DESIGN FOR INTERACTION: CONSOLIDATING THE USER-CENTERED DESIGN FOCUS IN INDUSTRIAL DESIGN ENGINEERING

Pieter Jan Stappers,[1] **Paul Hekkert**[1] **and David Keyson**[1]
[1]ID-StudioLab, Faculty of Industrial Design Engineering, Delft University of Technology

ABSTRACT
In 2002, the Faculty of Industrial Design Engineering at Delft University of Technology started a new master programme, focusing on user-product interaction as a basis for designing new products and services. This new programme stems from a range of student graduation projects, and collaborative research with industry, in which insights and methods from the behavioural sciences in combination with new technologies led to new concepts for products and services. In this four semester master programme, called 'design for interaction' (DfI), the school consolidated its experience in a curriculum of theory courses and design and research projects that systematically provided the skills and knowledge for designers to operate in this research-intensive area of modern product design. Designers from the Master program Design for Interaction help clients to design innovative and appropriate products and services by placing the key aspects of human-product interaction, i.e., use, understanding and experience, in the centre of the design process. The Master in DfI is specialised in analysing and conceptualising of and in designing for human-product interactions in relation to the physical, cultural, technological, and societal contexts in which the product is used. In this paper we describe the philosophy and goals of this programme, its structure, and illustrate the core essence of user-product design with some recent graduation projects. We conclude by reflecting on the lessons we learned, not only the successes, but also the problems and challenges ahead we have encountered.

Keywords: user-centred design, curriculum development, education, interaction design

1 INTRODUCTION

Over the past three decades, there has been a remarkable development of increasing attention in design for user-centred aspects: understanding the user has been recognized as a priority in generating better design solutions. This development has been vocal and visible especially in the area of 'interaction design', defined as "shaping our everyday life through digital artifacts – for work, play, and for entertainment" (Crampton-Smith, in Moggridge, 2007). But also outside the area of digital products, deeper levels of understanding users and the context of use has become essential for the design of products and services that serve those users.

The focus on human-product interaction requires scientific ingredients (especially cognitive, behavioural, cultural sciences), and engineering ingredients (e.g., artificial intelligence, and understanding of new materials). In 2002, the school of Industrial Design Engineering (*IDE*) added a new master programme to its curriculum: design for

(human-product) interaction (*DfI)*. This programme was set up in close connection to the large human-centred research programme of the school, and consolidated an existing stream of specialized graduation projects which had emerged over the preceding decade. In this paper we describe this master programme, its vision and structure, position in the school, and illustrate it with some sample graduation projects, showing how a single programme can harbour high-quality projects on a spectrum from experience-driven design research to scientifically informed practical design.
We conclude by discussing some of the lessons we learned in running this program over the past four years, as an independent Masters of Science in *Design for Interaction*.

2 WHAT

Industrial design engineering (IDE) is a design discipline which integrates the elements of people ('users', 'consumers'), business, and technology, as depicted in Figure 1. The Delft IDE programme, was founded in the 1960s with this integrative character as its basis. The focus on user-product interaction ('interaction' for short) includes elements from the behavioural sciences (especially for needs analysis and exploration, for formulating the 'problem space'), from engineering technology (especially for informing the 'solution space'), and design skills (for connecting these two into new solutions that match the needs of users). Business perspectives are not absent from this approach, but do not have the emphasis.
There are two other MSc programmes in the faculty of Industrial Design Engineering, viz., the undifferentiated Integrated Product Design (IPD), and the business-oriented Strategic Product Design. The three programmes have shared elements, (as noted in section 3 below), but carry a different emphasis, and appeal to different students' interests. The emphasis in the DfI programme is mainly on exploration of needs and opportunities, concept generation and concept testing with users.
Designing for interaction requires a wider set of tools than hitherto taught. In our approach, the notions of user experience and of contextualisation are key elements of the research and conceptualization methods taught. Techniques adapted from ethnography, psychology, and sociology, along with theories from these fields are part of the curriculum, next to human factors research methods and observational research.

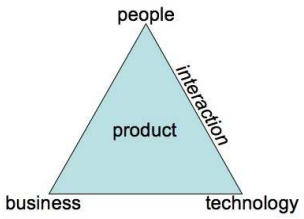

Figure 1 Main Ingredients of Industrial Design Engineering

When the school installed these elements into the programme, this was not done as a discrete jump. Many of the ingredients had been explored in the preceding decade, in the form of graduation projects, elective courses, and in connection with the substantial user-centred research programme in the faculty (of approximately 40 people). This experience allowed us to bring in the ingredients in forms which had already been adapted to the needs of design students, rather than importing modules from, e.g., psychology departments of other universities. Experience had taught that, in order for

such modules to serve the needs of designers, their content needed adaptation to the background and application needs of this audience, rather than the theory-driven needs of most disciplinary students.

