



Eindhoven designs

volume two

Developing the competence of designing intelligent systems

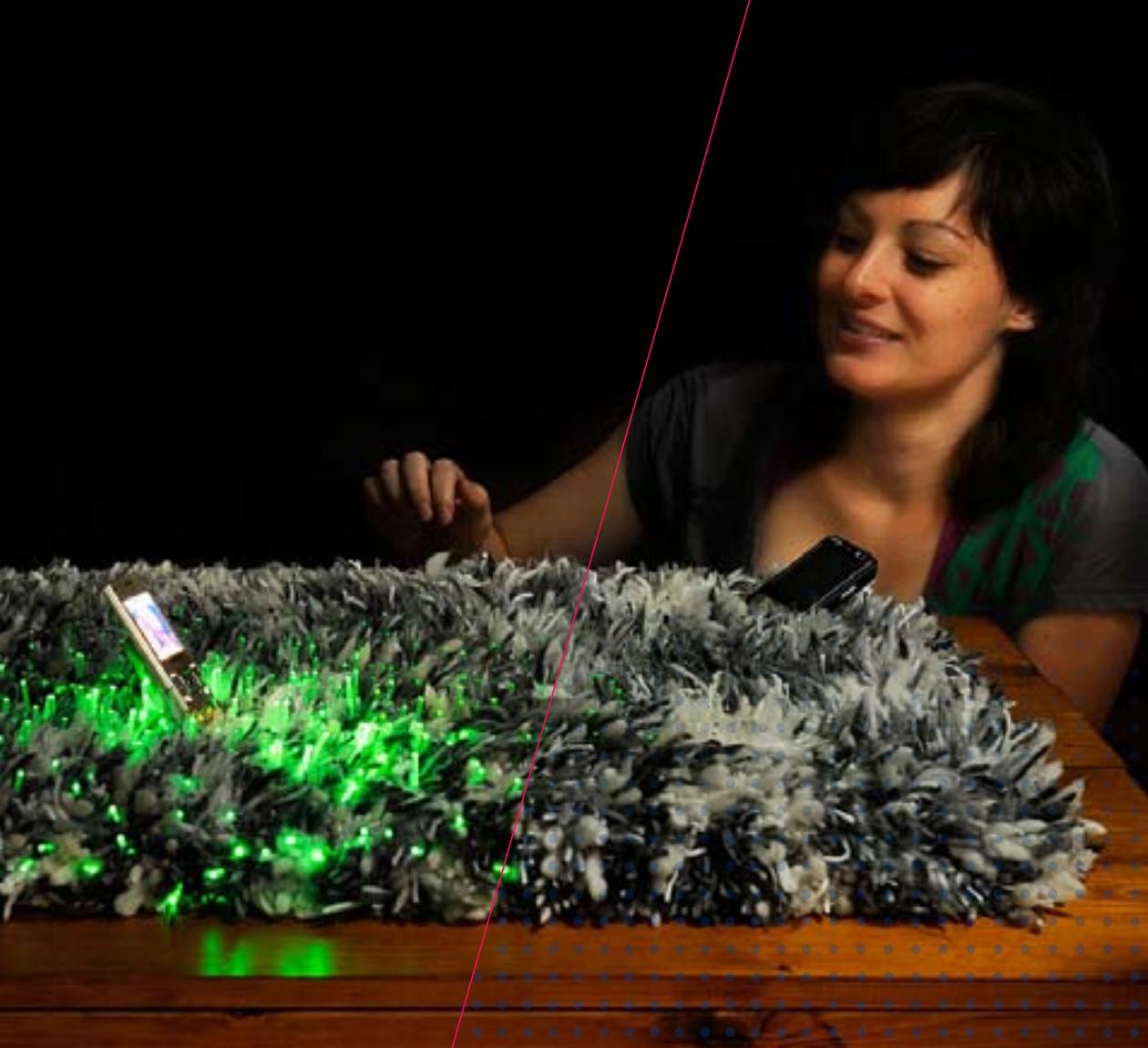
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TU **e**

Technische Universiteit
Eindhoven
University of Technology

Where innovation starts

Department of Industrial Design



Photos by Bart van Overbeek

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Preface

Since 2001 the Department of Industrial Design at Eindhoven University of Technology has been facilitating students to become professional designers. Given the department's focus, educational approach and organisation, our graduates distinguish themselves from other designers in various ways. They design intelligent systems, are life-long and self-managing learners, develop their expertise and identity continuously, and contribute to building communities at the intersection of design, engineering and science.

