

Design and the growth of knowledge

Best practices and ingredients for successful design research

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With a major editorial contribution by Jane Szita

These proceedings are based on the symposium
'Design and the growth of knowledge', held on
November 10, 2005.

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1. Introduction

Remko van der Lugt and Pieter Jan Stappers

The relationship between design and research is changing. Over the past decades, industrial design has established itself as an academic discipline, and is establishing its research culture. Whereas in the past design research had its outlets mainly within niches on the fringes of 'mother disciplines' - such as engineering or psychology - we can now begin to discern the outlines of an emerging field of design research with its own connections to practice and theory.

Academia is engaged in an intensive discussion about the form and contents that PhDs on design should have. Industry is struggling to find ways to incorporate design as a binding and driving factor in product development, which is becoming increasingly knowledge-intensive and cross-disciplinary in nature. And governments (especially in Asia) are starting to recognize design as a driving factor in innovation.

As we grappled with this emerging field, we felt that the time was ripe to make a connection between those doing design research in academia and in industry. On November 10th, 2005, a one-day symposium was held, featuring international speakers, with the participation of 50 practitioners from the broad spectrum of the field: researchers, practitioners and policy makers.

In the morning, three speakers from three continents presented their views and experience of designing as a form of research, and shared their knowledge. They were: Brenda Laurel, known for her work at Apple, Interval, Atari and the books *Computers as Theatre* and *Design Research*; Gillian Crampton Smith, of the Royal College of Art and Interaction Design Institute Ivrea; and Kun-Pyo Lee of the Korean Advanced Institute of Science and Technology. The afternoon consisted of discussions about experiences of design as a knowledge-growing activity.

Demarcation

The aim of the symposium was to take a broad inventory of the vital issues in the field. We wanted to identify viewpoints, issues, and concerns. The goal was not to focus on precise definitions of the terms 'design' and 'research'. That would engender extensive discussion and debate, with possibly valuable philosophical contributions, but would be beyond the scope of a condensed, one-day event.

Rather, we intended to keep the event loose and open-ended by relying on the participants' intuitive understanding of the terms. We wanted to bring into the open the many ways in which the participants deal with incorporating designing and research in their work, and to discuss the various considerations that are involved. Nevertheless, for the purpose of outlining the topic of the day, we can indicate the terms roughly as follows: *designing is an integrative, generative activity that aims to create products and/or services; research is an activity that aims to establish generalizable knowledge.*

Designing and doing research are also related. A design project can yield a variety of bits of knowledge that can be valuable in other places, i.e., constitute generalizable knowledge. Some of these bits can be important contributions to research. On the other hand, research projects can lead to solutions applicable to new products, e.g., by developing measurement instruments.

We focus on the contribution of designing as an activity within research, as an activity that generates knowledge. Hence the title of the symposium 'Design and the growth of knowledge', which draws on the title of the influential compilation on philosophy of science 'Criticism and the Growth of Knowledge' (Lakatos and Musgrave, 1970). Since then, we have learned that 'design and the growth of knowledge' was also a chapter title in Vicenti's (1990) monograph, *What engineers know and how they know it*.

Process

Prior to the symposium, both speakers and participants were handed an open and playful work package, consisting of a generative toolkit (Sleeswijk Visser et al, 2005) covering three questions about design research practice that we encountered in our own work and in discussions over the years. All speakers and participants were asked to reflect on, formulate a vision about, and recount experiences with three problems.

The first question is about the position of design research within the reality of organizations, budgets, and authority. The other two questions focus on how to manage the knowledge itself, starting from the observation that much knowledge gained in a design project gets lost:

- (1) In your practice, who do you need to convince that designing is a valuable way to generate knowledge that can be used beyond the product?
- (2) How do you keep the insights gained in design (research) projects, so you can reuse them?
- (3) How do you spread the insights to other people, or other projects?

The speakers were asked to reflect on these elements in their presentations, but to choose their own perspectives. Similarly, the participants were asked to depict their experiences and viewpoints in maps, which they discussed in the afternoon session. These discussions led to an overview of positions, issues and questions.

The aim of the day was to identify ingredients, share best practices, be surprised by new insights, and finetune our questions. With this publication, we want to make these insights available, on the one hand as an entry point for participants and researchers, providing support and insight in the emerging field of design research. The publication is also intended as a point of reference for researchers, practitioners and policy makers who are interested in deepening their understanding of design as a knowledge-growing activity.

To kick-start the reader, first we provide a perspective on how design can be a part of research (and vice versa). As an example, Ianus Keller's (2005) PhD project is included, in which he actively aimed at uniting design and research (see inset on page 12). Next, we report on the three speakers' presentations. Then, we provide a summary of the issues, positions and questions covered in the afternoon discussions. Finally, John Thackara, who moderated the symposium, provides an afterword, in which he reflects on the day and on the topic of design and the growth of knowledge.

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november 10, 2005

design and the growth of knowledge

Toolkit intro

Dear symposium participant,

Designing generates knowledge. Knowledge that is difficult to acquire by other means, especially in interdisciplinary areas. Knowledge that can be used beyond the product that was designed. Still, a lot of knowledge that is generated by design gets lost from view. For example, the traditional story of science, as told by academic journals, emphasizes the evaluation of existing ideas, leaving the generation of new ideas underexposed.

In the symposium we want to deepen our insight in how designing fits into doing research: how designing contributes to knowledge. We feel that we don't need to argue that designing is a valuable way of generating knowledge, but there are many questions as to how we and others succeed in designing as a part of doing research. We are looking for best practices and ingredients for success in this area. For this we would like you to share your experience, to tell 'what works well'.

This toolkit contains three miniposter assembly kits (acceptance & support, preserving insight, and spreading the word) and two project description forms. We would want you to complete at least one of the miniposters and one of the project description forms as a preparation before you get to the symposium. Pick the ones about which you have the most interesting things to say. If you have time (and message) to complete more than one, please do so!

Goal of the toolkit is to let you sort out your own thoughts; the speakers in the morning session will also present their thoughts with these miniposters. In the afternoon sessions we use the miniposters as 'visual position statements' and the project forms for reference. Some of these materials will return in the proceedings.

... in your own place and time, and bring the results to the ...
... register at the venue.
... your browser to

05

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your name

company

son/company of the described project

☐ spreading the word



Acknowledgements

Many people were involved in making this report of the symposium possible. Jane Szita did a wonderful job patiently editing the raw materials that we fed her. Corrie van der Lelie and Jonas Piet took care of the graphic design. Ianus Keller provided a case description of his Ph.D. work, which we see as an excellent example of how design can be a means to grow knowledge. Gert Pasman co-organised the symposium and Annemarie Metselaar provided the much-needed support during the day. Cees de Bont provided a warm welcome to the participants.

Maaïke Kleinsmann and Sander Mulder facilitated afternoon group discussions. Max Munnecke, Daniel Saakes, & Wouter van der Hoog attempted to absorb and record all the thoughts and opinions that came up in these discussions. We would like to thank all participants for sharing their insights and the many colleagues that were somehow involved in making the symposium happen. Finally we would like to thank the Faculty of Industrial Design Engineering for hosting this event and for providing the much-needed financial support.





The spiral of innovation

2. Designing as a part of research

Pieter Jan Stappers

The relationship between design and research has been the subject of lively debate for a long time. There are similarities and differences between the two activities. Both contain generative and evaluative processes, often a cyclic succession of the two in an interactive process: a spiral growth of knowledge. Both lead to the growth of knowledge, insight, and possibly useful things, such as products and applications. But they differ in their aims, accepted techniques, questions of what counts as success or evidence, and the types of people and work cultures that are involved in them. In the past decades, it has become the 'received view' that research deserves a serious role in design. In design education, we see a worldwide rise in the number of universities that offer programmes in industrial design.

However, the reverse view, that design is an essential ingredient in research, has received less attention. There are several ways in which design occurs within research. First, the term 'experimental design' suggests such a way but indicates a setup (mostly from a standard collection of established techniques), not a generative activity. Second, it is acknowledged that all science involves both generative and evaluative activities. But the official signs of academic culture, its journals, stress the reporting of its evaluative activities, experiments. The generative activities that require creative thinking are only presented as a small part somewhere between the introduction and the literature review. The third way, in which the activities of designing are themselves a way of generating knowledge that is important for the progress of science, has lately gained importance. It is this last way that is the focus here.

The growth of knowledge

The activities of designing often lead to generalizable knowledge that is of no less value than the assumed certainties that come from the experimental testing of hypotheses. The contribution of designers, and of a designerly approach within research, should bring the strengths of designers to the growth of knowledge. In Delft, over the years we have found the strengths of the designer - as a type of engineer - to be the following: the ability to integrate findings from different disciplines; to communicate with experts of different disciplines; to keep in mind the interests of all different stakeholders (e.g., user, technology, business); to take decisions and make progress in the light of incomplete information; to maintain a focus on the aim (the product). These are qualities which are well respected in industrial practice, and are of value for research as well, especially in human-centred research, or other places where many different disciplines meet (or should meet).

Typical of designing is the iterative spiral of generating and evaluating, sketching and reviewing, modelling and testing, brainstorming and discussing. Especially at the beginning phases, but also throughout the process, designing is marked by its integration of ingredients (theories, insights, methods) from many diverse disciplines. It selects from these disciplines, it confronts them with each other and with the phenomenon under study, it integrates and bridges disciplines, and makes compromises (not always to the liking of people working in those disciplines). In the figure, the spiral is a vortex which sucks in insights from other disciplines. This is sometimes seen as *the* research part of designing.

But equally in this confrontation, integration, and bridge-building, design yields outcomes which are of value for these other disciplines. The vortex can throw out insights that ought to be of value if they can be caught by these other disciplines. Unfortunately, the barriers between disciplines don't always make this easy. The past generation of researchers in design have often felt that they had to make dire concessions to the design quality of their work in order to communicate their findings in the traditions of the respective 'mother disciplines'.

Central to the vortex is the advancement of the design concept(s), often – I'd like to say, preferably – in the form of prototypes. In the vortex figure, it is represented by the central arrow. Prototypes have many roles: they are the physical place where the phenomena are confronted, where the theory comes down to earth, and *all* the decisions must be made to connect to the earth, not just the ones which fit nicely within the theory. Prototypes serve as a kind of working hypothesis, not necessarily a static one that is tested and refuted or proven to be 'true', but possibly a dynamic one that is adjusted, grown, and shown to work.

Cabinet: integrating and spinning off insights through a working prototype

Ianus Keller

In his PhD research, designer and researcher Ianus Keller wanted to gain knowledge on (1) how designers use visual material in their design process and (2) what new media tools can do to support the use of visual material. During his research, Keller extensively used working prototypes as a means to integrate insights from different disciplines, to test his hypotheses on his users and to demonstrate the effect of new media on his phenomenon.

The research started out building upon the results of an overlapping earlier PhD thesis, "Designing with Precedents" by Pasman, in which the designer's use of existing previous designs was explored using a working software prototype called

"ProductWorld". ProductWorld allows designers to organize existing products on different criteria and represent them in a multi-dimensional interactive space.

A series of prototypes formed the spine of this project. With his first working prototype, the "TRI" setup, Keller explored the effects of new media tools when used in a different scale and context. TRI combined previous experiences in Virtual Reality setups, creating a platform through which users could interact with computer interfaces projected on a large vertical curved screen and on a table-sized horizontal area. TRI was used in the researcher's workspace as a platform to explore interaction and the effects of new

media in a working context. It was used to informally share visual material, communicate user contexts in video collages and to simulate interfaces by projecting interfaces on physical models.

The second prototype was built using the results from a contextual inquiry at five design agencies, which both in method and content overlapped and modified Pasman's earlier contextual inquiry. The prototype, called "Cabinet", was developed to specifically support designers in collecting visual materials. *Cabinet addressed the problem that designers keep two distinct collections: physical and digital materials.*

Typically, physical materials are collected continuously for inspiration without a specific goal and are often based purely on visual attributes. Digital material are gathered or scanned for a specific project or goal, often to support a presentation.



The prototype stands for an engineering goal, an effect to be achieved in the world, rather than a pure knowledge goal, a truth to be known in the mind.

Possibly more important than this confrontation with nature is the confrontation across disciplines: prototypes realize phenomena in delineated conditions, they embody processes and notions from theory and transform them into experience. As such, they enable experts from different disciplines to momentarily drop their respective jargons and frameworks and to meet in the common playing field of everyday language and experience.