Moreover, the programme required not just an infusion of knowledge about 'how people understand, use, and experience products' (our definition of 'interaction') and skills in techniques to gather these insights, but also knowledge and skills on how this is matched to opportunities offered by technology, such as sensor, software, networking, and artificial intelligence, but also new materials. These skills involve the ability to create working prototypes with which user experiences of products can be conceptualized and evaluated. And to iterate this process in cycles of increased sophistication. Key to this approach is the use of rapid prototyping tools, combined with flexible technology modular systems.

The above ingredients, summarized in Table 1, indicate the emphasis of the Design for Interaction programme. It also shows how the programme is a specialization of industrial design engineering, not a departure from it. IDE already had a focus on integrating many expertises, communicating with different stakeholders, and developing concepts on the basis of various requirements). In the DfI programme, the emphasis on the people-side (as compared to business and technology) is built on the foundation of an already balanced and integrated Bachelor programme covering the whole triangle of Figure 1.

Table 1 Achievement levels (adapted from [1], p17)

A Design for Interaction graduate can…
• gather, integrate, and communicate specialist knowledge from humanities and behavioural sciences, and translate this knowledge into design parameters; • analyse product use and its different contexts and communicate the findings effectively • conceptualize the above into concepts for new products • gather and integrate knowledge on new technologies into design opportunities • develop prototypes of experiential quality and test these with users • set up and conduct a research project • answer research questions by designing a product or prototype • contribute effectively to a product development team.

The Design for Interaction study reflects the notion that interaction design has shifted: from use to presence, from task-oriented to experience driven, from object-focused to contextualized. Because we view at designing as 'designing (for) interaction' - instead of products - technologies that enable such interactions (sensors, aware systems, etc) are of special interest. But we are NOT technology driven. These technologies are means to achieve our interaction-ends, just like materials can be such means, or services, or multimedia applications, or form, or... In that sense, we clearly differ limited conceptions of interaction design. We interact with our coffee cup and our dictionary, with our car, guitar, and our mobile phone! Students are taught to first consider and build an understanding of the current and desired user experience, in terms of psycho-social, technological, and cultural factors, before considering any early product ideas.

3 STRUCTURE OF THE PROGRAMME

The learning goals summarized in Table 1 are implemented in a four semester programme. The goals of the first year are to build a foundation via lectures on theory, practical exercises in methods and techniques, and projects applying these elements in design and research; the second year consists largely of design projects.

Table 2 Semester course structure ([1]); names in italics are shared with other Masters

	Design Project (ECTS)	**Theory Courses (ECTS)**
1	Exploring Interactions (9) **Emphasis on exploration and concept generation, and developing a personal design style.**	Product Understanding Use, and Experience (6) Context and Conceptualisation (6) *Electives (6)* *Design Theory and Methodology (3)*
2	Usability Testing and Redesign (9) **Emphasis on concept evaluation, research skills, and integrating technology.**	Interactive Technology Design (6) Observational Research (3) Visual Communication Design (3) *Electives (6)* *Applied Research Methods (3)*
3	*Integral Design Project (12)* **Emphasis on working in a multidisciplinary design team.**	Reflection on Designing (3) *Preparation for Graduation (6)* *Electives (6)* *Internationalisation (3)*
4	Graduation project (30) **Emphasis on independently carrying out a complete design project.**	

4 SAMPLES OF GRADUATION PROJECTS

In developing the DfI programme, our experience in research-linked design graduation projects proved the most reliable guide in setting the direction; more than abstract theoretical considerations. These projects, in which a thorough analysis of user needs is coupled to innovative solutions, best communicate the essential value of the DfI approach. Figure 2 shows two (out of eight) projects which we used in defining and communicating the essence of the programme. Figure 3 shows two more projects, this time by students who had taken the programme. In each of these projects, a thorough study of a user context and a strong vision on how that can be improved, guided the design.

5 LESSONS LEARNED

Introducing the human-centred focus of DfI was not the only thing that happened in 2002. Also, TU Delft changed all its MSc programmes from Dutch to English, encouraging an influx of students with a BSc education lacking certain elements offered in the 40 year old Delft programme, that had always been taken for granted. Some students lacked technical, or insufficient independence. But also other students had a more mature design attitude than the rather rational-design based BSc programme. The variety of student backgrounds, as compared to the BSc in IDE offered in Delft, including, computer science, interior design, communication design, and even cognitive psychology) has led to a broadening of approaches and constructive discussions

between students. Working in English has proved an advantage: recent theories and new terms have found there way rapidly into the course material and into design practice.
In retrospect, we were fortunate that the programme could be built on our previous experience with graduation projects. Having to adapt the required inputs from non-design disciplinary programmes would have increased the integration problems immensely. Moreover, the mature user-centred research programme of the school, and its visible manifestation in ID-StudioLab ([4]), provided an experienced basis of expertise, as well as a testing ground for exercises and research-related design projects.