The design of our curriculum is rooted in the department's focus on designing intelligent systems, products and services for social/societal transformation, a competency-centred approach to learning, and a network organisation that aims to integrate education and research. In this book we elucidate the theoretical bases for this foundational trinity and illustrate how we have implemented them in our curriculum. As such, it offers an explanation of the what, why and how to our staff members and students. But it may also prove to be a source of inspiration for external curriculum designers who would like to adopt a similar innovative and integrative approach or who are merely curious about the ins and outs. Moreover, it might give insight to our industrial partners: what can they expect and how can they benefit from the department and our students? What can our new type of designers do for you?

For people who would like to have more detailed and practical information about our curriculum, we suggest having a look at our intranet: <http://w3.id.tue.nl/en/intranet/>

Designing, improving, and enabling an innovative curriculum such as ours requires a continuous and joint effort. We would like to thank all staff members and students for their contributions to this process. Several of them took the responsibility to shape, for example, competency areas and Themes as described in this book. Many of them participated in sessions and workshops we or they organised as part of the implementation process. Their comments, questions and effort have been input for further improvement, have sharpened our thinking and have inspired us to write this book.

We are very grateful for what all our students achieve in our programme and for the support our staff members provide them with. We would like to thank all students whose work is shown on the photographs in this book. Furthermore, we would like to give special thanks to those students whose work has been illustrated in this book for wanting to share it with this larger audience: Bas Groenendaal, Erica Battaglia, Veronica Cornacchini, Youyou Yang, Pak Wing Man, Jesper Schwachöfer, Sibrecht Bouwstra, John Helmes, Eva Hopma, Floris Kimman, Bram Knaapen, David Menting, and Emin Sinani.

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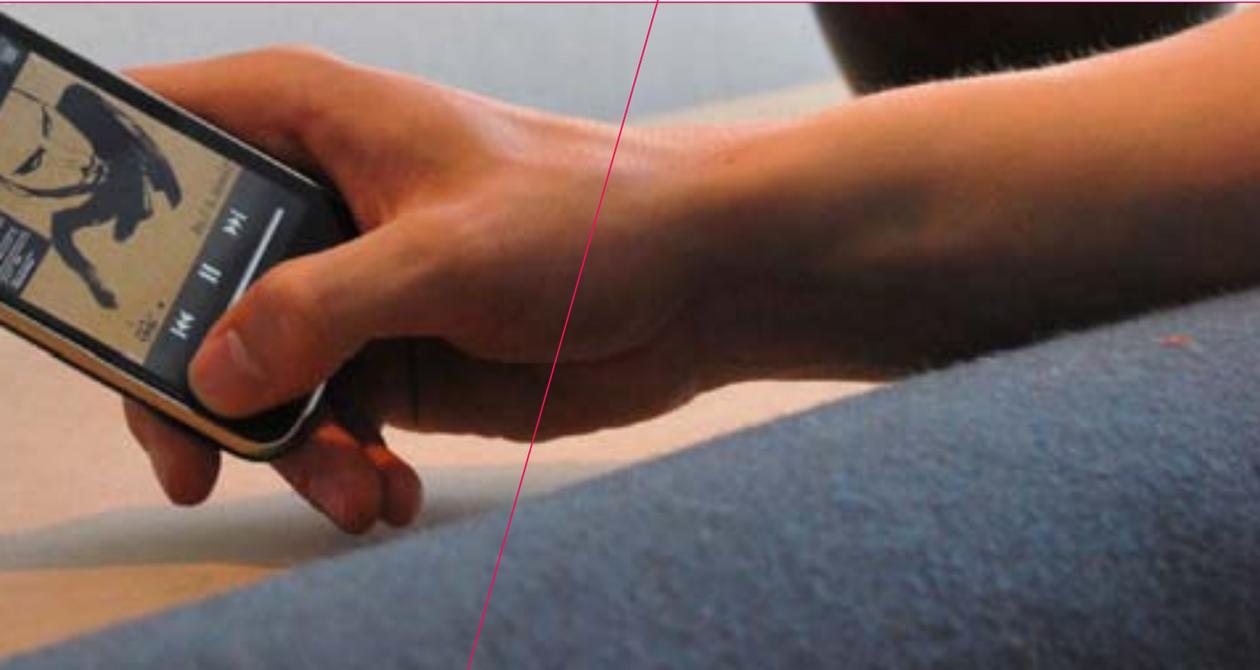