Magic and serendipity

Cabinet combines the physical and digital collections by making the interaction with digital material more physical and allowing for collecting digital material as easily as physical material is gathered. The digital collection is projected as compositions of thumbnails and stacks on a large table-sized surface, and the designer can organize these compositions and stacks by directly interacting with them on the surface. Physical material can easily be added to the collection by placing a physical image or object on the table and taking a photograph, using the digital camera overhead. The digitized image is then projected over the original in the same position and scale, offering a smooth and almost magical transition from physical to digital. Cabinet integrates the insights from theory and practice with the experiences from working with TRI into a working prototype that can work in practice.

To demonstrate and evaluate the value and relevance of the research, Cabinet was finally placed inside the design practice. For four weeks, three designers at well-known Dutch design firms used Cabinet in their own projects without experimental conditions. During this research the possibilities for such a radical interaction style in a directed functional tool was revealed. Apart from

Designers have known this for longer than scientists, and have produced various means of visualizing, representing and embodying ideas that would otherwise remain inaccessible to those who are not simultaneously fluent in all the relevant contributing aspects that merge in a design decision. My favourite example is the storyboard, as used in the movie industry and in interaction design: this is a visual/verbal expression tool that communicates the disciplinary concerns of literally dozens of specialists involved into a shared language, by appealing to a shared language of experience.

blurring the line between physical and digital material, the experiment also showed that designers combined their source and inspiration materials with their own sketches, concepts and drawings.

The insights from the research revealed that designers collect visual material as a way to keep themselves sensitive to the world around them. *This sensitivity enables serendipitous encounters: finding inspirational things you weren't looking for.* The insights delivered by the different prototypes are currently being applied to other tools and domains.

In its turn, Keller's research spawned partial innovations and ideas that were used in ID-StudioLab research outside of

the Cabinet development. Combinations of physical models with digital projections are being explored through Daniel Saakes' research into material expressions. In addition, Remko van der Lugt and Daniel Saakes are exploring the applicability in creative group meetings of the new media interactions embodied by TRI and Cabinet.

Cabinet itself is currently in use at the ID-StudioLab as a tool for collecting visual material by researchers and as an instrument for further research. Furthermore, Keller is exploring commercial applications for Cabinet and Cabinet-inspired interaction devices with different industrial partners.

For more information visit: www.forinspirationonly.com





Varied and informal visualisations are characteristic of the design studio

Organizing design research beyond projects

The model of the vortex, which sucks in and spins out knowledge and insights, has implications for the way we organize the practice of doing research. Many of the findings in design research (or in any research) do not get reported in the final publications. At all kinds of levels, insights on theory, technique, tricks, etc. are made which can be shared in informal ways by those close by. It is often the informal channels that work best: possibly due to the hybrid nature of design decisions, the majority of decisions are taken 'on the move', without producing a full documentation which can be frozen, and referred to later. This is the same in industrial practice, where most of the design decisions cannot be retrieved later. A lot of knowledge tends to seep through the 'cracks between the woodwork'.

Maintaining the undercurrent of ideas, considerations, solutions, and insights-in-progress is the strength of the design studio, where different designers work, sometimes on different projects with different aims, but constantly learning from the corner of their eyes, by peeking over each other's shoulders, and by commenting on, disagreeing with, or borrowing from all these little insights buzzing about the place. We should learn more from this as we form research projects, by promoting insights to spill over disciplinary barriers, rather than restricting interactions within strictly delimited projects. Many insights are carried through informal channels, and are carried implicitly in the experience of the people involved, or get lost. In the vortex model, a studio can be a pool of different vortices, each receptive to the insights that the others spin out, and giving back in the same manner.

The storyboard as a visual/ verbal expression tool, appeals to a shared language of experience



RESEARCH INSPIRED BY:

QUEST FOR
FUNDAMENTAL
UNDERSTANDING

QUEST FOR FUNDAMENTAL UNDERSTANDING	RESEARCH INSPIRED BY:	
	YES	NO
QUEST FOR FUNDAMENTAL UNDERSTANDING	PURE BASIC (BOHR)	USE-INSPIRED (PASTEUR)
	NO	PURE APPLIED (EDISON)
	CONSIDERATIONS OF USE	

Design research between basic and applied

There is another way in which the concerns of design and research are related and thought different, and that is in their objectives. Because of its dedication to applicable results, it is often regarded as 'only' applied research, valuable work, but of short-term and local value only. In my experience, that view is too narrow, although the problem is true that 'research insights' of many design projects do not get communicated outside the project and fail to find their way back to the disciplines that ought to deal with them.

The arguments that Donald Stokes (1997) developed for the US research funding policy, shed a light on this relation between basic and applied research, helping (at least for me) towards a better understanding of the potential place for designing within research. Stokes argued as follows. In the traditional, linear view of science, popular since World War II, basic research is put at one end of the spectrum, applied research at the other extreme. Fundamental science yielded generalizable knowledge. Design research would be counted among the applied, because it is close to application and, in the linear model, generalizability and applicability are opposites. The value of applied science for the growth of knowledge would be only to provide new questions for fundamental research. Stokes argued that the linear model is mistaken, and that generalizability and applicability are not opposite poles, but rather independent dimensions on which research can be scaled. Next to the two earlier extremes, characterized by Niels Bohr and Thomas Edison, he puts Pasteur's research as an example of research that is both strongly fundamental and strongly aiming for applicability. That is where the best of design research can be

Pasteur's quadrant: comparing different types of research (and researchers) based on what motivates them (from Keller, p. 150)

located. In its aim for applicability, it can take on the phenomena head-on; in its aim for innovation and quality, its findings can be used beyond the product aim in a current project.

Conclusion

It has been noted that many of the great fundamental thinkers were heavily involved in realizing applications. Aristotle, Galileo, Leonardo, Newton, Huijgens, Pasteur, and the Wright brothers, did not confine their work to 'mere' theory or plain application. They had an 'effects' agenda which drove their development of knowledge and application in unison. It is in this way that design research, designing as a part of research, and design skills within research, can make the most fruitful contribution. We haven't seen designers in research for very long. In the past decades, we've seen designers starting their way in PhDs. Let's see what they can contribute. Our expectations should not be low.

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STUDYING TWEEENS BY LOOKING AT THEIR SHOES

3. Combining Design and Research in MOBO

Brenda Laurel

“Human-centred and design-centred research can live happily together,” argued Brenda Laurel in her presentation. “Together they can then be more than the sum of their parts.” She illustrated her claim with an extended case study of a product prototype called MOBO, devised by her graduate students for that important new demographic group, tweens. MOBO began with research findings that were designed into often unexpected scenarios; it ended with a structural analysis aimed at “finding the void” – that neglected empty space where a novel product can be brought into existence.

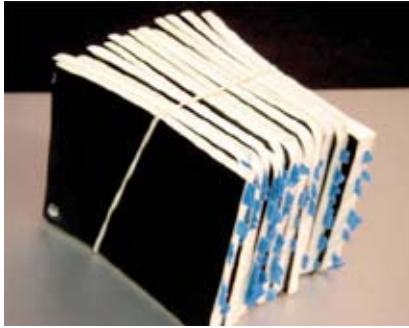


Laurel began by noting a certain conflict between those people doing human-centered research, and those doing design-centered research – that is, using design as the subject of research. By demonstrating MOBO, a project recently completed by her students in the graduate Media Design Program at Art Center College of Design, she promised the enthusiastic audience that she would demonstrate that it is possible to combine the two methods.

The MOBO project addressed the population of tweens, or 11- to 14-year-olds, in terms of what Laurel explained as “a space bounded by the following three terms: technology,

engagement, and personal agency.” She asked the students to try to understand each term as thoroughly as possible in relation to the demographic (as well as in relation with one another). Technologically, for example, the mobile phone is the dominant device of the tween generation.

The nine-month project started with photos of the tween subjects’ feet (research ethics forbids publishing the faces of the subjects, but Laurel insisted that “you learn an awful lot about someone by looking at their shoes.”). It then moved on to building research tools like the “swipe wall,” representing the sorts of products, experiences, and styles



REALITY MAP, PHOTO AUDITS, INTERVIEWS - SOME OF THE METHODS USED

that are targeted at tweens, and the “vibe wall” which was used as a place for the students to examine their feelings about terms being explored. According to Laurel, the latter is vital in helping researchers to quickly shed their prejudices at the start of the project.

Reality maps

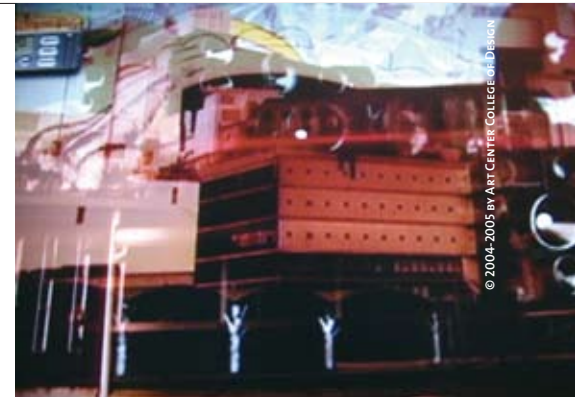
Having used these tools to form questions and hypotheses, Laurel explained, it was time to interview target populations. In doing research with this age group, she strongly advised working with friendship pairs, in this case “dyads” (subjects were chosen and then asked to bring along their best friend). The reason for this choice is that researchers can learn more from “cross-talk”, and the presence of friends ensures

honesty. Also during the interviews, researchers took photos of the tweens’ clothes, and accessories. In addition to the interviews, a method called a photo audit was also used. This involved giving each child a disposable camera to take pictures of their life – and getting them to send the film back undeveloped meant they did not self-censor the images.

Using these raw materials (interviews and photos), it was now time to “design representations of our findings,” explained Laurel. The result was sketch analyses in categories such as “tween realities”, “personas”, “scenarios”, and “tween vibrations”. These “reality maps” allowed researchers to visualize important aspects of reality for the age group. The maps also led them to identify the so-called “tension points” in the children’s lives. One such tension point emerged as the conflict between the tweens’ desire to



TIME, A POINT OF TENSION IN TWEEN REALITY



EXCITEMENT FLOW, A VIBRATIONS DURING A TWEENS' DAY



FRUSTRATION, ANOTHER TEXTURE OF EXPERIENCE

socialise and their dependence on adults for transport. Another was the conflict between wanting to do lots of activities in addition to school, and having no time to relax as a result (researchers called this “time versus no time”). Finally, there was the quintessential tween dilemma of wanting to be a teenager, but not yet being able to be a teenager, which according to Laurel was responsible for a big investment in their fantasy lives.

Researchers also looked at the different textures of experience that tweens go through during their daily lives, by making installations grouping tween experiences using key term. “Excitement flow” was the term used to represent a high adrenaline, video game, fast music energy level. In contrast, “slow flow” was the name given to the times when tweens relax, watch television and talk on the phone.

Good (and bad) vibrations

“Insecurity” emerged as one of the most important vibrations with tweens, reported Laurel. They worried specifically about having the most up-to-date cellphone, being in style, or having a good skateboard – all the outward visible signs of social status. In addition, they showed a great deal of frustration and a feeling that the world is unfair. The “pressure” vibration related to having to perform on time, getting up early, being always under pressure to get good grades, and the non-stop pace of modern life.

Finally, the “comfort” zone was almost always experienced in their bedrooms, or through using a mobile phone or SMS, or even playing or messaging on a computer. Tellingly, Laurel’s researches found that, when tweens were asked to give words that described technology for them,



PERSONAS TO REPRESENT CLUSTERS OF TRAITS, FOUND AMONG THE SUBJECTS

without exception the words they chose were positive. “Technology for them is comfort,” she concluded, explaining how they use it (in all its forms) to stay connected with friends.

Another aspect of the project, Laurel explained, involved personas, which her team attempted to realise more solidly than usual, by building them in layers of translucent paper. This method allowed them to make visual correlations between the different layers of the persona – the social layer, the technology layer, the aspirational layer, and the layer of inner thoughts and beliefs.

Laurel cited the example of “Jake”, a skater boy, whose social layer was determined by his skateboard. The skater boys in the group, Laurel noted, tended to be individualists with surfer aspirations, gentle, and respectful towards their



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parents. In contrast, the “ballers” – as they call themselves – are boys who are into team sports, who are more likely to become soldiers or executives. Laurel characterised these two types as “two versions of alpha maleness”.

Having now developed tween realities and reality maps, vibrations and personas, the research group could formulate scenarios using a graphic novel format. According to Laurel, “the worst scenarios I’ve ever seen are the ones where everything goes right. If there isn’t a failure mode, if there is no accident or mess in the scenario, then it is a bad scenario. There needs to be a surprise, there needs to be some delight, and there needs to be a failure.”



