SITUATING SITUATION-BASED DESIGN - THE INTEGRATION OF PROTOTYPING TO CHANGE THE SCOPE OF DESIGN COMPETENCE

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ABSTRACT
The professional field where industrial designers operate is evolving from a product design tradition into a wider range of relevant areas. Some more recent arrivals - interaction design and service design - offer new dimensions to an already complex discipline. The borders between these different areas are floating and they become woven together where products appear as a mix of new services based on new interaction elements embedded in physical objects. This article discusses how industrial design students can adapt to developments in the industrial design domain based on shaping an integrative prototyping environment. This implies helping students acquire more integrated prototyping techniques to meet the demands of increased complexity. The paper argues that students introduced to new prototyping methods are more able to choose between different sets and combinations of tools and arrive at improved means for communicating their ideas of complex high-tech products. Based on experiments in an industrial design master course, with a focus on prototyping techniques, we have studied how different kinds of prototyping influence the students' design approaches. Through a set of shorter introduction courses the students developed new skills in prototyping that seemingly changed their scope. They developed and broadened their way of reflecting upon design strategies by adding a set of less traditional techniques for prototyping to their conventional design competencies.

Keywords: Prototyping, design competence, design education, design thinking

1 INTRODUCTION

Design as a professional discipline has evolved immensely during the last few decades. On one hand the scope for each individual designer seems to increase when s/he is expected to deal with ever more complex products, services and systems. On the other hand, the number of sub disciplines or specializations within design seems to grow by the day. The whole notion is becoming more diversified as more and more traditions start to subscribe on the concept of design. Some of the more important and interrelated drivers of these trends seem to be:

- The digital turn has made the product to be designed more diverse, compounded and complex, often including a bundle of physical items, services and even more elusive, but still palpable features to be experienced. The implementation of visions, like e.g. Mark Weiser's ubiquitous computing [1], has during the last decade escalated the complexity of design.
- Increased complexity has forced the organization of product development to move from a linear chain of functions working quite independently in a certain sequence, to a more interdisciplinary and team-based "Integrated Product Development" [2].
- The ever-evolving, technology-intensive nature of the twenty-first century work-place has caused an acceleration in the division of labour, whereby work practices are becoming highly specialised and learning and the communication of knowledge is in an constant state of flux [3].

For traditional industrial design education this represents a challenge where several issues have to be carefully addressed:

- How can the schools develop a curriculum that facilitate this complexity and utilize it for creating breakthrough solutions [4].
- How can the schools develop a curriculum that supports the use of new and more appropriate tools in a structured way [5].
- How can the schools develop a curriculum that develops the students to efficient members of

interdisciplinary teams [6].

This paper therefore discusses how increasing complexity in design – materials, products, services, processes, content - might be met in industrial design education. The case presented is based upon a master course in industrial design entitled ***Design in high-tech research environments - protoHype***, based at Institute of Design at The Oslo School of Architecture and Design, AHO. The product briefs in the case are provided by partner companies from the research project ***D·side***. The D·side research project is funded by the Norwegian Research Council and investigates how design can support interdisciplinary environments and enable innovation in medical-technical industry.

2 PERSPECTIVES ON DESIGN APPROACH

The industrial designer seems to be involved in shaping increasingly more complex products. For the design educator this means that there is a need to devise an approach that provides students with examples of new types of prototyping techniques that may not only develop new approaches to structuring of design strategies but also help them to tackle given and emerging design problems based on this emerging complexity. One relevant topology of concepts comes from Erich Jantsch's hierarchy of strategies: Know How (i), Know What (ii) and Know Where-to (iii) [7]. In this case the levels refers to the designer's ability to *know how* things are usually done, to *know what* to do or design e.g. by interacting with users and other stakeholders and finally to *know where-to* go on a more strategic level. A starting point for this discussion can be drawn from a similar model that encompasses three different approaches to thinking in design. Bryan Lawson and Kees Dorst describe three different ways of thinking about design competence [8].

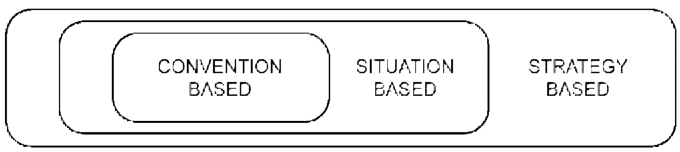

Figure 1. Types of thinking in design

The first level, *convention-based design thinking,* describes a rule-based design approach where the designer uses conventional tools or strategies to solve a design assignment. One of the advantages with a rule-based approach is that it can help the designer tackle very complex problems using set tools in combination with experience and logic. These tools can be seen as instrumental recipes, e.g. guidelines for decomposing a product or routines for user-tests. This rule-based behaviour can be seen to be a rigid way of working within a field, based on conventions, customs and habits.

