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ID in progress

Research through design



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Dean of the department of
Industrial Design

One of the fundamental starting points of a university program is the integration of education and research.



Preface

Industrial Design Research

The department of Industrial Design started in 2001 with an innovative competency based education concept, as was highlighted in the previous issues of ID in Progress.

During the first years all effort and creativity were concentrated on education; research was gradually built up from 2002 onward. Now that the education program is close to its final form, the staff can pay more attention to the development of the Industrial Design research. It is, therefore, the right time to highlight this essential part of the department, as one of the fundamental starting points of a university program is the integration of education and research.

People often wonder what research in an industrial design engineering context could be. The relation between design and research is not an obvious one. This issue of ID in Progress defines the department's research area by presenting its mission statement and explaining the integration of three paradigms. After reading about the specific approach of four of the capacity groups and their respective focal points you will understand the integration of research and design as we see it at Industrial Design TU/e.

First of all a general introduction about the new industrial Design discipline is presented. After that the four capacity groups are highlighted through interviews with their respective leaders. The infrastructure, depicting the coherence between the four groups is discussed. Finally associate professors, assistant professors and PhD's, illustrate their research activities and visions on research.

The stories of researchers and PhD students also demonstrate what research means in practice, how it is related to education and that the value of its outcome is oftentimes indispensable.

Prof.dr.ir. Jeu Schouten

Dean of the department of Industrial Design

Research through design



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A new discipline of Industrial Design

Research at the department of Industrial Design is based on the integration of three paradigms: engineering, (social) science and design. Each of them is equally important. The department aims to define a new Industrial Design content in a university environment with balanced relations to the professional and industrial field.

Within this newly defined ID discipline the following mission has been chosen: **Creating intelligent systems, products and related services**. This means a focus on a specific academic, industrial and commercial part of the very extensive field of Industrial Design, as this issue of ID in Progress illustrates.

Intelligent systems, products and related services

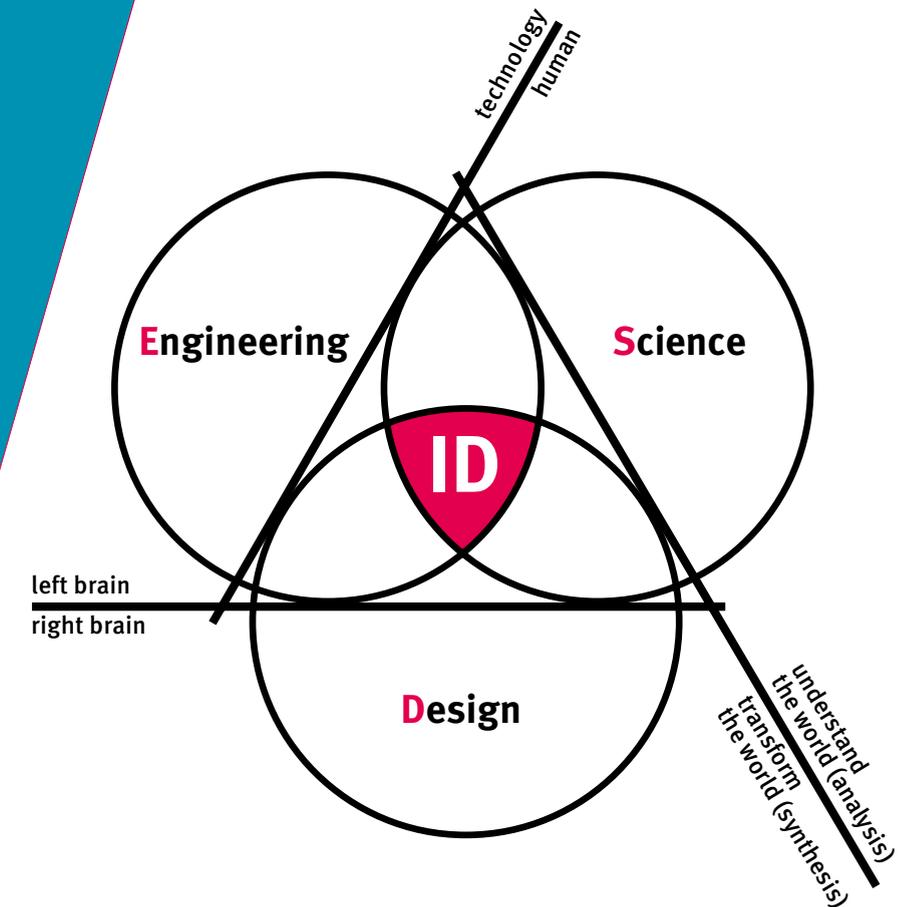
An intelligent system or product is characterized by adaptive behavior based on the situation, the context of use and the users' needs and desires. In particular, the focus is on problems and opportunities that benefit individuals, societies and different cultures worldwide.

With the term 'system' we primarily mean an adaptive environment in which humans can interact with intelligent products to get access to provided services. The intelligent products are connected to each other and to the surrounding system to achieve a new type of user experience.

To create such interactive and intelligent environments we provide expertise for the context of use, the conceptual design, the implementation, realization, and evaluation. Appropriate expertise for production processes is provided to realize all this in an industrial and commercial setting.

The main target of the design expertise of Industrial Design at the TU/e is the interaction between users and systems in a context of use. The design of these interactive patterns means creating a dynamic structure in four dimensions: the three building up space and time.

A new definition of the content of Industrial Design



Birth simulation research
(DI in collaboration with
Máxima Medisch Centrum)



The capacity group
Designed Intelligence
focuses on intelligent
products and services that
are characterized by three
main aspects: sensor-based
input, context awareness
and adaptive signal
processing, and actuator
controlled output.

Prof.dr. Matthias Rauterberg

Designed Intelligence

Focus of Designed Intelligence (DI)

'We feel that the subject of designed intelligence is of great importance for future products, systems and services. That is why we have made this our main field of research. We will focus on intelligent products and services that are characterized by three main aspects: sensor-based input, context awareness and adaptive signal processing, and actuator controlled output. We investigate the software and hardware architecture, and we provide the necessary technical expertise to build such systems. Most of our researchers have a strong background in computer science, electrical engineering and interaction design', Rauterberg explains.

Technology focused

'The Designed Intelligence research group is explicitly involved in the integration of technology. Every group defines the targets related to each competency area. Our group is responsible for the end targets of the competency area technology integration, meta-competency design research and meta competency analyzing complexity', Rauterberg clarifies.