TOOL FOR STRUCTURAL ANALYSIS OF THE TWEENS

Axes to grind

As a final summary of the research findings, the group developed a tool for structural analysis that views its study population using a number of axes. Laurel demonstrated a two-dimensional analysis of tweens in which the x-axis ranged from comfortable to uncomfortable, and the y-axis ranged from social to solitary. She then pointed out that all the products currently being developed for tweens are at the social end of the spectrum.

“But what about this space here, the solitary, uncomfortable space?” asked Laurel, addressing the opposite, uncommercialised, end of the axis. To usefully invent a product for tweens, she continued, it was necessary to “find the void” – the unaddressed problem that needs a solution. For tweens, stress is a clear void, and there are few products designed

to help them manage it. In response to this conclusion, the design students created MOBO, a handheld stress-relieving object that reflects two key findings of the research. The first was that when kids talked about their own room, they talked about it not as a place, but as an object. The other finding was their assessment of technology as a comfort.

Most importantly, MOBO actively pays attention to the tween, and it belongs to them only, as it is activated by the owner’s thumbprint. Seeming to cross that fascinating boundary between organic and techno, it has a heartbeat that synchronises with the owner’s. MOBO is a handheld device made of tactile material and containing an LED array, an accelerometer, a gravitometer, and a sensor that reacts to squeezing and pressure. Therefore it can respond to indicators of mood, for example changing colour according



THE MARKETING MATERIALS FOR THE MOBO TAP INTO THE FASCINATION WITH AMBIGUITY

to the speed of movement, or vibrating (analogous to a cat's purr); several MOBOs in the same place can respond to each other, by turning the same colour. For the branding and advertising, Laurel added, it was natural to tap into the fascination with ambiguity, the, "Is it alive?" notion.

After present a commercial the students made for the MOBO, Laurel summarised the process succinctly: the design of findings led to the creation of tools like personas, vibrations and reality maps. The tools were then recombined to make scenarios. These were then analysed to "find the void" based on structural analysis.

Finally, she pointed out that any research on any population can be used for anything: "We could have made something really nasty for these guys, something that would play on their insecurities and their stress, but instead we chose to make something, delightful, something that might also address some real issues in their lives," she said. However, she ended the presentation by returning to the initial point: that human-centered and design-centered research can indeed live happily together – with the whole being more than the sum of its parts.

4. Design as research that makes a difference

Gillian Crampton Smith

The starting point of Gillian Crampton Smith's presentation was the thorny question, is design itself a form of research? After rigorously considering all the arguments for and against, and concluding that some (but not all) design is indeed research, Crampton Smith went on to describe in detail some cases where this is most definitely the case. Her examples, all culled from her time heading the groundbreaking Interaction Design Institute Ivrea, ranged from Victor Vina's interactive boxes (which functioned as a kind of instant experiment kit for his fellow designers) to Michel Kieslinger's intriguing Fluid Time bus update service, which proves that technology can indeed be all things to all people, and is also an example of "design as a hypothesis that is then tested in the real world."



At the start of her presentation, Gillian Crampton Smith promised that her approach, rather than addressing research for design like Brenda Laurel's, would instead focus on design as research—in other words, how design itself can be research. To the group of (mainly) students assembled in the auditorium, she told a story from her own student days at Cambridge in the 1960s, when one of her lecturers confidently predicted that designers and architects would be replaced by computers in the coming 20 years. At age 21, just setting out on her design career, this was not what Crampton Smith wanted to hear – although,

of course, she needn't have worried. The last 40 years have proved Crampton Smith's lecturer completely wrong; yet, as she quickly pointed out, our attempts to make programmes which can design have given us (although not designing programmes) insight into what it means to design. In particular, attempts to subject the design process to methodical analysis and procedures have suggested that designing itself might be seen as a form of research.

Crampton Smith went on to cite three arguments relating to this hypothesis. The first view she examined was the contrary one, that design is not research ('research' here

being the scientific method of proposing hypotheses and experimenting to see if they hold water). This, she argued, is a category error, quoting from George Steiner (*Real Presences*), writing about the arts, especially literature, but making a point equally applicable to design:

“There are in art and poetics no crucial experiments, no litmus-paper tests. There can be no verifiable or falsifiable deductions entailing predictable consequences in the very concrete sense in which a scientific theory carries predictive force. One must be crystal clear on this. The analytic paradigm of tragedy in Aristotle’s *Poetics* is patterned on, it is not verified by, Sophocles’s *Oedipus Rex*.”

She followed this up with Kandinsky’s assertion (in *On the Spiritual in Art*) that, “In real art, theory does not precede practice but follows her.” It is a mistake, Crampton Smith stated, to impose on art and design the paradigms of the natural sciences.

Limited repertoire

She then turned her attention to the second argument, that all design is research: each problem is unique, and design culture progresses through exemplars. Donald Schön argued in his *Reflective Practitioner* (1983) that, “Designers work by developing a repertoire of solutions that they’ve seen or they’ve done themselves and in the preconscious mind they match the characteristics of these solutions that they have in the back of their mind with the requirements they have at hand.” Every new design project adds to the personal repertoire of the designer or the general repertoire of all designers.

This is particularly important for interaction design, Crampton Smith said. People have been theorizing about architecture at least since Vitruvius over two millennia ago, so architects have a vast body of discussion and exemplars to draw upon. But in the young art of interaction design (and especially because its technology changes so fast), the number of currently significant exemplars is relatively small.

As a pioneer of interaction design, few people can be as acutely aware of this as Crampton Smith herself, and she recalled how, in 1990, when she started teaching at the Royal College of Art, she had very few instances of good interaction design to show her students beyond the Macintosh interface. It all had to be invented, from scratch. There are now thousands of interaction projects, yet only a small proportion of these could honestly be defined as exemplary or significant for the discipline, she argued (and surely any

user of modern technology would agree) – indicating, in the end, that all design is not research.

The third view (and the one our presenter favours herself) turned out to be a kind of middle way: some, but not all, design is research. Crampton Smith pointed out that the Higher Education Funding Council for England tries to quantify the research output of each university department to decide its entitlement to funding, and that, “Design departments had to work very hard to persuade the assessors, typically from the sciences or the humanities, that our activity, making things, could be classed as research at all.” However, more recently the Council (*Guidance on Submissions*, 1995) has defined ‘research’ more broadly as:

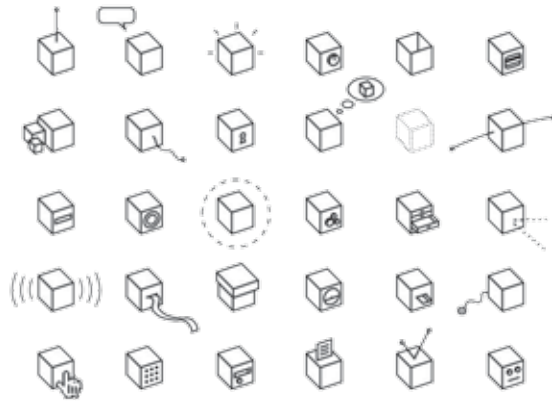
“Original investigation undertaken in order to gain knowledge and understanding [including] the invention and generation of ideas, images, performances and artefacts including design, where these lead to new or substantially improved insights; and the use of existing knowledge in experimental development to produce new or substantially improved materials, devices, products and processes, including design and construction.”

New definitions

Research, that is, includes ‘the invention ... of images ... and artifacts including design’ but only if it aims ‘to gain knowledge and understanding’. This definition, however, was framed for the academic context, not that of commercial practice. Therefore Crampton Smith offered a new definition of a research project in design (academic or commercial), as, “One which, whether or not this was its aim, discovers and demonstrates knowledge or understanding in a form which can be generalized and applied to a wider range of design situations.”

Crampton Smith then turned her attention to practical illustrations of her theory, showing some design projects from her students at Interaction Design Institute Ivrea (usually known as Interaction-Ivrea). She divided projects into three types: theoretical, undertaken for designers to understand either how to design better or what can be done in the medium; experimental, building future scenario prototypes into real contexts and trying out theories in the real world; and applied, or taking the results of the research and using them in real-world projects (more as the application of research, than pure research).

In addition to these three types of project, we seek three types of insight, according to Crampton Smith. The first



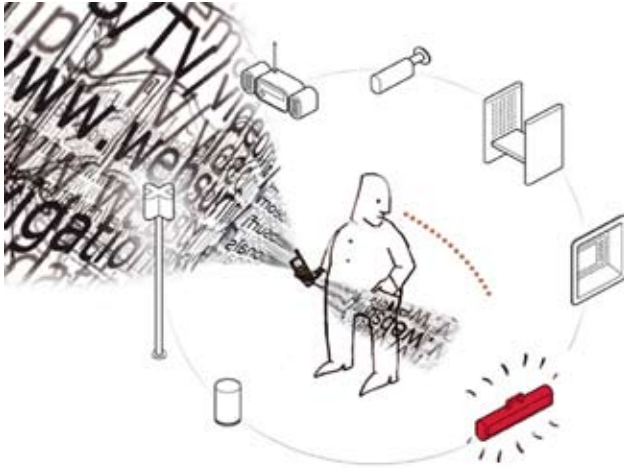
BOX BY VICTOR VINA, EXPERIMENTS WITH A NETWORK OF OBJECTS

is about people, about how technology might better support their needs, their values, and their desires. The second type of insight is into the medium: what is possible with the technology, what are the constraints. And the third type of insight is into process: how can we improve how systems, products and services are designed and implemented?

Box by Victor Vina was the first project Crampton Smith introduced. Vina's starting point could be summarised as: what are the basic ways in which you could think about networked objects? Or, in other words, if networked objects could speak to each other, what would they say? Vina's Box system was developed to allow designers to experiment with networked objects in an intuitive and simple way. For the project, Vina produced a large range of boxes, each one made out of cardboard and looking exactly like the

others: the visual appearance of the boxes, after all, is not the point here. Each box was enabled to do a simple thing (an input or output behaviour). His boxes could speak, bounce, print, or make sounds, and so on. All the boxes in the same space (in the Interaction-Ivrea HQ) were linked via a local wireless network, and other boxes in other locations were linked through the World Wide Web.

To allow his fellow designers to experiment with them, Vina made a visual programming language. Wherever they were in the world, all the boxes could be represented as icons on a screen. By drawing an arrow between any output box icon and any input box icon, the designer could the flow of information between the real boxes, allowing interactive systems to be designed and tested in a clear and simple way.



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MOBILE EMBODIMENTS TO EXTEND THE MOBILE PHONE OUT INTO THE WORLD

TURIN BUS MONITORING SYSTEM

Thinking outside the box

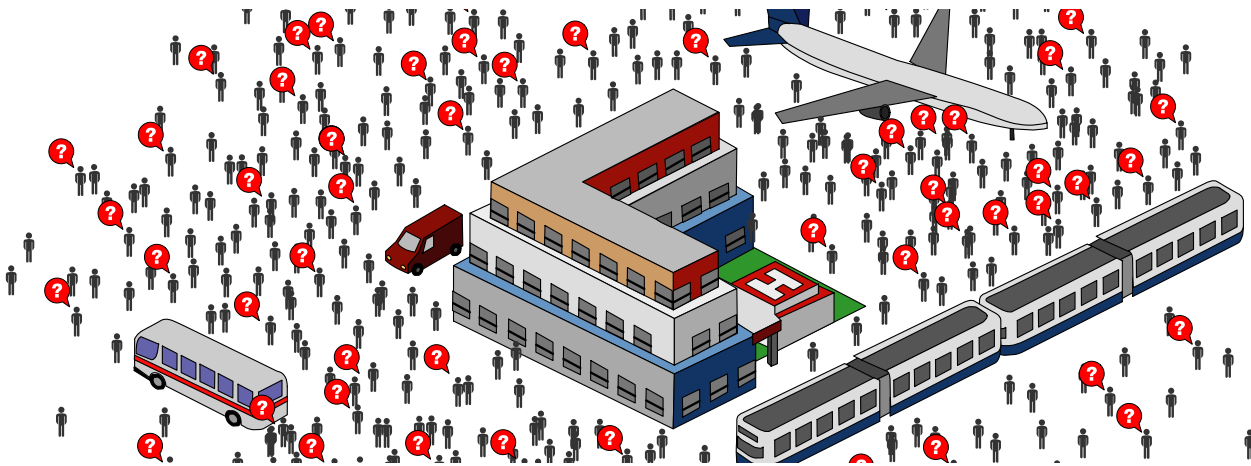
Crampton Smith went on to use this basic infrastructure in Ivrea's physical-computing classes. Each student had to design a pair of boxes, an input box and an output box, resulting in some behaviour. In one pair, for instance, moving one box caused the other one to draw a pattern. The box kits were used for over five years at Interaction-Ivrea, and were continuously developed. "Interactive systems are awkward to program from scratch," said Crampton Smith. "Therefore, we aimed that students should be able to work directly with the material without having to do too much programming."

