1. Design of the graphical user interface begins by using the 'Post-it method' of state transition chart. Designers sketch each state of the product on a Post-it note. The transition between each state and the control that effects it are also sketched on. By moving Post-its and changing the way state changes are effected, a swift and effective method of denoting and designing state transitions is formed
2. Each Post It Note illustration is numbered then copied onto a PowerPoint 'slide' (the slide number corresponding to the number on the Post It)
3. The PowerPoint presentation is navigated via keyboard inputs from the PC. If the Post It Note State Transition Diagram shows that a certain button moves us from the state sketched on Post It Note 1 to Post It Note 5 for example, the designer may trigger the PowerPoint slideshow to move from Slide 1 to Slide 5 when a keyboard key is pressed
4. A model of the design is built that incorporates simple switches where the buttons are. These buttons are wired to a PC via an IE unit which converts each press of the button into a keyboard input. In this way, every time a button is pressed on the model, the PC receives a keyboard input and triggers changes in the PowerPoint slideshow, simulating the product's GUI being activated via the model (see Fig 2)

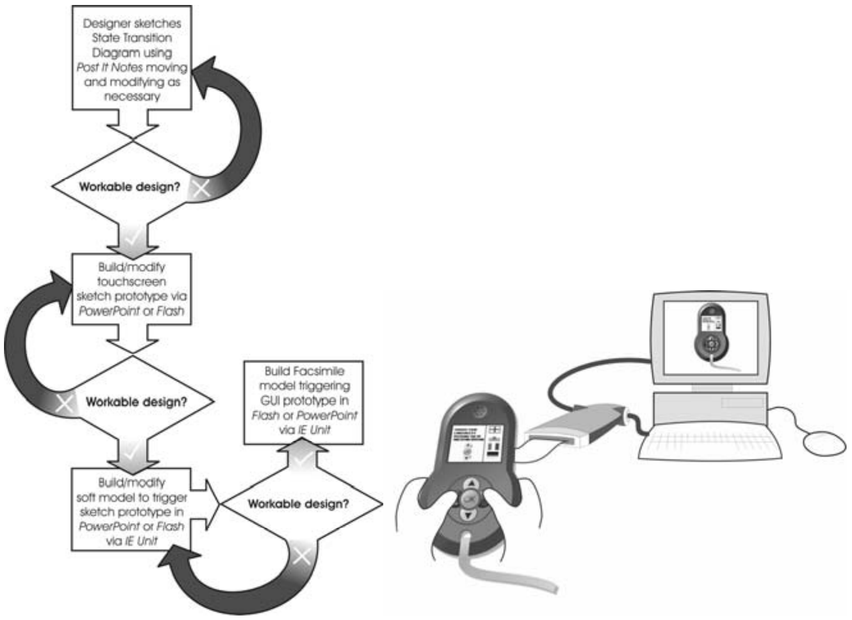

Figure 2. The IE system for designing information appliances culminates in a model triggering a PowerPoint show on a PC via an IE Unit

4. Testing of the IE system

The effectiveness of the IE System was proven in an empirical study in July 2005. Tests were undertaken to compare the performance of an actual product, a touch screen simulation and a GUI linked to a model of the same product via an IE Unit. The purpose of the trials was to find out whether the user experience with the IE System was significantly closer to user experience with the real product than the touch screen method.

A programme of tests and a method of conducting them were designed and tasks were chosen to include common activities (ranging from simple to complex), unusual functions (such as the phone's SMS button), and functions that involved more than straight forward transitions between product state. The programme was critically trialled on six participants to test its effectiveness. Modifications were made to the software, hardware and methods of testing and recording data as a consequence of these. A good example of the type of change effected was the addition of auditory feedback to the software simulation that confirmed a control input had been received. The team realised that this was an important aspect of the design and had to be present for a balanced trial to take place.

4.1 Participants

In total 48 undergraduate students took part. They were then given one minute to familiarise themselves with the interface before the tasks commenced. Six tasks were set to the participants. These were:

- Turn the phone on
- Call a number
- Add an entry to the phone's contact list
- Send an SMS to a contact
- Change the phone's background picture
- Turn the phone off

Two researchers monitored each user trial. Each task was timed and graded as follows:

- Success
- Completed (with minor difficulty)

- Completed (with serious difficulty)
- Not completed (catastrophe)

The trials were also videoed with sound and users were encouraged to 'think aloud' if they wished. Comments were noted as were actions or errors of specific interest.