Multidisciplinary approach

'Our research approach is a specific form of 'research through design', not 'design research' and not 'research for design'. In our opinion, industrial design research should be problem-oriented and design-oriented, based on respect for people and society in general. It should also be of scientifically sound. Our idea of problem orientation is based on a strong conviction that products and services should address society's problems through technology. Compared to more traditional disciplines such as mechanical engineering, electrical engineering and computer science, this means that we try to pay attention to peoples' actual needs. Our research is not focused on one specific technology. We favor a multidisciplinary approach'.

Main research questions

Rauterberg and his group define three main research questions. The first one is: how can we design useful and meaningful dynamic forms of artificial emotional intelligence? The second one is: how can we design useful and meaningful interactive forms of intelligent systems that provide pleasurable experiences and help generate and manage different intended user experiences? The third one is: how can we create new dynamic forms of interactive experiences that are more enjoyable than traditional user interfaces?

Rauterberg: 'These questions will all be tackled in various research projects. Objectively, the output consists of working prototypes demonstrating the concepts and guidelines, and papers in journals, conference proceedings and disciplinary journals. In addition, we are organizing several workshops, symposia and conferences'.

Professor Matthias Rauterberg

Head of the capacity group Designed Intelligence



‘Intelligent systems are part of an adaptive feedback system’, says professor Matthias Rauterberg, head of the Designed Intelligence research group, ‘They are connected to the user, who is characterized by his or her own adaptability as well. Together, these two adaptive systems result in high complexity, which is a real challenge to design’.

Actual projects

‘There are three research areas that we are involved with at the moment. First, we research ‘adaptive systems’, which implies bio feedback, for example EEG, smart sensors, smart material and learning algorithms. The Seat project, focusing on an intelligent airplane seat is an example of this. Second is ‘aware environments’, involving cultural computing, dynamic processes, sensing behavior and semantics is a second research area, of which Razvan Cristescu research (see page 32) concerning sensor networks is an example. Other important research in this field is conducted by Wei Chen and Ben Salem (‘Alice’). Finally, we work on ‘autonomous systems’, involving human-robot interaction, autonomous robots, mental modeling and embodied intelligence. Emilia Barakova (see page 24), Christoph Bartneck, Rene Ahn, Jun Hu and Frank Delbressine are involved in this subject matter, each from his or her own angle’, says Rauterberg.

The importance of mathematics

‘Traditionally, academic engineers use mathematics to design technology and to communicate and understand each other. Nowadays, most knowledge is coded into computerized tools. Calculations are done by the computer, but true understanding still requires mathematics. My colleague professor Loe Feijs and I propose to educate industrial design engineers who belong to the tradition and the community of academic engineers in the sense that they master significantly more mathematics than the VWO (highest Dutch secondary school) level. The meta-competency D, analyzing complexity, is mostly about mathematics. This meta-competency serves various purposes. Firstly, communication with engineers and researchers becomes possible. They make use of a vocabulary consisting of derivatives, phase angles, expectations, predicates, power sets, limits, determinants, gradients, vertexes, spectra and so on. Secondly, it helps enable the competency technology integration, for example making it possible to read books on electronics or neural networks. Thirdly, it helps enable the competency user focus and perspective, in particular statistics, making it possible to analyze the reliability of experiments with users’, Rauterberg argues.

The position of DI

Rauterberg: ‘Within DI there is room for everybody’s ambitions and research focus. Everyone has his or her own expertise and challenges. At DI you’ll find the majority of researchers at the intersection of the paradigms of engineering and science and engineering and design. But it’s not the intention that they stay there forever. You see researchers moving more towards the center of the intersection of engineering, science and design. The real progress of our department’s research lies in the ability to use all three paradigms and to realize the optimal intersection between the three’.

UCE research dealing with visual and haptic feedback for truck cockpits (in collaboration with the European Centre for Mobility Documentation). The car door becomes red if the truck changes lane while another vehicle passes.

The capacity group **User Centered Engineering** focuses both on analysis and synthesis related activities. Essential is the involvement of the end user and the multiple design iterations the researcher goes through together with the user.

Prof.dr.ir. Berry Eggen

User Centered Engineering

Research in a design engineering context is of an exceptional nature. 'In fact', says Berry Eggen, head of the UCE research group, 'some people may even misread the word 'research', as to them it only brings connotations of analysis and not of creation and synthesis.'

Research in the field of Industrial Design

Berry Eggen: 'Research carried out in the User Centered Engineering (UCE) group covers both analysis and synthesis related activities. Essential is the involvement of the end user and the multiple design iterations the researcher goes through together with the user. User centered design is both analysis and synthesis, a constant stream of ideas and evaluations. In this context research really means research by or through design and not 'about' design. By creating prototypes you enable new ways of analyzing.' One might think that research in such a context resembles the way an artist works. But in fact, the work of an UCE researcher is very much the opposite of what an arts oriented designer does. Eggen: 'A design artist expresses his unique thoughts without explicitly taking the wishes of the user into account. It's a statement about our culture, often a question mark. On the other hand, an industrial design engineer, especially within UCE, considers user involvement the key motto. Knowledge about the user and his context is modeled and forms a solid basis for the user-system interaction design. At UCE there is no design without user involvement. A user should become happy, less handicapped, more inspired, or energized by the design. Sometimes the user even becomes co-designer.'

Research related to education

'Research is mainly part of the Master', says Eggen. 'In the Master there is more room for research than in the Bachelor. In fact, researchers and students collaborate on projects and modules based on a shared interest concerning certain issues. In the Bachelor assignments like 'Human Processes', or 'User Testing' involve UCE type research. By doing these assignments Bachelor students get a basic feel for research, collecting data, analyzing, and reporting properly. But this is basic compared to what the Master student deals with when exploring persuasive technologies, for example. The term persuasive refers to the fact that technology can be applied to change behavior and motivation, often subtly or unconsciously. Other interesting and more advanced issues in the Master are speech-based and multi-modal interaction, which pose challenging analytical and design problems.' Eggen strongly believes in the model postulating the interaction between the different paradigms of science, engineering, and design, as presented elsewhere in this issue. 'In the case of UCE, more design inclined researchers could be a real asset to the research group', Eggen concludes.

Professor Berry Eggen

Head of the capacity group User Centered Engineering



‘Research in a design engineering context is of an exceptional nature. In fact’, says Berry Eggen, head of the UCE capacity group, ‘some people may even misread the word ‘research’, as to them it only brings connotations of analysis and not of creation and synthesis.’