The box project, she continued, was not about people but about a medium – and about allowing experimentation within that medium. It was one in a series of Interaction-Ivrea projects designed as platforms to allow easy experimentation with design aspects of the medium, without the difficulty of building prototypes. Other such projects were Processing, a graphic programming language developed by Ben Fry and Casey Reas at the Media lab and continued at Interaction-Ivrea; Wiring, a board using the Processing programming environment; and Arduino, a new

board developed to make low-cost physical computing accessible to designers.

Crampton Smith then introduced what she called "another key project" from Ivrea. Mobile Embodiments, by Analía Cervini, Giulio Ceppi and Juan Kayser, asks how we might 'extend' the mobile phone out into the world. They invented displays, situated in the domestic or urban environment, for which the mobile phone could be the trigger. A park bench, for example, delivers surround sound; an ATM prints out messages from your mobile device; a public ticker-tape screen displays your SMSs as you pass. This again was research into the medium of interaction design: given existing technologies, what different approaches could designers take to make them more usable, useful and enjoyable?

She then introduced a third key project, called Fluid Time. This began as a theoretical design project, about identifying a general change in human behaviour as the result of new technology and seeing how to design for it. It then developed into an experimental project in the real world: "We can think of the designs as embodiments of a hypothesis which is then tested in the world," said Crampton Smith.



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PEOPLE WERE ENCOURAGED TO LIVE WITH THE DEVICES



‘I HATE TEMPO MORTI’; I TEND TO FILL THEM ALL THE TIME. FLUIDTIME IS A GOOD SUPPORT FOR THIS”

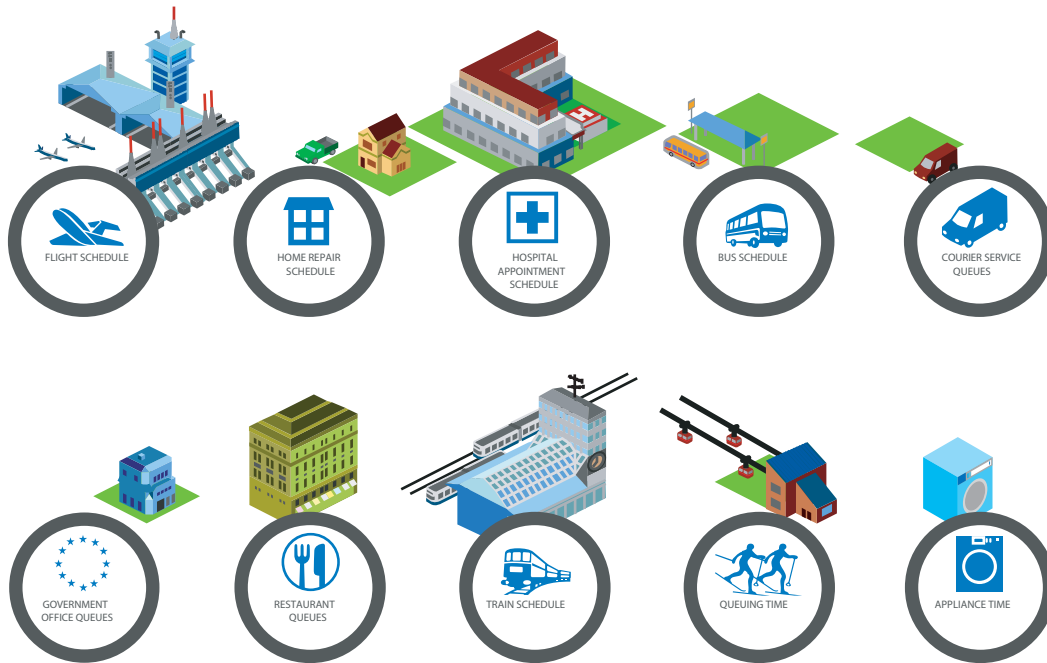
The importance of being fluid

The hypothesis behind Fluid Time is that our lives are unnecessarily restricted by traditional timetables. Fixed appointments and timetables are always subject to changes, and these changes can be tracked using mobile technology. So, while doing his Masters project at the Royal College of Art, Michael Kieslinger designed devices that would tell you how things were proceeding, so you could check if your doctor's appointments were on time, delayed — or maybe ahead of time, so that she could see you earlier than booked. Or you could see if your flight from Vienna was still expected on schedule.

In the second, experimental, phase, at Interaction-Ivrea, Kieslinger and his team of designers and engineers designed two fully working prototypes and tested them in

real situations. The first was the Interaction-Ivrea communal laundry service: they asked students what kind of device would help them book, control and monitor the washing machine in the basement. The second prototype, a bus-monitoring system for Turin, was handled in another way: they designed devices from their imagination and then encouraged people to live with them in the real world to test them.

In Turin, luckily, the current location of all buses is openly available on the Web. So the team designed interfaces which allowed users to glance at their mobile phone or perhaps their watch, to discover when the next buses would arrive at their stop. The user feedback was interesting. One subject found that she could adjust her walking speed to arrive just on time for the bus; another found she no



FLUID TIME COULD BE USEFUL IN A WIDE RANGE OF ACTIVITIES

longer had to endure the ‘dead time’ when she wasn’t doing anything; a third appreciated the fact that he could save time by slotting in more activities; and one simply liked playing with his device and watching the bus icons as they moved across its screen. “This experiment taught us that people are very different in their reaction to technology,” said Crampton Smith. “We must design devices that give them the freedom to use them in the way that suits them best.”

Wrapping up her presentation, she stated, “I want to end on the need to make a difference.” She quoted Philip Johnson-Laird, who said that “Research isn’t research until it’s communicated”, adding that she would take this further and say that research isn’t research until it makes a difference. “Maybe I don’t really believe that,” confessed Crampton Smith, “but I remain frustrated that, after 20 years

of interaction-design research and many excellent ideas about improving human-computer interaction, we are still spending our lives hunched in front of a tiny screen staring at Microsoft Office!”

So just how do we make all that research make a difference? Crampton Smith argued that communication is certainly necessary, but with careful thinking about to whom, and why, and, “how can they digest and retain it.” Designers should think more about bringing new products into the world, she added: “Are they culturally desirable? Technologically feasible? Economically and politically sustainable?” This is necessary because, as she concluded, “design must add to the richness and strange beauty of existence. That seems to me a duty that all designers, including interaction designers, owe to the world.”

5. Culture, Interface and Research

Kun-Pyo Lee



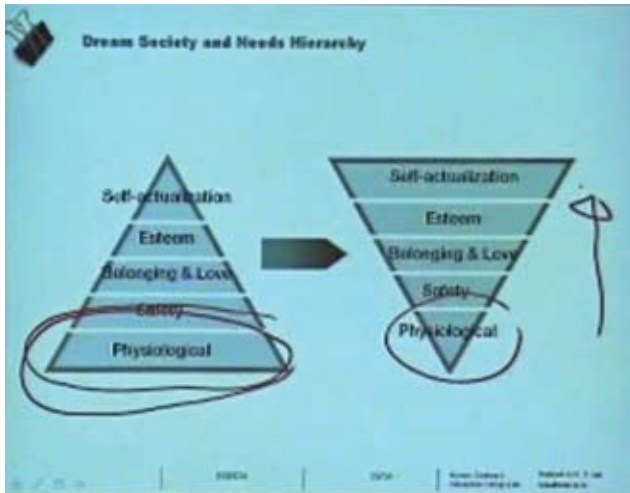
If, as Kun-Pyo Lee suggested in his presentation, “products are frozen information,” then it’s the designer’s job to select the right information to freeze. Today, that means interpreting a range of new paradigms, from ubiquitous computing to branding as storytelling. In a wide-ranging and suggestive account, Kun Pyo-Lee predicted that, with products now relying less on material functions, and more on immaterial ones, the future of designers will have a lot to do with identifying unspoken needs. How these might be established was suggested by a number of his own research approaches, aimed at arriving at just such a culture-centred design.

Kun-Pyo Lee began his talk by referencing a group of important thinkers: Jay Doblin, the design theorist; Danish futurist Rolf Jensen; psychologist Abraham Maslow; cognitive psychologist Donald Norman; and the prominent anthropologist, Edward T. Hall. While these thinkers belong to different fields, Lee argued, their work actually seems to be addressing the same basic issue: culture.

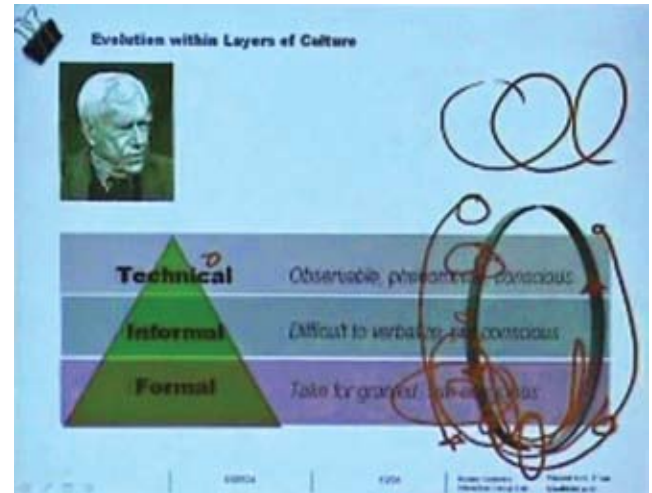
Jay Doblin, whom Lee’s acknowledged as his mentor, defined a product as “frozen information”. If we look at an ancient mural painting, we can understand how people lived long ago; we can defrost the information in the painting. Although we design an object, Lee said, it is important to remember that that process isn’t just about the object, but about the kind of information we freeze into it.

Taking the example of Lego, Lee pointed out the toy brick company’s good understanding of how to freeze the right type of information into a product, at the right time. When (in the 1970s) themeparks became popular, Lego created Legoland. In the 1980s, video games arrived, so Lego created its own video game. In the 1990s, robots such as the Sony Aibo began to hit the market; so the company developed a Lego robot range called Mindstorms. Then, at the end of the 1990s, it launched a Lego filmmaking series that allowed children to make their own movies, using Lego products - a Lego version of Spider Man, for example.

Lee went on to quote from Rolf Jensen’s book *The Dream Society*, which speculates about the new paradigms that will arrive after the Information Society. Rolf said that, “The heroes of the information society are the engineers,



THE NEEDS HIERARCHY VERSUS THE DREAM SOCIETY



CONSCIOUS, PRE-CONSCIOUS AND SUBCONSCIOUS LEVEL

the ones developing new products and those doing research into new technology. The goal is material growth.” But, “In the Dream Society, the heroes will be storytellers, those who create the culture and image of a company. The best story will come out the winner: the purely material function gradually becomes trivial, taken for granted, a by-product.” Lee argued that this new discipline is one of many emerging disciplines where no one can claim sole ownership, and that designers need to get actively involved in these.

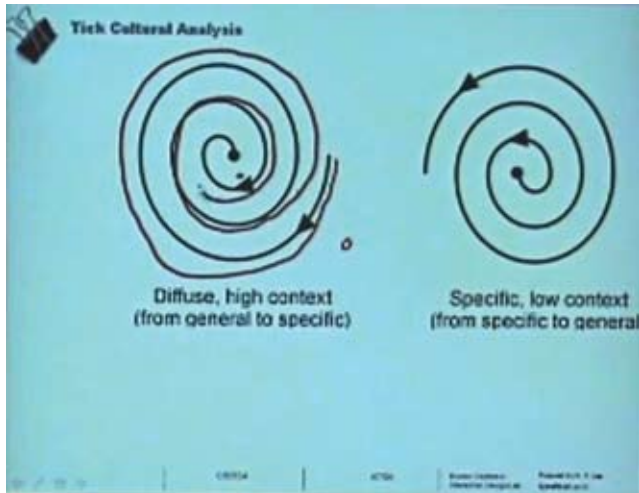
The eternal triangle

Turning his attention to Abraham Maslow, Lee demonstrated his ‘needs hierarchy’, triangle. With physiological needs (hunger, sex, sleep) at the bottom, and self-actualization at the top, Lee argued that the needs hierarchy is reflected in the argument of the ‘Dream Society’. Now our material needs are met and taken for granted, people can focus on self-actualization, stories, and culture.