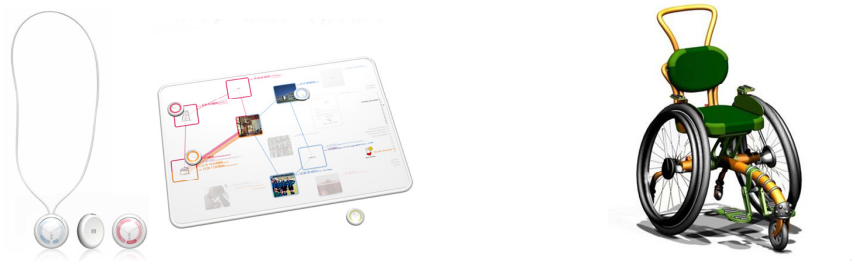

Figure 2 Two DfI graduation projects 'avant le lettre'. Left: Stephan Hoefnagels studied the busy lives of families with two working parents and designed a digital week planner (company: HP Labs; [5]). Right: Eva Dijkhuis designed a wheelchair for children, based on a vision on their social needs: whereas contemporary designs stress the children as being 'fragile' and needing to be placed apart, her design elicits a more assertive, even aggressive part, encouraging the child to take part in activities ([2]).

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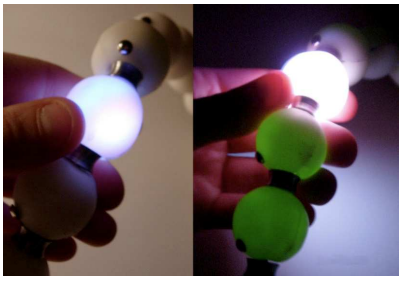

Figure 3 Two DfI graduation projects. Helma van Rijn worked intensively with parents and experts to design 'linkx', a language-learning toy for autistic children. Her design was based on a thorough exploration of the needs and abilities of children and parents (company: LinguaBytes; see http://studiolab.io.tudelft.nl/vanrijn/LINKX). Eva-Nina Kuenze designed a chain of beads to lure people who are a little stressed into relaxing interaction. When you play with the beads, the chain registers your arousal state and gives bio-feedback through a soft lighting up of the beads. The result is a soothing and enchanting form of soft prevention. (Company: Philips)

A major learning point for students in the programme was relieving them from an engineering fixation on products as 'mere carriers of technical function' to conceiving products as 'enablers of valuable experiences'. This requires not just instilling knowledge of human needs, but actually conceiving product concepts at the level of human needs, as founded in the ViP approach ([3]). Such a shift in level supports

radical innovation, leading to humanistic designs such as those in Figures 2 and 3. Although designers need to avoid a fixation on technology, replacing this by an exclusive view on the user doesn't solve it. Successful design always relies on a thorough understanding of both.

Maybe the biggest mistake that was made in forming the people-centred master programme was its name: 'Design for Interaction'. We had underestimated the current connotations of the terms 'Interaction Design' and 'Interface Design', which for many people (and in many textbooks) is synonymous with an exclusive focus on a product type or a specific technology (digital systems, websites, interfaces or displays). But we see no reason for this product domain focus. The user-centred focus is just as important for non-digital products such as chairs, cars, hospital interiors, and retail services. And, in reverse, the use of digital components is becoming so ubiquitous (e.g. RFIDs projected to replace barcodes), that the adjective 'digital' is no longer indicative of a product category, as it had been in the 80s and 90s. In retrospect, another name would better describe the programme (but reasons of administrative nature make it very difficult to change the name of a programme).

6 CONCLUSION

After four years of teaching Design for Interaction, the programme has stabilized sufficiently for us to feel confident in drawing the above conclusions. It has been a dynamic period, we had to adjust teaching methods as the number of students quickly rose from 30 to 60. This year, the school is recasting its BSc programme in IDE, partly on the lessons learned from the master programmes. It seems the user is here to stay.

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[1]Prof. dr. Pieter Jan STAPPERS
ID-StudioLab,
Faculty of Industrial Design Engineering
Landbergstraat 15, NL-2628CE, Delft
p.j.stappers@tudelft.nl
+31152785202