Examples of typical UCE research

Eggen: ‘UCE conducts various research programs. One of them involves studying awareness systems. One problem, for example, is the frequent interruption staff faces when they are in their office. PhD student Aga Matysiak has developed interruption mediating devices in an office oriented context. How can you regulate interruptions without losing important new information? A complex problem, asking for a user-centered design solution. Another example is the so-called ‘interactive table’, with applications in the domains home, play, and work. Here, tangible objects interact with the table and are used to increase ‘fun’. This is a search for the killer application. Interaction objects are developed in collaboration with the end user. Assistant professor Elise van den Hoven and Master student Saskia Bakker have presented and published their design research findings at several international conferences.’ Eggen emphasizes again: ‘It’s not just research, the mere analysis of existing facts, it’s also inventing. It’s knowledge gathering and the creation of a new prototype, leading to further analysis and, ultimately, an improved prototype.’

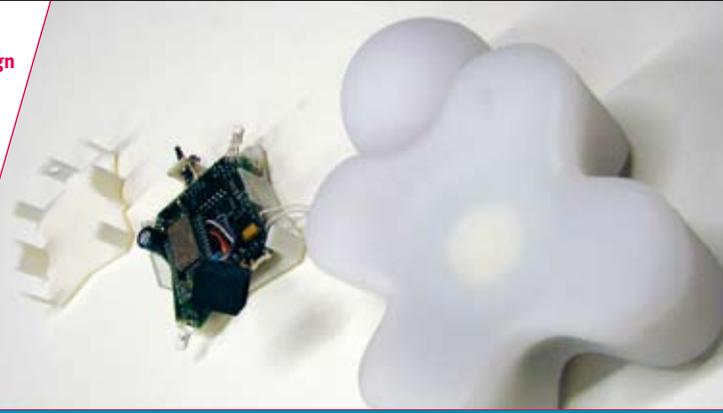
Playful systems

Another example of a typical UCE study is the research related to the design of playful, challenging systems for children as a tool for preventing obesity. Assistant professor Tilde Bekker and her colleagues and students are working on this. Eggen: ‘Game is a medium for behavioral change. The children are attracted by the game, while in the meantime losing weight, without having to bother about that in a negative way. This is a good example of persuasive technology.’

Challenging research concepts

UCE is based on the contributions of (social) psychology and engineering. One very interesting theory when exploring and designing for the field of communication is the so-called ‘Common Ground theory’. Eggen: ‘What you see is that in communication the question ‘What do the communicating individuals share with one another?’ is an essential one, very much stipulating the communication.’ Another appealing theory is the so-called ‘Distributed Cognition theory’. This theory helps to understand how individuals incorporate the use of tools and involve other people to process information and solve problems. An invaluable framework in studying the design of intelligent systems, products, and their related services.

'Scottie' is a tool for non verbal communication developed for Waag Society



The capacity group
Designing Quality in Interaction focuses primarily on richness and aesthetics in interaction.

Prof.dr. Kees Overbeeke

Designing Quality in Interaction

The research group Designing Quality in Interaction (DQI) was established in 2006 and focuses primarily on richness and aesthetics in interaction. DQI's head, Kees Overbeeke emphasizes that there is no strict boundary between the 'technological inside' and the 'designed outside'.

Why 'quality' of interaction?

Overbeeke: 'We thought for quite a while and finally chose this title because of the focus on aspects such as intuition and the quality aspects of the designing itself. It's about the actual, physical part of the design. DQI contributes to the overall 'design for interaction' concept.'

Reaching quality within the department

'Quality is also to be expected from staff and students', says Overbeeke. 'We should get rid of the tendency to be happy with the average. You cannot become an 'average' designer. Striving for excellence is necessary for students and staff.' Asked how the department can achieve this, Overbeeke adds: 'You should not force people or tell them to do this or that, but make them realize what their responsibilities are in the whole process. In order to achieve excellence, people need to be seduced and not forced. Therefore, it is right and necessary to put so much emphasis on reflection within ID. As a result of that students come up with different questions and different solutions. I hear it often.'

The nature of the TU/e Industrial Design course

Industrial Design is very much oriented towards the professional field. Overbeeke compares Industrial Design with the field of medicine. 'There is a connection with medicine that is much stronger than it may appear at first sight. In both cases the in situ application is essential. You cannot become a doctor by reading books only. The same goes for a designer. No book can teach you how to design. 'You need to think with your hands', develop 'designerly skills', and reflect on them. Because of this orientation towards the professional field, it is important that students go on internship in the Bachelor and the Master.'

About research

'A common mistake', Overbeeke remarks when asked about the nature of research in a design context, 'is that people think design research examines the way designers work. That is a kind of rigid analytical approach. ID research should not be about design, about finding new design methods. The focus should be on research through design, reflection on action.'

Asked whether Industrial Design can be considered a true academic field Overbeeke replies that ID is indeed academic. 'If you look at the complexity of the subject we are tackling and the fact that internationally we are seen as one of the most outstanding research schools in the world, on the brink of achieving a unique model, I have no doubt about the academic

Professor Kees Overbeeke

Head of the capacity group Designing Quality in Interaction



‘We do not educate designers; we educate designers of intelligent systems. We are the first department focusing on this subject in combination with a revolutionary educational model. When thinking of collaborations we must realize that we are ahead of companies in many respects’, Kees Overbeeke says.

status of our course. But it is important to note that an industrial design course is not aimed at educating researchers. Students should acquire research insight and research tools. Previous years showed an interest in the academic skills of Bachelor students. It was amazing to see some of them reaching a level that one can only hope for in the Master, producing articles and appearing on important international seminars. What you may observe now, is that the development of academic skills, writing articles for example, happens mostly in the Master. Unfortunately we cannot have professors and associate professors do all the teaching in both Bachelor and Master courses’.

Overbeeke strongly believes in cooperation between the capacity groups. ‘We need the other groups and should inspire each other mutually. Recently we all realized the importance of the mutual dependency and the value that comes with this interrelatedness. Now we have to work it out.’

Leading the way

Overbeeke continues: ‘We do not educate designers; we educate designers of intelligent systems. We are the first department focusing on this subject in combination with a revolutionary educational model. When thinking of collaborations we must realize that we are ahead of companies in many respects. I think that we can offer more to companies than vice versa. At times it is even difficult to explain what exactly it is that we are doing, because we are leading the way. This does not imply that we do not have fruitful relations with companies such as Microsoft, Nokia research, Sony interactive, and BMW. The same applies to internationalization. We are leading the way. If we manage to realize an industrial design paradigm in which engineering, science, and design are properly integrated, we have put a tremendous step forward in the field of design engineering.’



The capacity group
Business Process Design focuses on the way a product is created, realized, introduced into the market and on the services that come with it; with an eye on the market and the user.

Prof.dr.ir. Aarnout Brombacher

Business Process Design

Professor Aarnout Brombacher is heading the brand new capacity group Business Process Design. If you think this is primarily about earning money with new products you are wrong. The group focuses on the way a product is created, realized, introduced into the market and on the services that come with it; with an eye on the market and the user.