Again, Lee traced a similar triangle in the work of Edward T. Hall (author of books like *The Silent Language* and *The Hidden Dimension*), examining the layers of culture. At the top of Hall’s triangle is the ‘artifact’ or ‘technical’ level, which we might otherwise call the ‘conscious’ level.

Below that is the ‘informal’ level, where you have knowledge of the intuitive kind, know-how that’s difficult to verbalize. This is the ‘pre-conscious’ level. Then the bottom level, which consists of basic (shared) assumptions, is called the ‘formal’ level, and corresponds to the subconscious.

When a new product is launched on the market, Lee noted, most discussion takes place at the apex of the triangle: the technical level. In the case of the mobile phone, this meant that we were first occupied with its weight, how to use it, whether it worked or not. But soon, all the mobile phone manufacturers had reached the same level of technological excellence and consumers could take the qualities of the technical level for granted. Then the mobile phone became an object of value on the ‘informal’ level. It began to have different attributes associated with it, becoming a stylish accessory and desirable gadget. But the value was still perceived on the individual level. Further along the line, the mobile graduated to the ‘formal’ level. It’s now a basic assumption, a given fact in today’s world. Today, said Lee, we badly need a new kind of designer who can link the technical and formal levels together; in other words, modern design should be capable not just of crafting objects, but of understanding society’s formal subconscious needs and creating new stories.



CULTURE AFFECTS THE INTERACTION WITH A PRODUCT

Moving on to yet another triangle, Lee addressed Jay Doblin's USA theory ("Utility, Social, Aesthetics"), placing 'utility' at the apex (in place of technical). 'Aesthetics' was placed in the middle (informal) and 'social' (formal) at the base – creating an echo of Hall's triangle. Applying the USA theory to an Mp3 player, Lee noted that the design – as his theory would predict – was initially concerned solely with the functional level, like the memory and size of the Mp3 player.

However, he noted that Apple did it differently, crossing the chasm between function and aesthetics surprisingly quickly with the iPod. On the aesthetic level, variations began to emerge: different colours and finishes. Now, iPod is firmly in the symbolic level with products like the U2 iPod: an iPod with the autographs of the U2 band members protected under a transparent finish. The U2 iPod, Lee emphasised, makes a radical shift. It is no longer simply an Mp3 player. The user is not just using an audio player, but enjoying the symbolism (stories) stored in the device.

When I hear the word 'culture'...

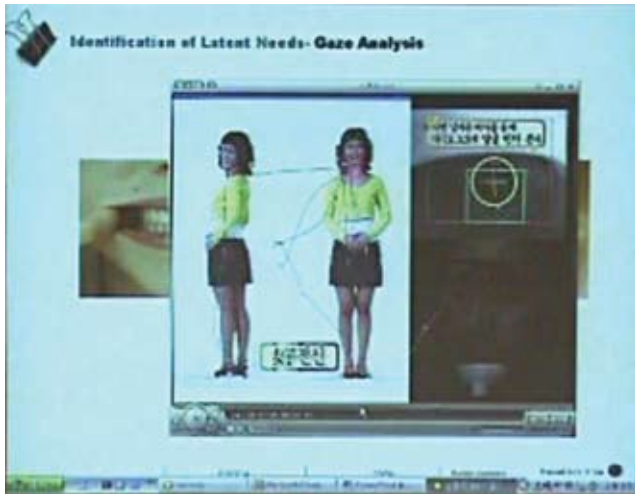
Returning to the by now familiar triangle model, Lee then discussed Donald Norman's Emotional Design, which distinguishes between the 'visceral', the 'behavioural', and

the 'reflective'. Lee changed the terms into what he called more accessible ones: visceral to 'feeling', behavioural to 'habit', and reflective to 'belief'. So, when a person first encounters an object, they have a feeling. Then, if the feeling is strong enough to cause an engagement of use, it becomes a habit. If the habit is strong enough, then beliefs can be constructed.

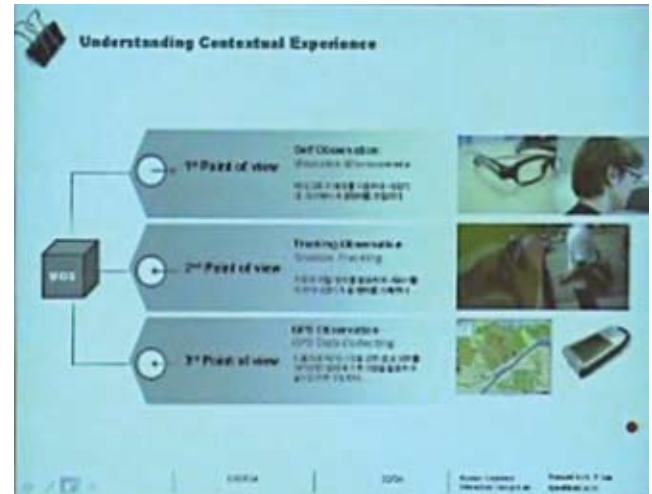
Again, like all the other thinkers, argued Lee, Norman is talking about culture. He summarised his argument by placing hardware and software in the category of tools, which occupy the top of the triangle, 'useware' and 'feelware' on the second, affective level, and finally 'cultureware' on the third, socio-cultural level. Designers should be paying more attention to cultureware, he believes.

Lee then turned to a discussion of cultural diversity. He cited the "aesthetic stereotype", illustrating this with images from a Japanese watchmaker that designs for the European market – there are specific designs for the UK, Germany, Italy, France, and Spain. The watch form is based on the intended geographic region – this is cultural design, said Lee. As for what graphic designers call "cross-cultural design", he added, this is still very much at a superficial level. To demonstrate the difficulties of cross-cultural design, Lee recounted an anecdote from his time in Chicago as a visiting professor in the 1990s. The directions on the box of a frozen pizza advised placing the pizza on the second rack of the oven. "I thought the second rack meant, second from the top," said Lee. "I took it for granted that second means from the top. But many of my American colleagues told me, "no, second means from the bottom." That was a scary moment! I asked myself, why is that?" Since then, Lee has been concerned with the ways in which culture affects human interaction with products.

Since modern tools are no longer extensions of the body, but are often based on a display, the requirements for designers are very different, argued Lee, and include skills in user testing and interface design instead of the old skills like



EYE TRACKING MAY GIVE SOME CLUES ABOUT BEHAVIOUR OF USERS



USER TESTING OF A MOBILE PHONE INTERFACE IN A REAL CONTEXT

drawing. There is also a new emotional side to products such as the Sony Aibo, he continued, requiring other sets of skills – “Perhaps facial expression design skills,” he suggested. Even more challenging is the shift for designers from designing single configurations of one tool, for one human being, with the emergence of ubiquitous computing. “How should we design this relationship, which is actually nothing but culture?” he asked.

Geography, and the subconscious

Design as a discipline must study human interaction to arrive at an answer, yet this is far from straightforward, said Lee, pointing to the fact that a simple interview survey does not work in Asia – people are too polite to give honest responses. Instead, methods can be used such as gaze analysis (eye tracking systems), which Lee has employed in a survey of car drivers. Interestingly, the results showed differences in eye movement patterns for different generations, with younger drivers focussing more on the audio console of the car, and older drivers on the steering wheel. “These are clues we can give to stylist when designing a car interior,” said Lee.

Another solution devised by Lee’s department had to do with avoiding lab-based user testing situations, where

people are usually nervous. His team therefore developed a pair of glasses with a video camera embedded into the frame. The test user could wear the glasses and record their interaction with the device outside the lab.

Video-ethnographic techniques present a different problem, since these generate excessive amounts of video footage. Lee’s lab therefore developed a software programme for recording and analysing user patterns of experience. Another elegant software solution was developed to enable user testing of mobile phone interfaces in a real context. Designers can devise new mobile phone interfaces using a simulation tool. The new interface is then uploaded to a server, and a mobile phone can download it for testing. When the testing is complete, the user uploads the interface back onto the server. Lee’s team downloads it and can study the recorded user actions using the simulator.

In general terms, Lee argued, cultural studies are inadequate. They generally feature simple statistical analysis, like people’s favourite colours and forms. “We need to link the phenomenal behaviour with the subconscious, latent level,” said Lee. “We need a tool for understanding why people behave the way they do.” In the meantime, he recommended reading the book, *The Geography of a Thought* by Richard Nisbett, giving the example of an



experiment in it that asks you to draw a line between images of a cow, a hen, and a field, depending on how they relate to each other. While Westerners draw a line between the cow and the hen, Lee said, Asians draw a line between the cow and the field – because Asian people are more concerned with relationships, rather than individuals.

The great divide

Such findings can – indeed, should – influence interface design. Lee used Edward T. Hall’s terminology of ‘monochronism’ (doing one thing at a time) and ‘polychronism’ (doing many things together) to illustrate the question of the appropriate depth of an interface structure: should it be shallow and wide, or narrow and deep? Since Korean people are polychronistic, argued Lee, they don’t want to go into an interface structure too deeply. But other cultures will be monochronistically inclined.

The point of discussing such cultural differences, of course, was to further demonstrate the need to develop a culture-centred design. Finally, Lee returned to the image of the triangle. This time, it showed consumers in relation to designers. Designers only focus on the top 20% of consumers, he said, while the remaining 80% of consumers are

neglected due to being of less commercial value. Designers should have the social responsibility to consider this 80% of underprivileged consumers, he argued. He quoted from the Miniature Earth’s website: “If the world were a village of 100 people, there would be 61 Asians, only 12 Europeans, 13 Africans, only 14 Americans (from both North and South America). There would be 50 men and 50 women. 26 people are white and 74 are non-white. 67 are non-Christian. Only 6 people own 59% of the entire community wealth. 80 people live in poverty. 14 people can read. 33 die of famine. Just 7 people have a higher education, and 8 will own a computer.

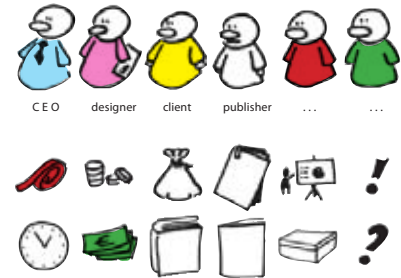
“If you have never seen a relative die in a war, if you’ve never been a slave, if you’ve never been tortured, you are luckier than 500 million people. If you keep your food in a fridge, you clothes in a closet, if you have a roof over your head, a bed to sleep in, you are richer than 75% of the entire world population. If you have a bank account, you’re part of the 8% wealthiest people in the world. If you can read these words you are luckier than one billion people who can’t read at all.”

“This,” he concluded, to a clearly moved audience, “is our discipline’s social responsibility.”



6. WORKSHOPS

6.1 Introduction



There are many questions as to how we can succeed in designing as a part of doing research, or conducting what we call 'design research'. In an afternoon workshop, we explored best practices and the ingredients for success in this area. The keynote speakers and 40 invited experts from a variety of fields participated in this workshop (see pages 50 and 51 for a list of the participants). They included R&D managers from multinational corporations, designers from specialized and general design consultancies, academics from universities and polytechnics, and policy makers at national and EU level. They shared their experiences and keys to success with respect to design research in the broadest sense.

Approach

About a week before the workshop, each participant received a 'toolkit', designed to sensitize and prepare the participants for the workshop. Here we drew from

recently developed design research methods by using a 'sensitizing tool' from Contextmapping (Sleeswijk Visser et al, 2005). Each toolkit contained three mini-poster exercises to stimulate the participants to reflect on, and to express, their experiences with respect to design research. There were also two 'project description forms', inviting participants to prepare an example case to bring to the table. Each of these exercises came with a mini poster background, and a set of triggering words and images designed to get the participants going (see illustration on the opposite page). The exercises addressed the three workshop topics: 'preserving insights', 'acceptance and support', and 'spreading the word'. Participants were asked to complete at least one mini poster and one project description form, preferably the ones for the topics about which they had the most interesting things to say. They brought the completed mini posters and forms to the workshop, where they

were used as visual position statements and for reference later in preparing these proceedings.

The afternoon session split the 40 participants into three groups, each group focusing (initially) on one of the three topics mentioned above. The groups were free to modify and interpret the topic. Each group ended up addressing all three topics, and discussing the different views on design research in general. During the workshops, the participants tried to create and clarify a shared understanding of the topics. They shared and discussed cases that exemplified the 'growth of knowledge'. The afternoon ended with a plenary session, consisting of short summarizing presentations from each of the groups. During the group meetings and the plenary sessions, notes were recorded. These notes, and the recordings of the final presentations, served as the information pool from which we drew the themes outlined below.