Photo by Bart van Overbeeke

Chapter 1

Foundation: ID in a nutshell

Eindhoven University of Technology (TU/e) intends to be a research-driven, design-oriented university of technology at an international level with the primary objective of providing young people with an academic education within the ‘engineering science & technology’ domain. It aims to advance the development of technological innovations leading to the growth of welfare and well-being, both within its own region (technology & innovation hotspot Eindhoven) and beyond (The Mission of the TU/e).

In 2001, TU/e started the Department of Industrial Design based on discussions with leading industry representatives, including Philips, Ericsson and Océ. Seven years later the department already had more than 500 students, both Bachelor and Master, and around 80 staff members involved in education. There are more than a thousand industrial design courses around the world. The educational programme of Industrial Design at the TU/e (ID) distinguishes itself by its foundational trinity of focus, educational approach and organisation, namely:

- Focus: intelligent systems, products and related services for social/societal transformation
- Educational approach: competency-centred learning
- Organisation: education and research integrating network

In this chapter we will explain these foundations and elucidate why we consider this trinity important for the purpose of educating future designers. In the following chapters we will provide an in-depth explanation of our foundations and the consequences for our educational program.



Focus: intelligent systems for social/societal transformation

Based on its discussions with industry, the department decided to concentrate on the design of intelligent systems, products and related services, which addresses aspects such as adaptive behaviour, context-awareness and highly dynamic interaction. The traditional focus of industrial design on products is moving more and more towards systems. At ID we see systems as adaptive environments in which humans can interact with intelligent products to gain access to services provided. These intelligent products are connected to each other and the surrounding system to achieve a new type of user experience. Especially the shift towards the complexity of systems and the non-physical aspects of services requires different competencies from designers. Moreover, these competencies will need to develop towards the future since the scope and definition of systems will probably grow over time, including people, organisations, logistics, politics, economics and education.

Being intelligent means that the adaptive behaviour is based on the situation, context of use and users' needs and desires. In particular we focus on opportunities that are of benefit to individuals, societies and different cultures worldwide. This implies that intelligence incorporates an ethical dimension. However, our contemporary culture has lost a unifying ideology

(Branzi, 1989). Therefore, we believe that designers have to not only develop the next generation of digital systems, products and related services with which people can pursue their lives, but also investigate what kind of life and society we (designers, users, industry, society, ...) want these products to support (Hummels, Ross and Overbeeke, 2003). When is it beneficial to us and what makes it so?

This asks for a new type of innovation that can transform the lives of people, the way we act in the world and the way we experience the world, and consequently transform our society. Such innovative intelligent systems, products and services that 'weave into everyday life until they are indistinguishable from it' will inherently bring about a profound social transformation (Ross, 2008). Design is pre-eminently the profession that can deal with the complexity of these new innovative systems for social transformation. According to Bruce Nussbaum, design is now the force within the business culture, because designers focus on human behaviour, on iteration and speed, and are searching for new options and opportunities; they are able to construct instead of destruct and through their designs connect to powerful emotions (Nussbaum, 2008). Moreover, the complexity of these new systems asks for a new type of designer being on

the edge of design, engineering and (social) science (Bartneck and Rauterberg, 2007).