Figure 3. IE unit user trial

4.2 Results

Performance of participants was converted to interval data by assigning the following numerical values to their outcome per task (0 = success, 1 = minor, 2 = serious, 3 = catastrophe). Outlying task times (3 SDs from the mean) were replaced with the next highest or lowest task times to prevent loss of data points. One value was replaced for the Call Number task, whilst 3 values were replaced for the Power Off task. Analysis of performance outcome and performance time used a 3 (device type) x 6 (phone task) mixed analysis of variance (ANOVA)

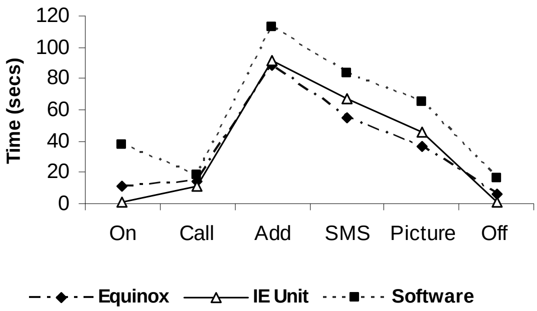

Figure 4. Mean time taken to complete each of the six phone tasks as a function of device type (see 4.1 for full details of tasks)

4.3 Performance Time

Fig 4 shows that the task times for the IE Unit and Equinox phone were more similar than the software simulation, and that on average, participants took longer to complete phone tasks on the latter unit. This was particularly salient in the case of the Power On function. It also shows that the six tasks differed in the amount of time required to complete them with the Add Contact task taking the longest.

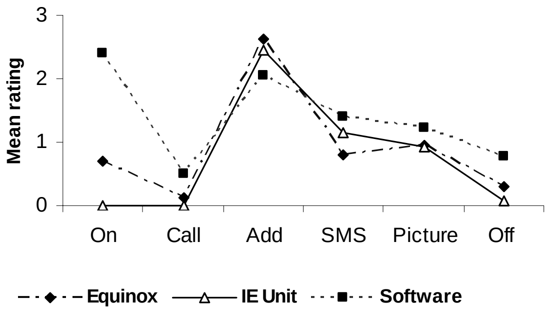

Figure 5. Performance outcome (rating) for each of the six phone tasks as a function of device type (see 4.1 for full details of tasks)

4.4 Performance Outcome

Fig 5 shows that in general, participants using the IE Unit and Equinox phone recorded better performance than participants using the software simulation. However this appeared to interact with the type of task. For example, Add to Phone Book was actually better using software simulation when compared to the other two devices.

5. The combination of ethnography and futures thinking with the IE system

The IE system is designed for maximum flexibility and importantly speed to allow it to be utilised during the phase of the design process where major, defining decisions are made that govern most consequent decisions. This phase typically passes very quickly and utilises techniques such as sketching and soft modelling in card or foam to rapidly assess concepts. The attractiveness of the IE system is that it enables the designer to rapidly test concepts relating to the way in which the product and its control inputs interact with the graphical user interface.

The combination of forecasting and ethnographic approaches aims to rapidly and accurately assess users' current and future desires and lifestyles (Evans 2006). The information gathered is used to ensure that organisations invest their resources in marketable and usable products. One of the key methods used to gather information as to user wishes and opinions is to observe their use of product prototypes. The more time it takes to prototype a product accurately the less frequently these types of tests can take place and the less likely that major changes can be made economically.

The use of ethnography as a tool to understand consumer provides rich data for forecasting. The combination of ethnographic insight, with a futures perspective, is key to establishing a link between the user and the future. The futures perspective provides deep understanding of technology and culture at the macro level. Ethnography provides deep understanding of people and culture at the micro level (Shupp 2005), (Masten and Plowman 2003).