The second level, ***situation-based design thinking***, reflects upon design situations where the designer analyses and responds to the design task appropriately. At this level the designer is able to see emerging opportunities within a complex setting and is able to exercise considerable mental flexibility in response to this setting. This is where the 'rules of the game' become much less mechanical and act more as guides. Here, the designer needs to combine his or her trained skills with an element of improvisation or intuition so as to make an appropriate design proposal.

The third level, *strategy-based design thinking*, describes design thinking where the response is planned and is based on a certain degree of strategy. This approach may build on common knowledge of the dynamics of the design process but it can also represent a personal strategy or style of working.

These three levels provide a useful frame for locating competencies in formal design education at tertiary level. The situation-based model is selected for its fit with the prototyping central in the protoHype course. Prototyping has proved to be an ideal tool for experimentation [9] and a supplement to sketches. In addition physical prototypes can envision complex systems helping teams to explore for example potential service applications [10]. In the next section the situation-based model is applied to the protoHype course. Thereafter follows the development of the students' ways of working subsequent to being introduced to various tools for prototyping.

3 CASE - THE PROTOHYPE COURSE

Our intention in introducing the course *protoHype* was to focus on new ways of developing and communicating design. This was geared to help the students to meet the evolving challenges in handling the design profession. The course was structured in two main parts where the first part consisted of three short sections of two weeks each. Students from industrial design and product design engineering were enrolled and they worked in groups of two to four persons. In the short sections the student groups were set up randomly. In part 2 the students chose their project and collaborative partner from a pool of cases from the D·side project network. Our aim was to provide a broader set of tools and strategies for designing. This structure was implemented to provide a certain level of common knowledge in different kinds of prototyping. The short sections were divided into: physical-, interactive- and virtual prototyping, the latter typically being scenario building and video sketching.

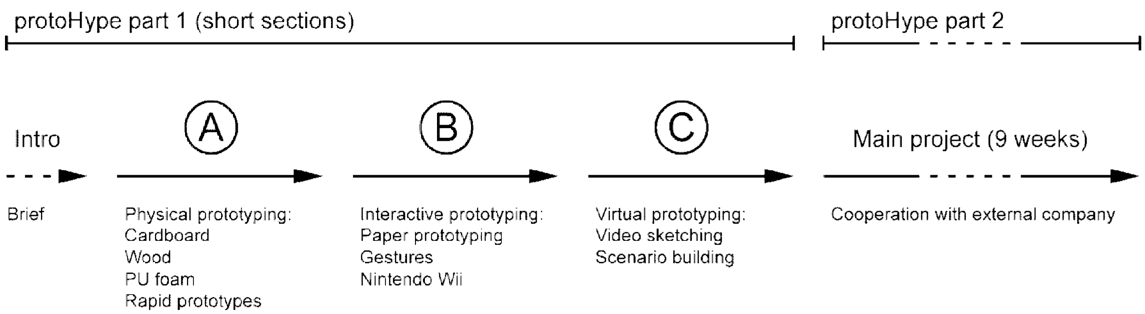

Figure 2. Structure of the Industrial design Master course protoHype

In part 1 a company from the D·side project network was invited to present a design brief related to one of their ongoing product development projects. This company uses a new type of CMOS computer chip for more accurate and effective processing of radio signals, functioning as a radar. With this new chip the company can develop smaller radars and, for example, can measure small hand gestures in front of a screen. To provide an understanding of the technology and attract attention the company wanted design proposals for a product for exhibitions and meetings with potential clients. The brief presented was to produce a docking station for an iPad with embedded radar technology where the user can operate the screen without touching it in an area of approximately two feet in front of the screen. The brief included a short description of the task, technical specifications of the given components available today and an isometric drawing of the intended placement of these components.

3.1 The short sections

The student assignment was to answer the brief based on input from the three short sections. Section A was about *physical prototyping*. The students were assigned to produce hand drawn sketches and physical mock-ups in e.g. cardboard, wood, polyurethane foam and even rapid prototyping. This approach was clearly oriented towards the physical docking station, to develop an impression of the size and elements of the product. Section B was an introduction to *interactive prototyping* that consisted of paper-prototyping of display functions, digital prototyping and testing of hand gestures in computer game consoles like the Nintendo Wii. In section C the students received an introduction to *virtual prototyping*, to video sketching and scenario building as tools for communicating ideas. The students were introduced to quite simple ways of illustrating the use of different products and technologies, e.g. filming projections or gestures illustrating how the technology can be used.