Electrical engineering and finding flaws

After Brombacher studied in Twente (UT) electrical engineering, he became project leader in the Philips video recorder design department in 1986. Since then he built a huge experience with regard to introduction, success and failure of consumer electronics. One typical experience leading to new insight is the question why video recorders from around the nineties started to fail and maintenance engineers couldn't find the problem ('no fault found phenomenon'). Brombacher and his team found that this is explained by the fact that the production of recorders became highly rationalized, logistics became the main organizing factor. Brombacher: This led to enormous involvement of third parties leading to flaws in the design no one could track anymore. By the beginning of the nineties, in the Netherlands the design became a matter of problem finding and working towards design release, meaning making the design ready for production. By then design, testing, manufacturing, distribution and services were distributed throughout the world, whereas before the nineties the production and distribution was located in Austria only.' Brombacher also saw the rise and fall of the DCC (digital cassette) and the CDi. Examples of technological advanced devices, mainly results of 'technology push', failing because the business aspect was not taken into account sufficiently' Brombacher says.

The chain of business aspects

Brombacher: 'Ambient intelligent products, the main focus of this department, require a well designed process, a well thought chain of business aspects. We need to know the user, we need to understand the process of designing. That's one of the reasons why it is of paramount importance to work together as research groups and work on the three paradigm model together.'

Asked about the definition of a chain of business aspects, Brombacher replies: 'The chain of business aspects has to do with e.g. the 'life style' that is associated with a product. Looking at the success of the iPod, you see it is in fact nothing more than a MP-3 player, but it comes with a look and feel that is associated with certain groups; the iPod buyer becomes member of the 'iPod family'. That aspect is vital in the chain of business aspects. A less technology oriented example is Becel. The aspect of health and prevention of elevated cholesterol levels as supported by doctors and insurances is part of the chain of business aspects. This leads to a successful position of this product in the market. It's not about the exact contents of what is

Professor Aarnout Brombacher

Head of the capacity group Business Process Design



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in the buttercup anymore. Neglecting only one chain in the business aspects chain can lead to disastrous results and failure of a product. In the highly advanced and complicated global market of today you daily see interesting products that fail, due to this aspect', Brombacher concludes.

What is 'Business Process Design'?

Brombacher 'Business is not about 'how to make profit?', but about how you can position a product into the market. Especially in the case of ambient intelligence products you need to focus on the user reaction that results from the use of the product, more precisely the services related to the product. The 'Tom Tom' is a success especially due to the services that come with the navigation tool.' Asked what risk we run with the development of intelligent services Brombacher says: 'If an intelligent product means we are giving up part of our thinking because a device is thinking instead of ourselves we should and must trust and rely on that device. And, if it does something we do not expect, we are in trouble. E.g. there is a navigation tool that has a map only valid for just one year. Imagine you lose your way, because of that, while you are on the road, you feel really treated badly. The importance of the chain of business aspects can help designing better products, systems and services.'

A joint research infrastructure

The integration of the research of the four capacity groups results in the Industrial Design content according to the new defined discipline.

To facilitate and activate the process of integration, the department's research infrastructure is united in the '/d.search-labs' (design/research), which are used by all capacity groups in joint projects integrating different fields of knowledge in ID's 'research through design' approach.

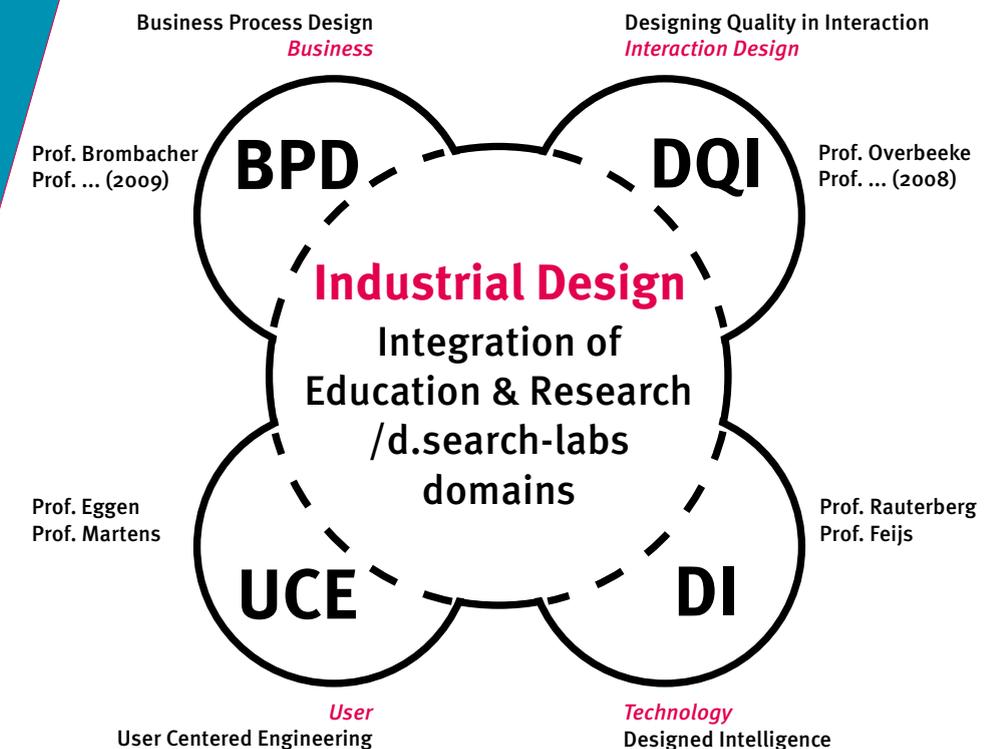
The /d.search-labs aim to use the power of design to strengthen the integration of the 'knowledge triangle', education, research and innovation, in the context of the multi-disciplinary field of industrial design.

The /d.search-labs is the practice-equivalent design space where staff and students work together on projects covering the entire product creation process from idea creation up to building and testing of prototypes as well as user testing.

There are brainstorm facilities, extensive computer infrastructures for design and analyses, mechanical and electronic building facilities for prototypes, rapid prototyping, testing equipment and video meeting facilities for project group meeting with overseas partner groups

The /d.search-labs pool existing resources and talented people to become a center of excellence with a world-renowned design identity and excellent facilities that provide an attractive context for students, researchers, academic and industrial designers, and industry.