As an exponent of an approach they call Ethnofuturism, Shupp and his colleagues at Cheskin (a prominent US Consulting and Strategic Market Research consultancy) have been developing the use of ethnography as a rich data source for futures activities:

"To make educated guesses about how consumers will behave in the future, we combine the futures perspective with astute ethnographic observation. We observe how people live their day-to-day lives, understand unmet and often unarticulated needs, and gain a holistic understanding of their current and future needs. By understanding individual attitudes, beliefs, and behaviour, we can map emerging consumer characteristics to future products. While technologies often change at breathtaking speeds, people's needs change much more slowly. Understanding current and future needs deeply is the key to developing products and services that will resonate with consumers in the future. New possibilities abound; it is the possibilities that best meet consumer's needs that are most likely to be successful" (Shupp 2005)

6. The proposed information appliance development system

The combination of ethnography, futures thinking and the IE system addresses the challenges the authors identified earlier in the paper. These were the future demands and needs of the consumer, and the opportunity for the designer, rather than an electrical engineer, to develop interactive prototypes of the proposed information appliance. The following outlines the proposed system:

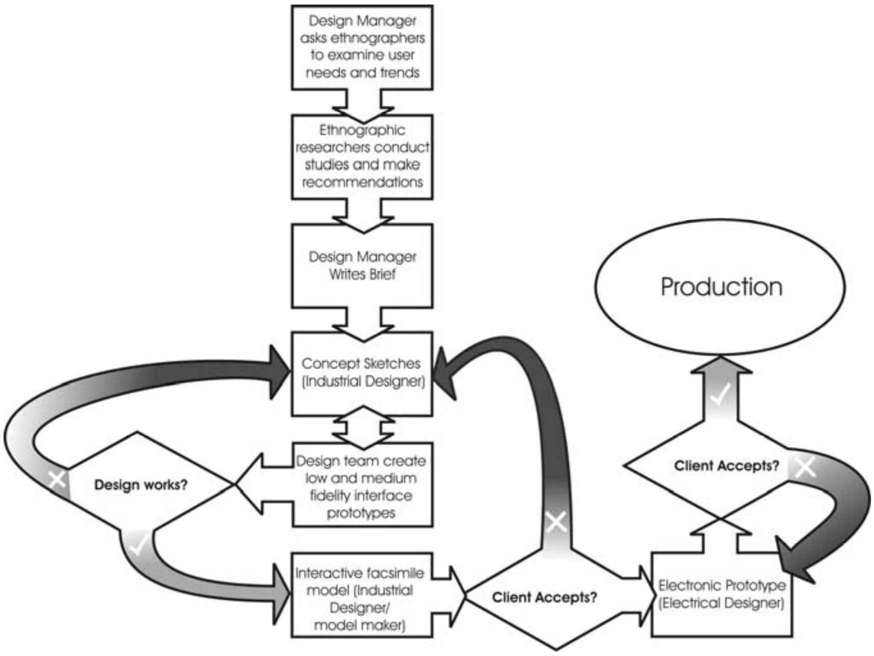

Figure 6. The proposed development system: ethnography and futures thinking with the IE system working in tandem

7. Conclusion and discussion

Branham (2000) suggested the need for new interactive design methods, techniques and tools to externalise thoughts and ideas, forcing the designer to be more explicit, and that is what the authors (and others) have been trying to achieve.

One of the key benefits of the proposed system is the opportunity for the designer to not only design and develop future information appliances, but to take these proposals out to potential consumers and test their concepts. Of paramount importance is the ability to do this quickly, and to be able to adjust these proposals themselves, in an almost immediate timeframe.

Ethnography continues to develop not only a methodology, but its relevance, acceptance and utilisation within design research. It is a process that is in a transitional state from its anthropological roots into a refined commercial design tool. Ethnography illustrates the context of everyday life, providing a holistic view of people and culture that allow understanding of attitudes and behaviour in a wider social context. It is particularly applicable for technology products that call for understanding of both the individual users perspective and the 'big picture'. It proves to be a powerful tool when combined with futures thinking. In turn, this feeds rich data into the development process of information appliances that allows a rapid development process to proceed.

The proposed development system outlined needs testing far more rigorously than has been possible in the development of this paper. The authors propose further work to develop and refine this approach. Our ultimate goal is to develop an process that can be commercially as well as pedagogically valuable. The limitations of the scope of the paper are noted and is intended this will be addressed in future work.

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