3.2 Collaboration with technology companies

In the second main part of the protoHype course, students were asked to choose between several projects presented by technology companies from the D·side research network. The students were asked to establish meetings with the companies to develop a situation based plan for the design project and finally present a design concept supporting the companies ongoing product development. The students were encouraged to use the different prototyping techniques in concert based on the design situations they would meet. The students were still free to use their tools of choice for this assignment.

4 DISCUSSION - PROTOTYPING BASED ON SITUATION

The initial brief was an example of a detailed prescription where the physical size of essential technical components is set and is not easily changeable. With the new chip the company can provide a technology so small that computer chip and antennas in the future could be placed almost invisible around an iPad for controlling the screen without touching it. Today, the chip itself is small enough to do this, but the antennas are still too large for this purpose, but they are constantly decreasing. The pictures show an illustration from the initial brief where the company had described an intentional structure of the today available components and one of the design proposals from short section A:

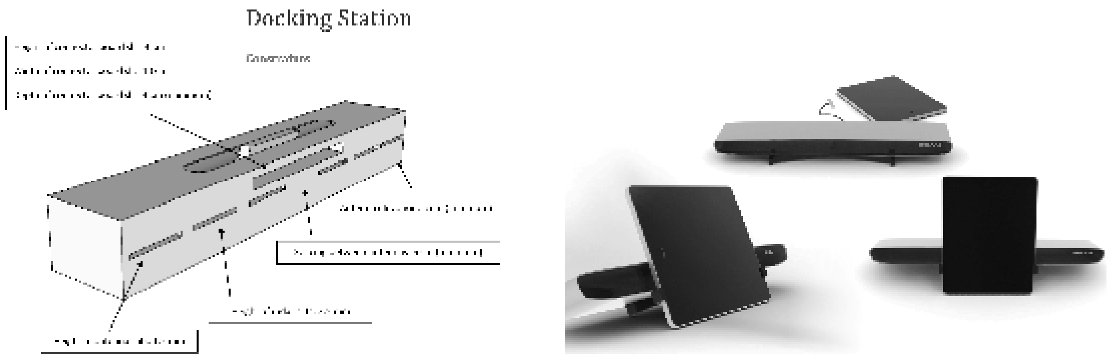

Figure 3. Illustration from the brief (left) and one example from the design proposals (right)

We observed that the students mainly executed convention based design thinking when they focused on working with formal aspects, such as structure, technical constraints and aesthetic expressions. In the first assignment the students presented a wide variety of proposals. Still the design solutions were highly influenced by the constraints of the technology. There was a large mismatch in the brief between the future size of the product and the size of the technical components available today. The students seemed to be very concerned about the physical limitations set by the company in order to provide the technology to work properly.

4.1 A change of scope

With the short sections B and C we introduced the students to a change of scope. It stretched from what happens on the screen of the iPad, to what type of gestures can control the display content, to different kinds of alternative applications. The students worked on the same brief but started out from different angles. This gave them support in broadening their starting point for the design discussion.

Figure 4. Screenshots from video illustrating the use of an iPad note displayer shoving the docking station on the piano (left) and the gesture for turning pages

The images above are screenshots from a video demonstrating a digital note displayer controlled with gestures. We observed how the students developed new creative solutions based on the introduction of alternative tools for prototyping. Overall, we wanted to challenge the students to establish a broader specter of tools for solving complex design tasks. We tested a structure that gave the students several distinct tools for designing new products. We argue that this structure can help the students to explore the design task and move outside more technology driven aspects. Based on our observations, they seemed to perform situation-based thinking in their creative process by being able to choose between other means for designing. Our approach was not to pre-set strict formats for the design work or to find the one right answer for an ultimate design process. Our goal was to improve the students' ability to identify and communicate their roles and to execute the different aspects of the design process.