Operational structure of the Industrial Design Department



Intelligent Systems

Dr. Emilia Barakova, MSc

Assistant professor in
Designed Intelligence

Emilia Barakova was born in Bulgaria and has extensive experience with intelligent systems and artificial intelligence. She conducts research in the Designed Intelligence capacity group. Robotics is her main interest. 'I want to become a top researcher, I strive only for the very best', Emilia Barakova says.

Trained in Japan

'I received a magnificent education and research experience during my four years at the prestigious RIKEN institute in Tokyo. This is an excellent research institute where researchers publish only in the top journals. I learned a lot about all aspects of the brain: chemical, physical, neurological and behavioral. I have a fundamental interest in how the brain functions. If you reach out your hand, the same brain parts are activated as when you imitate the behavior. Still there are fundamental differences between how the brain functions in such situations', Emilia Barakova explains.

Intelligence, a buzz word

'I'm interested in both the intelligence of robots and in how people react to robots. For me it is a challenge to design a robot that can move, think and plan like a human. Until recently computers were mainly good at tasks such as calculating. Now we can make a computer that beats Gary Kasparov at chess, but we cannot make a computer that can be part of a junior football team. Computers are not intelligent. They can only perform tasks that we program. Intelligence is not an easy concept at all. Intelligence is a buzz word, but no one has a good definition, there is no common ground about what it means. At the department we focus on intelligence, while at the same time still looking for a good definition of the term. To me intelligence has to do with creativity, learning and adapting. Intelligence is very much connected to social behavior', says Emilia.

Multi-agent systems, emergency principle

'Brains are simple in the sense that they make use of neurons capable of firing. The complexity comes from the combination of firing neurons and the enormous amount of neurons. This is the basis of a multi-agent system. The combination of a few simple principles can result in very complex behavior. The whole is more than the sum of its parts', Emilia summarizes.



Sociable toys

'I would like to make real social robots. With second-year students I'm working on a project to create sociable toys for autistic children. The design concerns building blocks that are able to change color and to communicate about their color with neighboring blocks. These neighboring blocks constitute the surroundings of a block. The blocks react to changes in the number and color of blocks within their surroundings, while being part of the surroundings of other blocks at the same time. In this way a dynamic system emerges. This system is being used to make the blocks behave in such a way that they display rudimentary social group behavior. The ambition is to teach autistic children a way of thinking that helps them function in a group', Emilia explains.

The importance of working together

Emilia: 'Adaptation, which is essential in intelligence, starts with being able to move. That's essentially why animals are more intelligent than plants. Like animals, humans learn a lot through imitation. Humans are more advanced than animals not because they have bigger brains, but because they are capable of truly cooperating with and learning from one another. The victory over the SARS disease, that was on the verge of becoming a global disaster a few years ago, proves this point. If scientists hadn't worked together on this on a worldwide scale, the disease would have turned into a worldwide epidemic.'

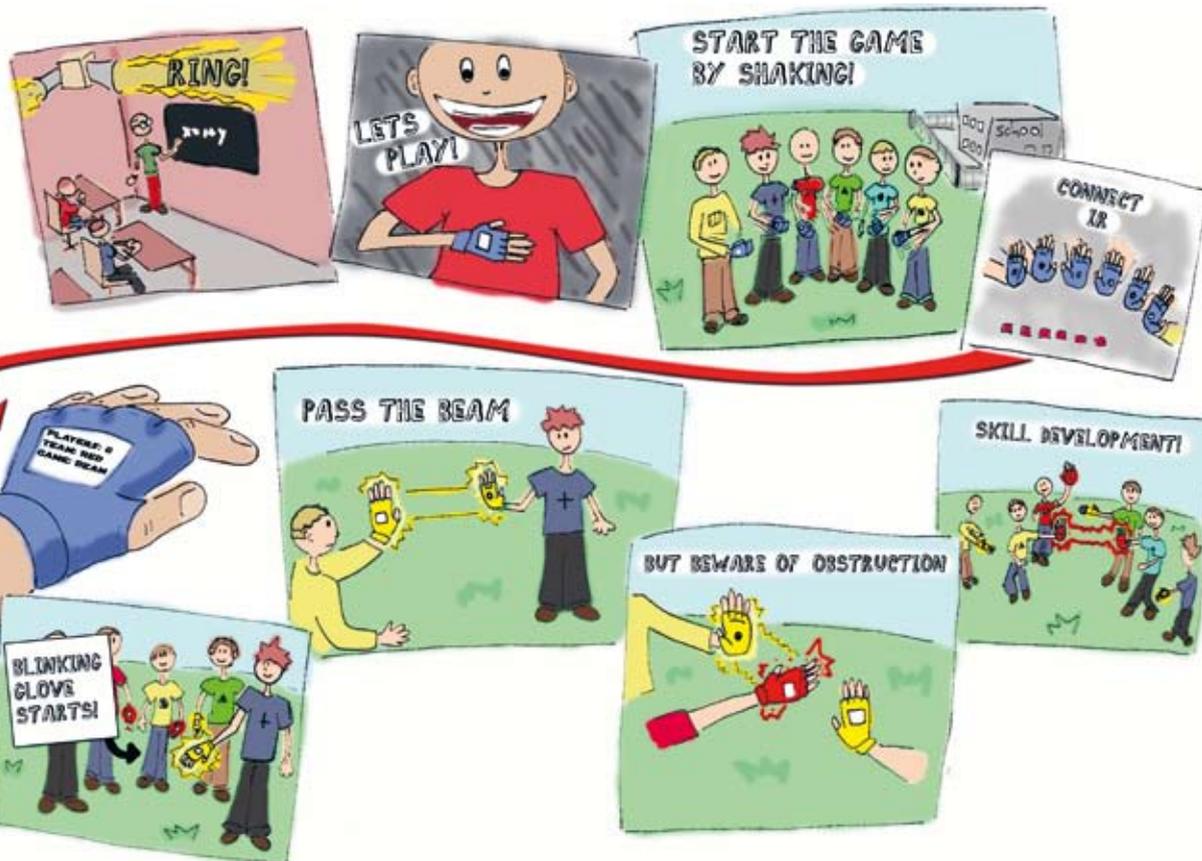
Emilia Barakova, MSc PhD, has been appointed as assistant professor on a tenure track of the TU/e's 'Women and Science' program. Tenure tracks are career paths for researchers.

User interfaces

Dr.ir. Tilde Bekker

Assistant professor in
User Centered Engineering

'I studied Industrial Design Engineering in Delft University of Technology. I was interested in ergonomic research, but at the end of the 80's you could not graduate on a research project, you needed to present a design. So I combined research on school furniture for disabled people with a redesign of a table for this target group.'