These envisioned innovations cannot merely be technology-driven, or based on needs of users in existing product ecologies. As new technology is potentially capable of transforming our world in ways that we cannot know of beforehand, we educate students who are able to apply new technologies in innovative, daring and preferably beautiful

ways, driven by a design vision of how our (social) world could be in the (near) future, and based on explorative studies and solid research with users in the social-cultural context (Hummels & Frens, 2008). Moreover, it requires an intense relationship with industry to turn this design vision into reality. In the chapter “Social and societal transformation through intelligent systems” we explain in depth the concept of transformation, exemplified by design projects.

Educational approach: competency-centred learning

During the discussions with industry leaders in the starting period of our department, it became clear that they were interested in hiring academically trained Industrial Design engineers, who are able to lead and work in multi-disciplinary teams, bringing the different perspectives together, and to bridge the worlds of new technological and business strengths on the one hand, and the societal and user desires, needs and opportunities on the other.

The approach of becoming such an integrator was also scrutinised when looking at the societal developments with respect to learning: present-day society asks for self-directed and life-long learning. Society in the twenty-first century is characterised by rapid changes

in various domains, e.g. political, economical, social, aesthetical and ethical. At the same time, science and technology are developing at a very high pace, which is turning this era into a ‘knowledge age’. The amount of knowledge is increasing very fast and is expected to go on growing at an even higher pace. Together with the advances in information and communication technology, this increases the volume of easily accessible information beyond imagination. Functioning effectively in this society requires the ability to deal creatively and flexibly with large amounts of constantly evolving information and the ability to learn continuously. Life-long learning, in turn, requires the ability to direct and regulate your learning. The notion of self-directed or self-regulated



learning refers to the degree in which students are behaviourally, meta-cognitively and motivationally active in their learning.

These societal changes are reflected in the professional workplace. They also denote the challenge that higher education faces in having to prepare students to become professional experts in this new workplace. They need to become experts who create, apply and disseminate knowledge, and continuously construct and reconstruct their expertise in a process of life-long learning. They also need to become experts who are required to work in teams, to cooperate with experts in various fields, and to participate in complex networks of information, resources and instruction. Meeting the goals of education requires a high consistency between instruction, learning and assessment. Since the goals of education in the knowledge era have changed, a new perspective for this consistency is needed (Birenbaum, 2003; Segers, Dochy and Cascallar, 2003).

The perspective that ID has chosen is competency-centred learning, an educational model in which learning and working come together. Students learn to learn (what, how and why) and we facilitate their learning in order for them to have the ability to deal creatively and flexibly with the large amounts of constantly evolving information in our 'knowledge era'.

Competency-centred learning offers students the opportunity to give equal weight to knowledge, skills and attitudes, and stimulates them to learn by doing. Within our department, a competency is defined

as an individual's ability to select, acquire, and use the knowledge, skills, and attitudes that are required for effective behaviour in a specific professional, social or learning context. Therefore it offers a holistic view of design, where the student develops the overall competence to design by integrating, in our case, ten competency areas related to users, (interaction) design, technology, business, society, modelling, processes, ideation, teamwork and self-directed learning. The ID Competence Framework will be explained in the homonymous chapter.

The nature of design beautifully intertwines the different types of knowledge with different human skills, in this case cognitive, emotional, perceptual-motor and social. It is about learning and performing through practical application, while simultaneously acquiring theoretical skills. For example, design uses formal scientific notations (based on mathematics) as well as knowledge that is harder to formalise (e.g. aesthetics and creativity). Moreover, knowledge can be obtained through the analytical skills of the designer (e.g. analysing user behaviour), as well as through the synthetic skills of the designer (e.g. building physical models).

In addition to skills and knowledge, competency development focuses on the designer's attitude, such as taking responsibility and professionalism. Therefore our students work as 'junior employees' in an authentic and professional context. Moreover, competency-centred learning is a highly person-and-context-dependent process. A different context asks for different

competencies, and different students will prefer different competencies and develop them differently. Therefore, our students take responsibility for and create their own programme. We have developed a variety of learning activities with an emphasis on experiential learning and self-reflection, while taking into account differences between individual students. Students can choose from these learning activities such as assignments, modules and classes that best match their learning goals and required competency development for a particular semester. All this, of course, within the structure and content which the department provides and with the help of senior employees (staff) who serve as project coach, competency coach and expert. Moreover, students work on projects with different real clients and experts, which integrates and tunes their competency development required for becoming interactive/intelligent system designers. The focus is on interactive systems, products and related service with an awareness of intelligent systems at the Bachelor level, moving on to depth and expertise on intelligent systems at the Master level.