4.2 Increasing complexity

Today, designers meet increasingly complex problems and products. The designer is engaged to design services based on new ways of interacting based on new kind of technology in physical products. As a result, the designer needs to both have a wider range of skills than before and the ability to choose the appropriate design strategy. We gave the students an introduction to two new methods in the short sections. In the main project we saw that the students was less convention based exploring and investigating the design task. We observed that the students were oriented towards situation-based design thinking and were able to postpone the use of established routines using the introduced techniques. We argue that this can help the students to develop their ability to more freely wave between a holistic overview and instrumental routines. It can enable them to identify the situation they are in and choose the appropriate set of means for solving the design assignment. However, we still cannot see that the students used a strategy-based design approach. The reason may be that it takes more time and experience to fully develop and communicate a strategy based design approach.

4.3 New prototyping techniques changes the approach

We saw that the students made a shift in the way they approached a typical technology driven design task using other types of means in the design process. This can provide essential input for the students in the process of developing their way of thinking about design from a convention-based approach to more situation-based, and eventually a strategic way of thinking. This expansion implies the need for learning both new skills and tools and, perhaps, new ways of thinking about and through design in order to handle the new areas of concern. Extracting different skills and tools into such processes can provide a platform for the evolving designer and point out directions of interest for the future design education.

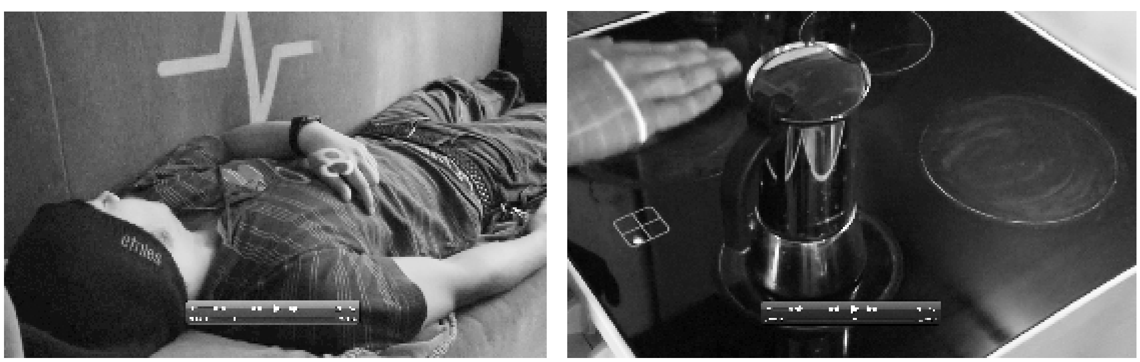

Figure 5. Screenshots illustrating how radar technology can synchronize the pulse with the alarm clock (left), and how you can raise the heat on your stove by raising the hand (right)

Based on methods from virtual prototyping one of the student groups presented a video. With simple tools they told a story on how a typical morning takes place with the radar technology embedded in products at home. As an example they projected an image on a bed wall showing your heartbeat when sleeping. The heartbeat was connected to the alarm clock adjusting your wake up alarm to your sleeping pattern. Another example from the video was a projection of bars rising on a boiling pot when the heat on the plate was adjusted. With this video the group presented ideas on how radar technology can be used less influenced by the physical constraints of the contemporary physical components.

From an educational perspective, one challenge expanding the field of industrial design is to cover an expanding curriculum within the same amount of time. One initiative may be to offer shorter specialized courses learning instrumental tools combined with more focus on education in design strategy. This can move the students' scope from *how* to perform towards *why* they perform. We observed that they in the main project tested out several types of strategies to explore the design task with less focus on the physical constraints and more on the user-experience of the product. The students seemed to be more focused on the overall scope of their design task.

5 CONCLUSION

This paper has addressed how the increasing complexity in design - materials, content, products, services, processes - might be met in industrial design education. When professional tasks radically change both their content and degree of complexity, one needs to reconsider *conventional* methods and tools and to try to adapt them to the new *situation*. In this case, we may ask what is the best *strategy*? What to keep, what to abandon, what to modify and what do add? In addition, do we need to specialize or do we need to become even broader in our approach? Our take in this particular course was to both concentrate *and* expand. This refers to that we decided to concentrate on one of the cores of design (i.e. making it possible to experience the not yet existing) combined with an expansion in scope by complementing traditional physical prototypes with more interactive and virtual prototypes. This implies a direction towards a diversity of specialized knowledge instead of broadening each individual's competence. We argue that by such a move we can equip the student with more relevant tools for interdisciplinary team-work than conventional training usually achieves. The outcome seems to indicate that this might be an approach to develop further and, arguably, by exploring possible *combinations* of different prototyping techniques we already have started to develop an Integrative Prototyping Environment (IPE). This is a strategic attempt to challenge established conventions in design education by testing complementary tools for prototyping for new emerging situations.

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