6.2 Results



Participants of the Blue workshop group

Interpreting the data from these workshops resulted in six themes, stated as questions:

1. What do we mean by 'knowledge'?
2. For what and whom do we preserve this knowledge?
3. How do we keep this knowledge alive?
4. How do we preserve it?
5. Who do we need to convince, to be allowed to do designing as a form of research, and how do we convince them?
6. How can we close the gap between designing and classical forms of research?

Each theme is discussed below, using citations that express the various views of the participants to deepen the topic.

1. **What do we mean by 'knowledge'? Or, what is this generalizable knowledge that goes beyond the designed product?**

Three case examples explained various ways in which design research generated knowledge that went beyond the designed product, i.e., knowledge that was used by the company for other purposes. One company broadened its knowledge base, a second changed its design approach based on the research, and a third company actively used knowledge gained in an earlier project for a very different application.

In the first case, a group of students developed an innovative concept design for welding equipment. For the company involved in this project, the new concept design provided a spark for exploring new knowledge domains, such as marketing and production. The designed product functioned as a trigger for exploring new knowledge. In the second case, the knowledge obtained from the designed product led to a new approach to product development. It is widely known that the Short Message Service (SMS) application was not originally designed

for consumers. Consumers themselves discovered that this application was valuable for them. Nokia used the knowledge that they obtained from the SMS case as the basis for setting up a platform for mobile phones, which is more suitable for participatory product development.

In the third case, knowledge gained in an exploratory project at Philips Research on enhancing the waking up experience, by for instance projecting images and messages onto the ceiling, are now used in products for medical examination rooms. The Philips Ambient Experience Design uses projection - as well as a number of other technologies - to customize the immediate environment in healthcare facilities for people who have to undergo examinations such as CT or MR scans. In all three examples, the participants found knowledge that goes beyond the designed product by engaging in - and reflecting on - their design activities, either on a content level, e.g., knowledge



about marketing or user psychology, or on a process level e.g., knowledge about a participatory approach to product development. Most workshop participants were familiar with preserving these two types of knowledge. Preserving knowledge seems to be an obvious thing to do. But what do we preserve this knowledge for, and who will retrieve it?

2. For what and whom do we preserve the knowledge?

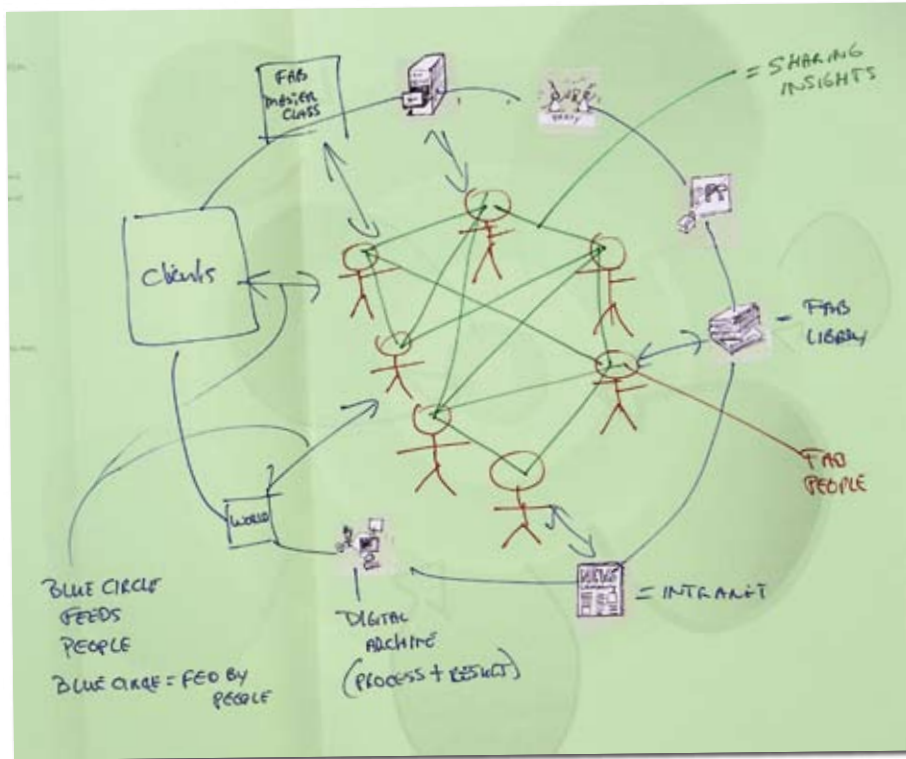
Several participants mentioned that preserving knowledge is not only about keeping the knowledge, but also about the act or habit of preserving. “A lot has to do with the culture of preserving, the rigour of storage, keeping it somehow.” (Henri Achten) This is particularly true for designers as they “...tend to be archive makers” (anon). But is it really necessary “to make knowledge explicit to preserve it?” (Elmo Diederiks) It appears that preserving knowledge is about preserving a broad set

of memories, rather than about preserving specific facts. When the knowledge surfaces at some point in the future, its value is often in things which would not have been explicitly identified at the time of storing it. “Looking through things again, makes you remember things that you have often forgotten.” (Gillian Crampton Smith) For example: in one case that was brought forward, a designer used preserved documents to create an overview of her design work. This helped her to reflect on how the quality of her work had developed over time. In another case, a team had produced a beautiful book (see illustration above), containing results and insights of a design project. The book stimulated the designers and the clients involved in the project to ‘show - and - tell’ about it. Having such a document to refer to helps designers to draw new knowledge from the project time and time again.

In short, as designers, we tend to preserve knowledge both because it is in our nature to preserve things, and

because we need preserved knowledge – for instance captured in artifacts – to recall the knowledge that we have obtained. The principal issue is that the preserved artifacts only stir up memories to people who were involved in the project. This means that the knowledge is in the people rather than in the artifact and the memories are typically not about detailed facts, but about the wider experience during designing.

This raises the question: how can we preserve people?, and especially, because people “float in and out of projects all the time” (Gillian Crampton Smith), how can we preserve people’s knowledge? Yet perhaps the actual question is, how can we make the preserved knowledge accessible for other people in the organization as well? Or alternatively, how do we keep the knowledge alive in our organization? To achieve this, many of the participants had explored methods of sharing, transferring and/or communicating the knowledge.



Left: The importance of a coffee machine in larger organisations

Above: A small organisation: What's the problem?

3. How do we keep knowledge alive? Or, how do we share, transfer, and communicate knowledge?

The participants discussed how knowledge can be communicated, in order to keep it alive in the organization. It was soon understood that communicating knowledge in a small company is rather different from communicating knowledge in a large company. A designer from a large company stated that, "the need and the way of preserving is complex when a company is big" (Tanya van Rompu). In contrast, a design consultant from a small design agency expressed his surprise that this was a topic at all. This difference between communication of design

knowledge in large and small companies was apparent in the mini posters that were created by the participants of the workshop, see illustrations above). Whereas smaller companies hardly encounter any problems, large companies struggle with issues such as 'knowledge management':

[S]: "We use 'shoeboxes', both digitally and physically. Prototypes and drawings, they stay alive. When somebody asks us, we just open the shoebox and everything, its entire history comes back. So what's the problem?" (Pim Jonkman)

[L1]: "Well, we have a design studio consisting of 200 people." (Paul Gardien)

[L2]: "The problem is also about storage." (Tanya van Rompu) [...]

[L3]: "You know what your project was about. Within Philips you are the only one. It is impossible for others to know everything about all the other projects." (Elmo Diederiks)

The latter issue of 'knowledge awareness' in the company turned out to be troublesome for many large companies, as illustrated by the quote: "If only HP knew what HP knows." (anon) In large companies, often web-based databases are maintained to facilitate the storage, retrieval and exchange of information and knowledge. "Although technology can facilitate, it can't replace actual face-to-face meetings." (anon) Participants also mentioned that "there is a distinction between formal and informal knowledge"



Participants of the Blue workshop group

(Aukje Thomassen), and formal and informal communication of knowledge. Yet both, formal and informal, are needed: “You have to experience things in order to understand them... It’s a sort of gut feeling. On the other hand, you need more formal knowledge, in order to transfer your ideas to the stakeholders involved.” (Elmo Diederiks)

“The coffee machine is a good way of passing knowledge through to other units. In informal chats, you are really sure that they pick it up. At P&G, we try to start from the user. We often make one-pagers with visuals and we force people to make one-month learning reports, which people can react to if you have done something interesting. Furthermore, all projects can be found in the internal database, but you only retrieve information from the searchable databases.” (Tanya van Rompuy)

People often have a personal preference for particular forms of knowledge and particular means of communicating knowledge. In order to keep the knowledge alive in your

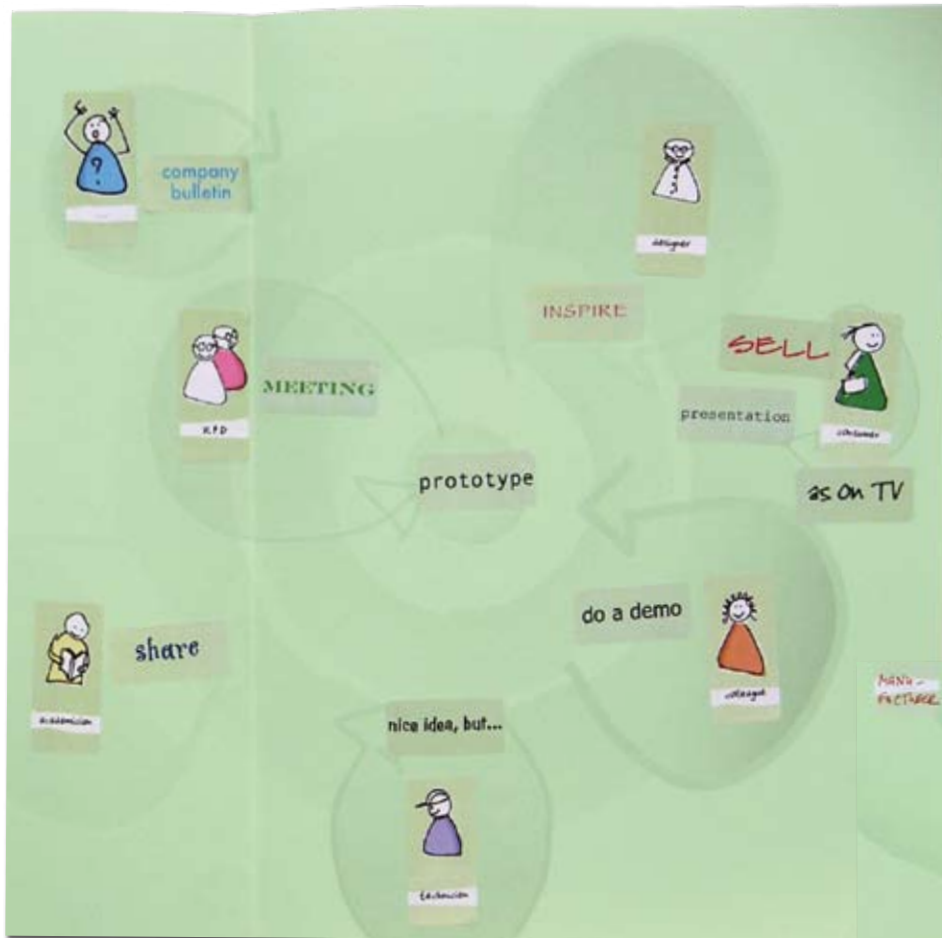
organization, “the knowledge has to speak to you” (anon), and to your colleagues. So “how do we preserve knowledge?” (Stefan Wensveen) A second related question that came up is: “What to keep, and what to throw away?” (Marcel Vroom)

4. How to preserve knowledge?

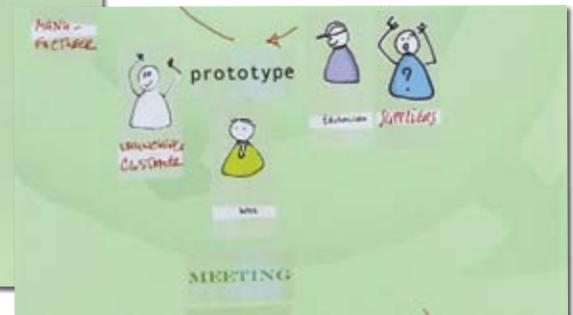
Although everybody recognizes the problem, there is no single answer to the question of how to preserve knowledge. Still, two issues were identified in the workshop that should be considered when preserving knowledge: (1) the medium for preserving the knowledge, and (2) the desired level of ambiguity. Several interesting ideas about preserving knowledge and insights were presented: “It should be inspirational on the one hand, and re-usable on the other hand.” (anon) “Keep the trash.” (Pim Jonkman) “You should have something short, visual and physical. This allows you to go with big steps through the process. Just shove it into a box.” (Pim Jonkman)

A common remark was that knowledge is, and should be, preserved in layers, allowing both for an initial overview and the subsequent gradual uncovering of detail. One attendee illustrated this remark with a story about an Italian designer, who archived his projects in small physical boxes. These boxes assisted in the process of gradually uncovering the different levels of detail of a past project. Similarly, short, visual and factual information sheets, such as infographics, could be used as a means to structure information and select relevant knowledge.