Assistant professor Tilde Bekker is a design scholar to the bone. Nearly all of her professional work is dedicated to research or research through design. She did a post doc in London on the subject of user input during the design process and she worked for several years at the IPO (Institute of Perception Research). 'Research has always fascinated me. My PhD was on the design of user interfaces, now a common subject, but fifteen years ago still undiscovered territory', Tilde Bekker says.

User studies with children

'Quality of design methods are rarely the object of scientific research. Which method is the best choice when designing? This is one of the focal points of my research', says Tilde. She was the co-supervisor of Wolmet Barendregt who did research on user tests with children. Tilde: 'One of the important findings is that children often cannot conduct a (computer) task and at the same time reflect on what they do and evaluate their interaction with a product (software).

In this study a set of cards with symbols, depicting reactions such as 'fun', 'boring', 'difficult' was designed to remedy this problem. Children using these cards were able to give more and more relevant feedback on the product they worked with, compared to children who reacted verbally. Furthermore, we found out that personality traits determined, to a large extent, the capability to reflect and give feedback. Extraverted, assertive children give more and better feedback.'

Whereas Barendregt involved six-year-olds in one of the final phases of the design process (evaluating a prototype), another PhD Tilde co-supervises, Wouter Sluis-Thiescheffer focuses on ten-year-olds during the orientation phase of the design. He relates the type of intelligence (e.g. spatial visual or verbal linguistic intelligence) to the number of ideas and criteria children can formulate. Children produce more ideas when they can make prototypes than when they participate in a verbal brainstorm session.

Motivate children to move

Tilde: 'We do a lot of second-year student projects of fourteen weeks, involving six students and a real client from outside the university. These projects relate to another of my research interests based on the idea that children can be persuaded to leave the computer and participate in challenging games that make them move. One of the essential things we can learn from popular computer games is that getting frequent feedback from games, in an attractive way, is a huge motivation to continue playing. Furthermore you need surprises and games should be adaptable to the user's wishes', Tilde observes.

Sensors and actuators

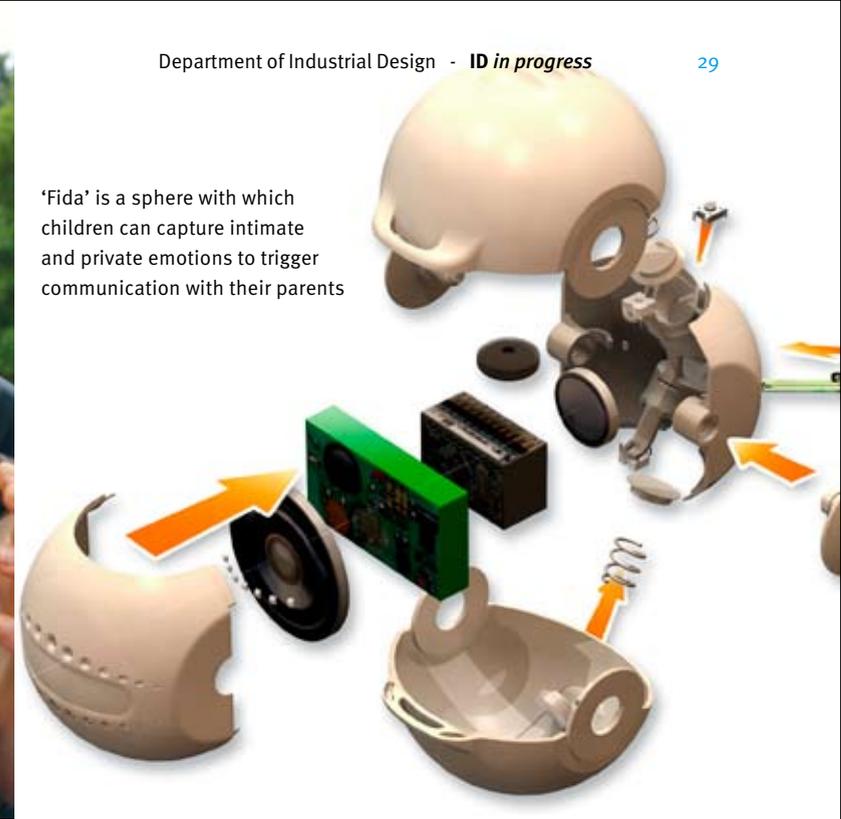
'The use of sensors and actuators can help to invent games that move far beyond the static situation behind a computer, but with the same attractiveness of computer games. Small tanks that move and shoot in conjunction with body movements (BattleBot), a virtual basketball game, in which infrared beams can literally be caught and interrupted, and a soccer ball, containing an accelerometer that counts the number of times it is passed, are a few of the many interesting examples. The design research in second-year projects in fact leads to ideas for more thorough research, resulting in insights that can be used by platforms such as the Creation Conversion Factory or be discussed during conferences related to persuasive technology, for example.'

Design as physical hypothesis

Dr.ir. Caroline Hummels

Associate professor in Designing Quality in Interaction

'I believe in Industrial Design's competency model and the focus on adaptive products. I would call myself a 'designer researcher of embodied resonant interaction'. It is unique that after only six years the Industrial Design course already serves as a role model', says Caroline Hummels.



'Fida' is a sphere with which children can capture intimate and private emotions to trigger communication with their parents

Art and Industrial Design Engineering

'I studied 3D Design at the Arnhem School of Arts. It helped me to form my own view on design. I also learned to draw well. After two years my attention shifted to industrial design engineering in Delft. When I studied there I did a lot of free-lance graphical and interface design work in my spare time. After graduation I became assistant professor in Delft. I developed ways of sketching in three dimensions with the help of virtual reality', says Caroline Hummels.

Future of design

'During my studies and my PhD research I started to realize that the experience you have with a product can be more important than the product itself. I was disappointed by the ugly black, technology push, products that invaded interiors at the end of the last century. But as Branzi said, since our contemporary culture lost its unifying ideology, we do not only have to develop the next generation of digital products, we also have to decide what kind of life and society we want these products to support', Caroline argues.

Industrial Design in Eindhoven

A key question Caroline raises when studying what she calls 'resonant interaction' is: Who is interacting with what and when and where does this interaction take place?

Caroline: 'The rise of adaptive products is a tremendous challenge for designers. For example, which aspects of the user(s), his actions and context should a product adapt to? I experimented quite a lot with personalized MP3 players. For me it is important to see what helps the user find enduring pleasure when using a product. For example, we found that an appropriate mix of control and excitement comprises a pleasant interaction. I study resonant interaction through building and testing products and installations. We are currently developing the third version of the installation called 'ISH'. ID student Jesper Schwachöfer and Nico van Meurs from the Utrecht

School of Arts are building it. It encompasses a multi-touch screen in combination with physical objects. Now it is used as a social video mixing console.'