A few examples of preserving knowledge were shared in which different media were combined to improve the accessibility of knowledge. For instance, Ianus Keller used different media, such as packaging, stickers and a DVD, in his Ph.D. thesis to “minimize the bookness of the book” (Ianus Keller), and to seduce its recipients to start reading it. These examples led to the question of “whether the medium is the most determining



Left and below: Prototypes preserve knowledge, are used for presentations and communication



factor" (Phil Tabor) in preserving and communicating knowledge.

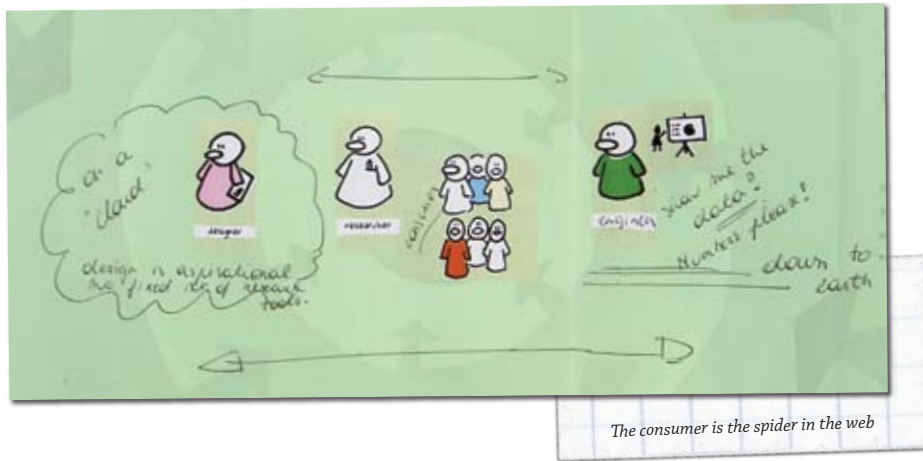
A recurring medium for preserving knowledge was the prototype. This medium was often used for preserving knowledge, simply because "prototypes are the only physical items that remain after a project has ended" (anon). "Documents and PDFs dissipate, but prototypes and self-running demos remain." (Jim Hennessey) "Prototypes are very powerful." (Paul Gardien)

Next to preserving knowledge, prototypes are also used for presentation

and for communication, as was visualized by two attendees in illustrations above. The following case was brought forward in which prototypes were used for preserving knowledge: "I have worked on dish washing detergent, which was difficult because of its compounds and viscosity and such. We have developed prototypes of the dispenser, but when they were finished, the development team said that they had changed the format. So the prototypes were not used, and people wanted to throw them away various times over the years. I was

opposed to that, merely because they had been very expensive. Years went by, and then we moved to another building six months ago. All of a sudden I saw my prototypes displayed in our office. Somebody put them there because he thought they were rather nice. I immediately thought: who started the project again?" (Tanya van Rompuy)

Tanya Van Rompuy also mentioned how the re-installing of the prototypes in the office did not just function as decoration, they also re-activated the knowledge they carried. People started



to ask about the thoughts behind the solution embodied by the prototypes. Through their physicality, prototypes remain 'in the way', occupying a physical space, unlike formal documents, which are easily stowed away in a locked cabinet in a storage room, and unlike digital documents on a computer, which can remain totally silent, hidden somewhere on a hard disk under a cryptic name.

By their nature, prototypes do not make implicit knowledge explicit. "Prototypes go through many iterations, and it is difficult to link them to what they were intended to be." (Tanya van Rompuy) As a consequence, "resurrection leads to an interpretation of its own" (anon). Some people consider this to be a loss of knowledge (of the original decisions and considerations): "In a Philips project, there was a lot of knowledge and visions behind the project, but the prototype was the only thing that remained. And now it seems that the project is reduced to only that prototype." (Paul Gardien)

Others think the ambiguity of preserved knowledge is desirable as it allows for new connections to be made: "I interpreted my own work differently every time I had a look at

it." (Pim Jonkman) Another attendee claimed that ambiguity, 'unfinishedness' is an indispensable quality of prototypes, because "you need room for interpretation if you want stakeholders on board" (Elmo Diederiks). This leads us to the topic of 'Acceptance and Support'.

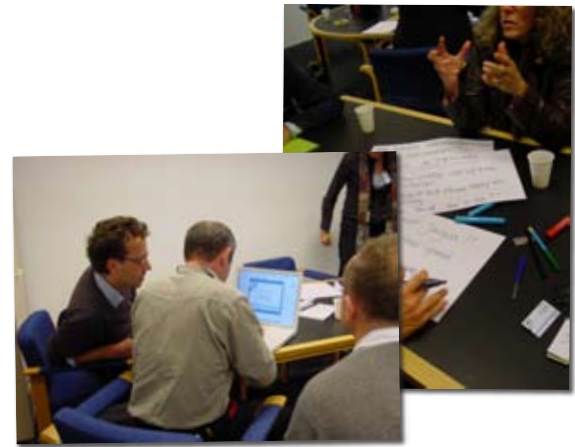
5. Who needs to be convinced that designing is a worthwhile approach to research, and how do we convince them?

Many people agreed that senior management are the first people that need to be convinced of a design research approach. "Without management support, you do not stand a chance." (anon) Then other stakeholders and/or shareholders can be convinced. "You should get the manager in your group." (Arthur Eger). But how do we convince them, and how can these factors be conveyed?

Starting with the latter question, good communication skills were found to be essential in being convincing. One attendee told the group about his recent experiences with media training.

In this training he was taught to stay on the message, and to formulate three key points, which were then to be constantly repeated in order to get the message across. The group agreed: "Designers need media training!" (anon) In addition, several people mentioned that it is important to speak the language of the people that you have to convince. In some cases, this means that you have to "give numbers" (anon) in order to get credibility, even if you yourself don't 'think numbers'. Another approach that was suggested was to "find a common ground" (anon). "Something in common brings everybody on board: 'end user' is often the magic word when talking to different disciplines" (Elmo Diederiks), because "everybody approaches the matter through the user's eyes to begin with" (anon). One attendee visualized the consumer as "the spider in the web", which means that the people involved in the design process are interconnected by the consumer (see illustration above).

To summarize: in order to convince people you need to have good communication skills; speak the language of the people that you have to convince; find a common ground, which may lie in



the everyday experience of the consumers with products; and have good reasons for design research to begin with.

Returning to the first question of what reasons convince, the researcher's, and/or designer's track record and personal relations were considered to be most crucial in convincing stakeholders to engage in design research. A few cases were brought forward in which showing successfully completed design research projects turned out to be very helpful: "By having the chance of showing a client [through example cases] how valuable research for design could be, I was able to get the money for doing the research." (Theo Groothuizen) Attendees suggested that a reliable base of design research cases would be useful for reviewing and explaining the design research approach and its benefits.

Showing successful projects from the past is no silver bullet. In one example, a successful earlier design project was shown to convince the stakeholders of the design research approach. "In spite of the results the

designers were not accepted as partners in research of new products and systems." (Theo Groothuizen) This problem was recognized by some others: "Practice does not value the (design) research we do. Academics don't consider it research at all." (Caroline Hummels)

The emerging methods of design research can fall on deaf ears in those trained in and adhering to rigorous classical discipline, for instance insisting on large numbers of participants and quantitative statistics even for exploratory studies. This statement raised the question of how we can identify and close the gap between design and research.

6. How to close the gap between design and research?

A joint answer to this question was to convince people, i.e., CEOs, stakeholders and shareholders, of the design research approach by involving them in design research themselves, and as a result "create co-ownership" (anon) and understanding.

"Give them a hands-on experience of how designing works. The value of design is understood after people experience it by doing it. [...] You can engage people in design research by sharing your tools, your methods." (Caroline Hummels) A nice example was brought forward in which people experienced design research by means of a workshop: "We held a one-day workshop at a conference in which we started with twelve personas and at the end of the day twelve working prototypes were built and tested in a matching experiment. This was a 'perfect' integration of theory (design for personality, update technology tangible interaction), hands-on design (vision, ideas, concepts, prototypes), and research (through design) in one day." (Caroline Hummels)

Although the outcome of the workshop did not teach its participants to design, it allowed them to experience the value of the approach. Hands-on experience with the objects of their decisions is a necessary ingredient for decision makers.

6.3 General Conclusions

During the workshop the participants identified case studies and discussed what could be learned from these case studies concerning design research. The discussion led to many ideas and suggestions, for instance about preserving and communicating knowledge. At the same time, many new questions about design research were posed. A clear answer to these questions was not found, nor was consensus reached on what constitutes design research (or its component terms design and research). Instead, the discussion led to a better understanding of design research, and in particular to a better understanding of how designing fits in with doing research, and how designing contributes to knowledge.

For example, it appeared that social aspects play a very important role in all aspects of design research; in 'preserving insights', in 'acceptance and support', as well as in 'spreading the word'. Several participants had experienced in practice that knowledge is preserved in people

rather than in artifacts, and recognized the importance of informal communication as a means to make this knowledge accessible to other people in the organization. Yet informal communication cannot replace formal communication. Finding the balance between these two forms of communication is an important topic of inquiry.

Another important thing that we learned, is that the composition of a project team is not as static as often presented. "People float in and out of projects all the time", so the composition of the project team is dynamic, changing continuously. As a consequence, there is a continuous flow of people and, if things go right, of knowledge. During the workshops this flow of knowledge was often considered to be problematic as it may cause knowledge to be lost. We think there is a positive side to knowledge flow as well: due to the exchange of knowledge between people, who have different backgrounds and work on different projects in parallel, new knowledge may

The afternoon ended with summarizing presentations from each of the groups.



be generated that is valuable for either the project running, for parallel projects or for future projects. Therefore, in our opinion, we should pay more attention to composing the project team, and empowering its members to leverage knowledge from earlier and other projects.

At the end of the day, we cannot claim that the sessions provided final answers to the questions of the day, but they gave us a good feeling for the manner in which the subject matter is experienced by those engaged in this emerging activity. There is a community of people practicing and studying design research, and a growing understanding of its importance for the development of both applied results (products) and fundamental results (knowledge). Future research will have to focus on developing policies, processes, techniques, and tools that support this community in further developing and applying its new promise into the practice and theory of product development.





"A lot has to do with the culture of preserving the rigor of storage, keeping it somehow." "Leaving the institute, I have looked through the stuff that passed by in the last 5 years. And it really got better."

For what or whom do we preserve knowledge?

PRESERVING knowledge

What do we mean by 'knowledge'?