Education feeds research and vice versa

'I consider myself a designer-researcher', says Caroline. 'I cannot separate the two; they are intertwined. Research through design means: iterations via synthesis, analysis, etc. The design can be seen as a physical hypothesis. It is also essential to me that education and research interact. Students can be of great value in the research process. They are able to build and analyze large numbers of design concepts and prototypes very quickly', Caroline notes. 'I give and develop various modules and assignments closely related to the competency areas 'Ideas and Concepts' and 'Form and Senses'. And I'm extremely proud that our students from the Interaction Design Master Class were considered the best when they presented Fida at the Microsoft Research Design Expo in Redmond, Washington' (see above).

Showing research endeavors

A research through design approach is not always an easy basis for communicating results. 'Writing articles in journals is not the only way to communicate your research efforts', Caroline argues. 'I think making models and giving demonstrations and presentations during conferences are important additions. You need the model itself to illustrate the research question you are tackling. Words and numbers cannot replace the interaction with a research prototype'.

Background

'I studied Industrial Design Engineering at Delft University of Technology and joined Philips after my graduation in 1990. As a consultant in the field of product innovation I have been involved in new product development both inside and outside of Philips. Currently I am managing a group of consultants, of which ten are located at InnoHub Singapore, of which Industrial Design at the TU/e is one of the partners.'

Current research

'My research addresses the business aspects of Industrial Design. Typically intelligent systems need several parties to make them a success in the market. When and how do you involve those parties in the design process? How can you create a business model and related product architecture that ensures a share of the success to all involved parties? Business partners are increasingly spread across the globe. Successful co-operation in new product development in this global context requires understanding of the cultural differences. A crucial party to take into account is the customer and/or end-user. We look for ways to involve them in the whole product development process.'

For our research it is very important to work with real business environments, which we can do through our network with industrial partners.'

International setting

'Reading and talking about international co-operation in development will provide you with some knowledge, but you don't know what it really means until you experience it for yourself. Thanks to the partnership with Philips InnoHub and other universities around the world we can set up assignments that offer students the opportunity to gain real experience in international co-operation. We, in turn, use those experiences in our research. In this way we aim to involve students in our research, while at the same time helping them build their competences.'

Main findings

'Our background lies in quality and reliability; we have been researching reasons for consumer complaints and have found that many complaints are due to expectations that are not met by the product/service or by usability. Currently we are working on the user perception of failures and how knowledge influences usability. Our research regarding business aspects has just started, so there are no results yet.'

Contribution of Business Process Design

'There is no greater reward for a designer than seeing that your product is the success you hoped it to be. By providing understanding of the market, cultural aspects, the business chain and business models we aim to give students the background to increase the chances of success. With our research we aim to develop insights into factors for successful co-operation in product development, and translate these insights into pragmatic approaches for designers of intelligent systems.'

Business Aspects

Dr.ir. Elke den Ouden

Senior researcher in
Business Process Design

'My research addresses the business aspects of Industrial Design. Typically intelligent systems need several parties to make them a success in the market. When and how do you involve those parties in the design process? How can you create a business model and related product architecture that ensures a share of the success to all involved parties?', says Elke den Ouden.



Information processing

Dr. Razvan Cristescu, MSc

Assistant professor in
Designed Intelligence

‘Sensor networks play a very important role in modern society, where you find an overload of data. How do we derive the important data out of all this information?’, Razvan Cristescu wonders. ‘You see applications of networks in all areas of society. In the early detection of earthquake and avalanche dangers, for example.’

Sensor network optimizing

‘I came to the TU/e because of an assistant professor position offered by the Industrial Design department. I interviewed with professors Feijs and Rauterberg of Designed Intelligence and with professor Bergmans of Electrical Engineering’, says Razvan Cristescu. ‘Although I will eventually be involved with both research and education the idea is that I start with my research first. The main theme I’ll be dealing with is putting into practice the insights that I gained during my PhD in Lausanne and subsequent work in academia and industry. In Lausanne I worked on theoretical issues concerning sensor networks, such as energy savings by reducing redundancy and improving data routing. Basically I’m an algorithms engineer.’

Background

Razvan Cristescu got his Master’s in Electrical Engineering and Computer Science from the Polytechnic University of Bucharest in 1998, his Licentiate of Technology in Information Sciences from the Technical University of Helsinki in 2000, and his PhD in Communication Systems from EPFL, Switzerland in 2004. He worked as a postdoc at the Center of Mathematics of Information at the California Institute of Technology, Los Angeles, for one year and spent the past two years as a senior R&D engineer in industry with a medical devices company (Becton Dickinson, Baltimore, Maryland). The common theme in his work is the research on information processing in large datasets, in particular sensor networks and medical diagnostics.

Applications of sensor networks

‘Sensor networks play a very important role in modern society, where you find an overload of data. How do we derive the important data out of all this information?’, Razvan wonders. ‘You see applications of networks in all areas of society. In the early detection of earthquake and avalanche dangers, for example. But you can also think of surveillance of dams, bridges, and



medical applications, like glucose monitoring for diabetes patients or movement activity for Parkinson patients. Optimization of data processing is very relevant to applications in the field of intelligent systems, products and related services, which is the focus of the department of Industrial Design.’

Network of researchers

‘A high-quality international network is very important. To keep abreast of the latest hot topics in the field I keep in touch with collaborators at EPFL, the University of Valencia, and at Caltech, and I am a member of IEEE (Institute of Electrical and Electronics Engineers). During the day I spend most of my time reading literature and identifying possible interesting problems concerning information processing in networks. The next steps are to investigate thoroughly whether any other researchers, in my own field or in other disciplines, have already tackled the problem, and of course attempting to solve the problem and disseminate it in international scientific avenues.’

Academic openness versus business secrecy

‘What I like in the academic world is the fact that you can discuss your insights and findings with a larger degree of freedom than in industry. When I worked for a company, secrecy was an important issue. Companies are eager to establish patents. Unfortunately, patents and open discussion do not go together very well. Therefore I’m happy to be here as a researcher.’

Visual Interaction Platform

Andrés Lucero, PDEng

PhD student of
User Centered Engineering

‘In my PhD research I examine how to support the work of Industrial Designers with technological tools in a sensible way. I really like to work closely with users so I have been studying design practice as a whole’, says Andrés Lucero.



From Santiago to Eindhoven

‘Coming from Santiago to Eindhoven, I had to make a transition from traditional non-technological design education taught by designers, to competency-based education focused on intelligent products coached by staff members representing a rich mix of disciplines. It was also a change from a warm, open, and hectic culture, to a somewhat colder, closed and structured culture. In Santiago, I had an 8 am to 8 pm schedule working as a designer and a teacher, and a mobile that rang every fifteen minutes. So when I came to Holland six years ago I got rid of my mobile and I still do not miss it. I also sold my car and now I love riding my bicycle. Dutch life suits us better, especially now that we have a two-year-old daughter’, says Andrés Lucero. But true integration is still a long way off. It can take years before a Dutch person invites you to his home.’

Working at the VIP lab

Andrés: ‘I do research related to the Visual Interaction Platform (VIP), a technically advanced lab focused on the creation of new tools that rely on computer vision for tangible interaction. My background in Visual Communication and Interaction Design was quite different from that of Professor Jean-Bernard Martens and Assistant Professor Dima Aliakseyeu, who both have a technology background. I disagree with them sometimes, but the discussions we have are good, fruitful and respectful and in the end our experiences are complementary. They both helped me achieve a more balanced process that is not exclusively based on user studies and design, but takes technological aspects into consideration as well.’

A holistic research approach

‘From my research, I have discovered that designers are open to all kinds of technological aids but that they are only willing to accept them, when they truly complement their work. So in my research I have tried to start by obtaining a global idea of the work designers do, in the context of their design studios. I have involved users throughout my research process, doing iterative studies in which I constantly feed back to the users the analysis and synthesis of the results of previous steps. As such, I favor a holistic, ‘demand pull’ approach, instead of a ‘technology push’ approach’, says Andrés decisively. ‘I have complemented my Dutch studies with industrial designers by conducting further studies in Finland with textile and fashion designers from the University of Art and Design Helsinki (Uiah) on their use of mood boards’.

Open door policy

‘I really love teaching here at ID but sometimes I need to restrict myself a bit more. I have an open door policy and I’m sometimes too willing to help students. I want to finish my thesis and be ready in the fall of 2008 and then see what the future – probably in Holland – brings.’

Inspired by new research directions

'I met Caroline Hummels in Delft, where she was exploring new ways of designing interactive products. It was so cool; I was instantly captivated by her research', says Philip Ross. 'Interaction is an integral part of design nowadays. I am specifically interested in the question how to design for beauty in human-product interaction', he adds.

Designing from human values

'I work from the hypothesis that what people find beautiful depends on what they find important in life. In my research, I found that it is possible to design for aesthetics in interaction basing the design on specific human values. Human values are concepts such as creativity, helpfulness, security and social power. It is striking to see how diverse and innovative the designs can be when they are designed for interactions with specific values in mind.'

Research through design

Philip believes in actually making things: 'Research through design'. As one of the first explorations of the subject of his thesis, he conducted a workshop in which the participants designed from different ethical perspectives. Among the results were two candy vending machines. One of them designed according to Kantian rationalism, the other one designed from a hedonistic perspective. The Kantian machine's interaction was based on a very abstract notion of candy. A person needed to select the amount of carbs, proteins, fats and sugars, after which the machine released a specific candy bar that met the preferred nutrients. The hedonistic machine displayed huge and rich heaps of candy, that could even be smelled. When the selection was made and money was thrown in a big tray on top of the machine, the candy was literally thrown into the user's lap.

Ethical perspective

Philip: 'These vending machines were built in a very low-fi manner, but they convinced me that the aesthetics of interaction could indeed be designed from a specific ethical perspective. For my final study I designed highly detailed interactive lamp prototypes, together with Rutger Menges, a Bachelor internship student at Designing Quality in Interaction. We gave special attention to their behavior in interaction, which we used to target specific values. One type of behavior, for example, would try to invite creative behavior in a person, while another would try to make a person helpful. I used these lamps in experiments to get an idea of whether people found one behavior more beautiful than the other and to see if this was related to their own values'.

The importance of prototypes

'It is essential to make prototypes and experiment with them. Designing, testing, analyzing, adjusting the design; this process is at the core of our research work. Interaction can be described with words only up to a point. I'm thankful that within the DQI group I have the liberty to experiment, build and reflect'.

Experiment, build, reflect

Ir. Philip Ross
PhD student in
Designing Quality in Interaction

Philip Ross is one of the talented industrial design engineers who came to the TU/e from Delft. Immediately after graduating with honors he was asked by professor Kees Overbeeke to do his PhD at the department of Industrial Design with professor Loe Feijs.



User tests for companies

Ir. Christelle Harkema

PhD student in
Business Process Design

‘I cannot stop thinking as a usability researcher. When I open a can and break the lip I wonder what went wrong in the design. When I put a DVD unit in my computer I expect it to work, without reading the manual’, Christelle Harkema says.



Christelle Harkema recently started a PhD project in the Business Process Design capacity group. Professor Brombacher and Assistant Professor Peter Sonnemans are her supervisors. Design for Usability is the umbrella under which five PhDs will do their research, leading to a methodology to design user-friendly products. ‘I would be delighted if my PhD resulted not just in another book, but in a method that companies could use in order to do good user tests.’

Design for usability

‘The user, the use (the way a product can be used) and the industry are three angles in the big Design for Usability project involving PhDs from Eindhoven, Twente and Delft. I focus on the use of intelligent products. Soft failures are very common. A soft failure is non-technical by nature. The functionality is there, but the user simply cannot access it. This is a well-known phenomenon in hi-tech products. Take for instance a mobile phone that is supposed to be able to communicate with Windows, but is not recognized by the computer, even though the software has been properly installed. It’s very much a matter of getting the designer’s view on usability in line with the user’s perception of usability.’

Background

‘I was born in Teteringen near Breda. I studied Industrial Design Engineering at Delft University of Technology and have always been interested in the question ‘How can we make useful products for people?’ I’m not an artist who just makes beautiful products without bothering too much about those who use them. I used to work at Indes performing user tests of products that were developed there.’

A usability designer

‘In the first year it’s a lot of reading and building a network, in the second and third years I will be doing a lot of use tests and the fourth year will be devoted to writing. I enjoy the research a lot. Time flies. It’s a subject that has always drawn my interest. I cannot stop thinking as a usability researcher. When I open a can and break the lip I wonder what went wrong in the design. When I put a DVD unit in my computer I expect it to work, without reading the manual. Christelle says. An experienced user should be able to install hardware and software intuitively. Technically it is possible, but it is really a matter of matching the designer’s view with the user’s.’

More communication between PhD’s

‘The only thing I miss is a bit more communication between the PhD candidates. There is a tendency to stick to your own research. But the content of my research is very interesting and worthwhile and the results will hopefully be applicable. As an Industrial Design Engineer you always want to develop a product in the end. In this case it would be a manual to conduct use tests for intelligent products.’

Colophon



Research through design

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