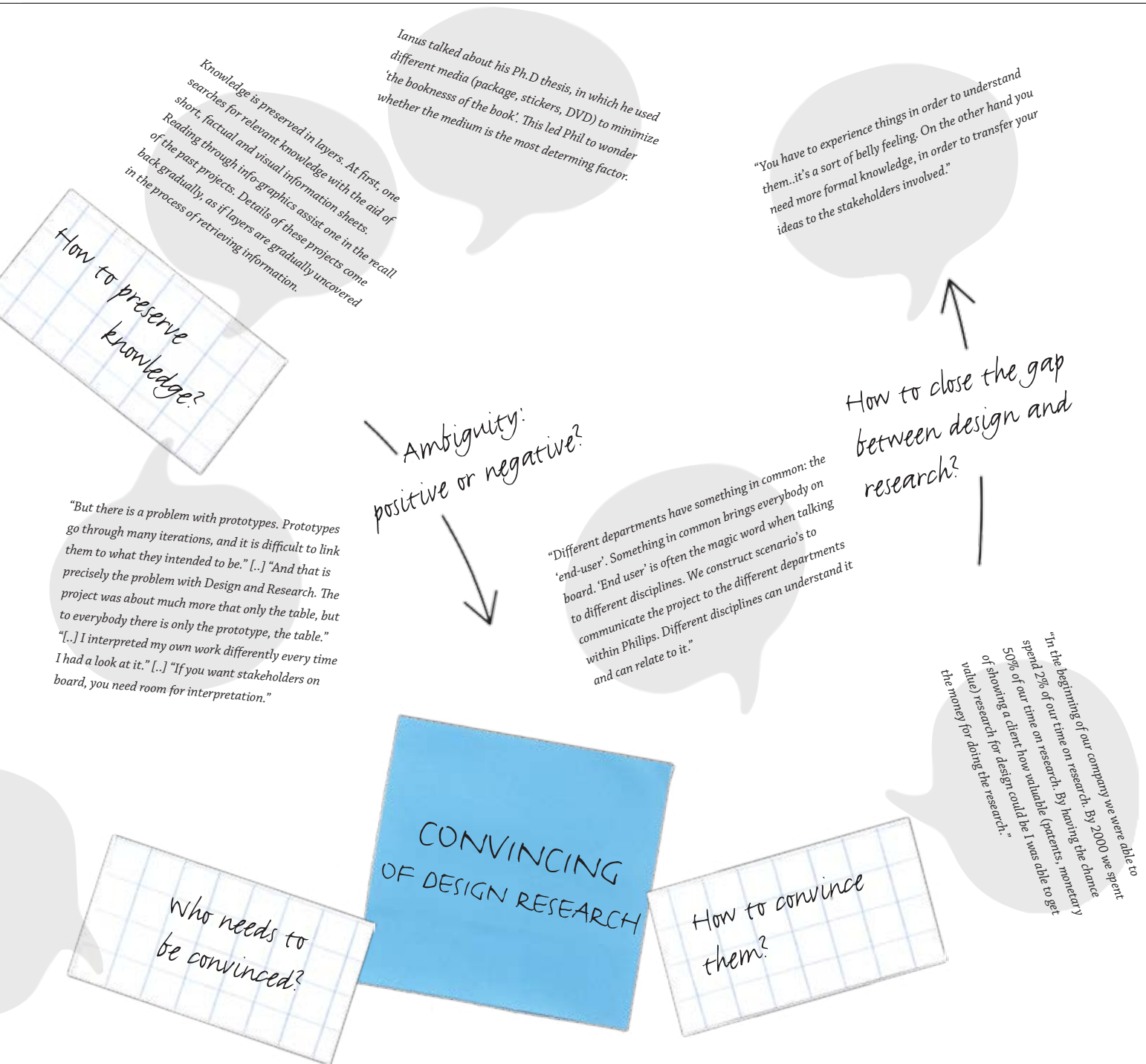
How to keep the knowledge alive?

COMMUNICATING KNOWLEDGE

"We use trashcans, both digitally and physically. Prototypes and drawings, they stay alive. When somebody asks us, we just open the trashcan and everything, its entire history, comes back. So what's the problem?" [...] "There is also an assumption present. You know what your project was about. Within Philips you are the only, it is impossible for others to know everything about all the other projects."

"SMS was not intended as a product for consumers, the consumers discovered this themselves. Nokia took this knowledge from the SMS case, and used it as the basis for a new approach to product development in general: a platform for mobile phones, more suitable for 'serendipity' or community-involved participatory product development."

"A group of students developed a new concept for welding equipment for a company, in which there was an LCD screen on the inside of a welding mask and a camera on the outside. This offered all kinds of new possibilities. [...] Having a design with a completely new concept forced the company to explore new knowledge domains about the product and this new concept was a new insight to the company."



7. Afterword



"Avoidance of difficulty or unpleasantness. Disavowal of extreme situations. Retreat into distraction. These appear to be the hallmarks of the fast-encroaching New Dark Ages". No, these words are not about the U.S. election results. They're a comment by Anne Marie Willis, editor of *Design Philosophy Papers*, on the state of design research. Having tried, via a mailing list, to engage 1,000 PhD design researchers in environmental issues, all that Willis encountered was "a small flicker of debate". Her conclusion: "There seems to be an inverse relation between the extremity of conditions, and our preparedness to contemplate them".

I don't agree. I was heartened at the TU Delft conference by the preparedness of academics and professionals to confront difficult questions. A lively debate is opening up not just about how we do design research but, more importantly, why we do it – and to what ends.

In 2005, for example, a new product was launched every three-and-a-half minutes. That's quite an impediment to what Brenda Laurel called "finding the void" – that neglected empty space where a novel product can be brought into existence.

For Kun Pyo-Lee, too, the designer's job these days has a lot to do with "identifying unspoken needs". Gillian Crampton Smith also pointed out that "one purpose of design research is the invention and generation of ideas, images, performances, artifacts". But although the speakers at Delft proposed novel ways to find

and occupy voids with products, there was an undercurrent during the informal discussions that questioned whether we should fill up all voids with products at all.

The importance of informal communication was a recurring theme. Many researchers and designers described their work as at least in part a social activity. And often informal. In one intriguing session, practitioners agreed that the composition of project teams is never as formal and static as is often presented. "People float in and out of projects all the time," someone said. The composition of a project team is dynamic, and changes continuously. As a consequence, we find that "a continuous flow of people that plays a vital role in spreading the word."

For Pieter Jan Stappers, these informal, associative, collaborative forms of research are the strength of the design studio, where different designers work, sometimes on different projects with different aims, but "constantly learning from the corner of their eyes, by peeking over each other's shoulders, and by commenting on and borrowing from all these little insights buzzing about the place."

Even in a heavyweight scientific institution like TU Delft, it seems, knowledge is preserved in people rather than only in artefacts or scientific papers. "Informal communication cannot replace formal communication," interjected one professor – perhaps anxious about the future of his job!

Multiple associations

The only problem with informal communication is that it is seldom costed properly when projects are being designed. The total cost of ownership (TCO) of a design research project would be higher in most cases if we made more realistic budgets for things like co-ordination and communication. These membrane-like activities are vital, but often don't get paid for, even though we do the work. (Or else, if we knew the true time costs, but could not get them included in the budget, then maybe we wouldn't do the project).

Designers, academics and companies tend to understand 'design research' in different ways. The words trigger multiple associations: technology scoping, market research, product development, trend forecasting. Five years ago, most of the academics would have said that these activities were not 'research' as they understood the term. But to judge by the Delft event, hard-and-fast distinctions between formal and informal knowledge are fast breaking down. A 'best practice', for example, is hard to document, or make objective. Practices, by definition, are rooted in a social and technological context. Remember all those new 'pure-play' business models invented by business school academics during the early dot.com boom? Nearly all these platonic concepts failed precisely because they were not rooted in a context. Academic research can draw our attention to new ways of working but I'm sceptical that academic research, by itself, can innovate methods out of context.

But the relative isolation from context apart, the academy has a role to play in reflection, criticism, and evaluation of the bigger picture. We need a critical debate about the concept of an 'un-met need,' for example.

If I reflect, after the meeting, on success factors for design research and the treatment of design knowledge, three things stand out for me. First, locate at least part of the project in a real-world context. I heard no convincing examples of purely theoretical design research. Second, design research should involve the innovative re-combination of actors among the worlds of science, government, business, and education. Third, if the results (and value) of design research are to be shared effectively, communication and dissemination methods need to be designed (and budgeted) in at the start. Stores of knowledge, put together by academic researchers, may be less useful in this context (remembering the recent failures of knowledge management) than *flows* of knowledge.

In the end, it is not a matter of either-or - academic vs. worldly research - but of both-and. This both-and conclusion raises tricky issues. *Systematic collaboration between academics and practitioners implies institutional and attitudinal transformation.* Does this transformation process need to be designed? This would be a worthy subject for a follow-up meeting.

John Thackara, May 2006

List of participants

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Eric van Zee

ten Kroode & van Zee

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BLUE

Acceptance & support

Location: Drawing studio

Facilitator: sander Mulder

Erik Geelhoed

HP Labs

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Pim Jonkman

Scope

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Sacha Silvester

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Arie Graafland

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Paul Gardien

Philips Research

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RED

Preserving the insight

Location: ID-studiolab

Facilitator: Remko van der Lugt

Jim Hennessey

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Henri Achten

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Petra Badke

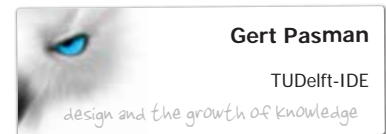
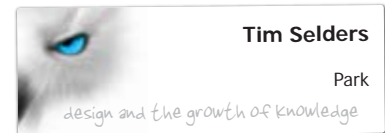
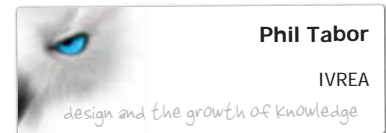
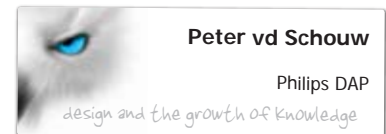
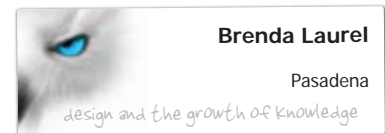
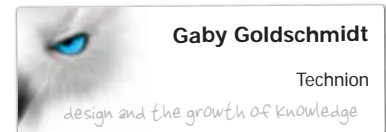
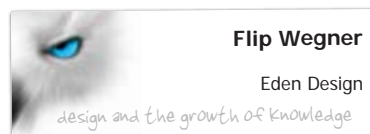
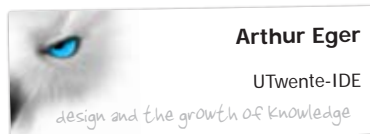
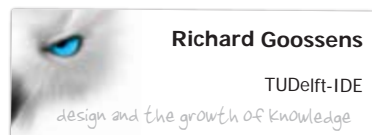
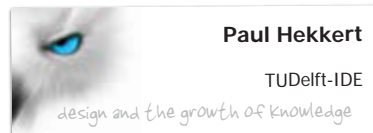
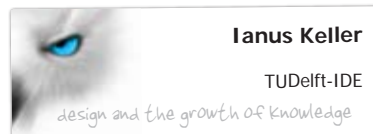
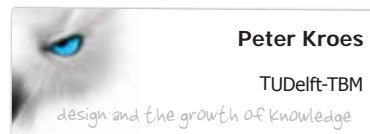
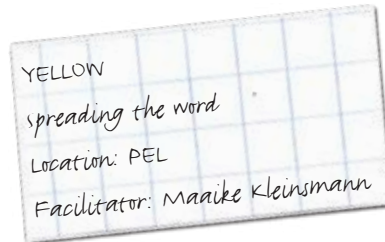
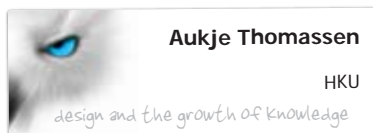
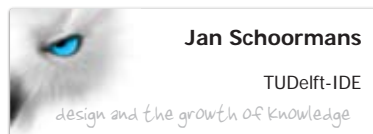
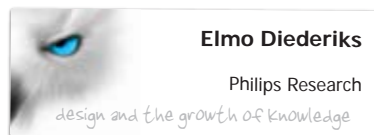
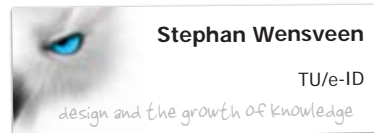
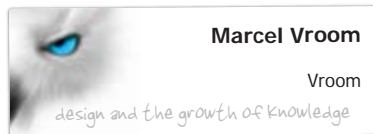
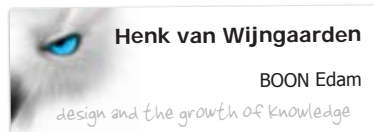
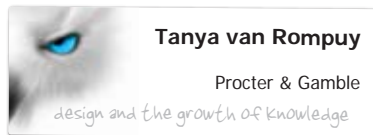
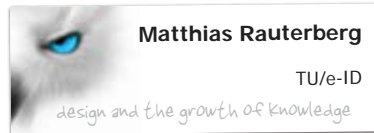
TU Delft-IDE

design and the growth of Knowledge

Gillian Crampton Smith

IVREA

design and the growth of Knowledge



What do we mean
by 'knowledge'?

Over the past decade, doing research has emerged as an important aspect of innovative, user-centred design. However, the reverse is often overlooked - namely, that designing is an important part of research.

Design generates knowledge which can be used beyond the product that was designed. Design generates knowledge that is difficult to achieve by other means, especially in interdisciplinary areas. www.id-studiolab.nl