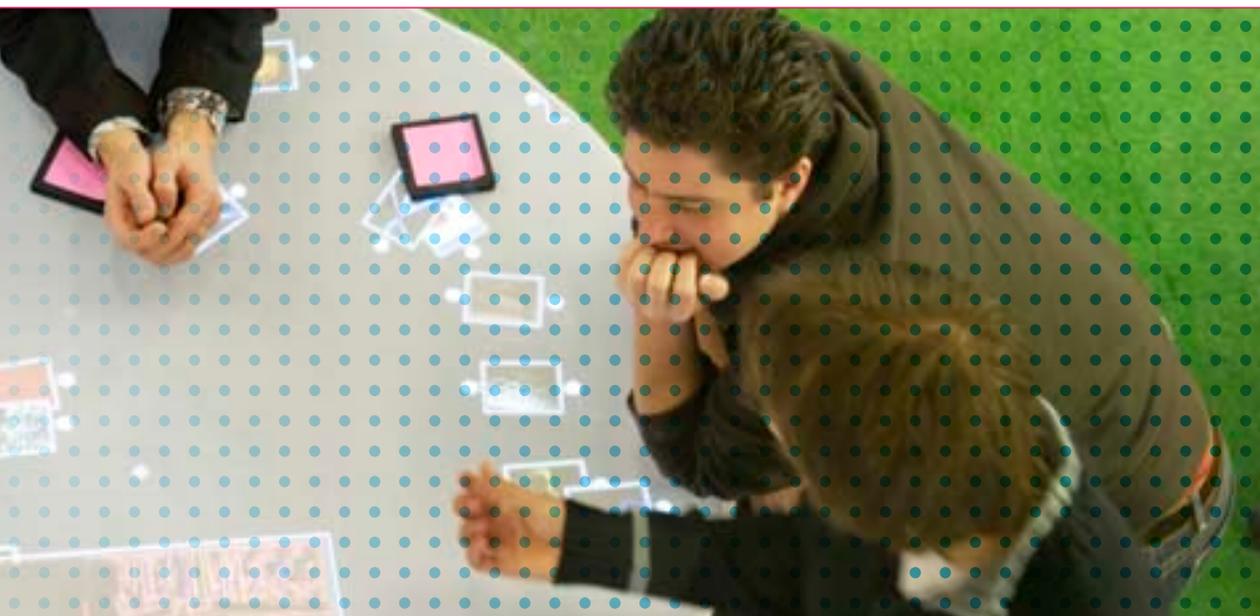
Since competency-centred learning is a holistic approach, the assessment does not use a grading system for separate learning activities, but focuses on the overall competence of designing, including the vision on designing, as well as the growth as a designer during the study. Students go through different stages during and after their study: (blank –) awareness – depth – expertise – visionary. Reflection in and on action (Schön, 1983) as well as reflection for action are important mechanisms to become aware of what one has learned, and to stimulate and direct this growth. During the semester, the coach, assessor, lecturer and expert provide feedback on student achievement and learning process in the different learning activities, which the student uses to reflect on his or her development. At the end of the semester, students create/update their showcase elucidating their development as a designer over the past semester, in the context of their history as a designer up to that point, and in relation to their envisioned development in the future. This interactive showcase is assessed at the end of each semester.



Organisation: education and research integrating network

Competency-centred learning is applicable not only to students, but also to all staff members. We want every individual as well as the entire department to develop their expertise and identity, to go beyond interactive products and move towards really intelligent systems by growing together as a community. Therefore, we emphasise the importance of expertise building, identity building and community building. This process of building refers to an individual level (student and staff) as well as to the departmental level (we as the Industrial Design department). We believe that it is only possible to handle the complexity, and design for intelligent systems, products and services at the intersection of design, engineering and science, if we use and share the expertise of the entire ID community. We need integration in several ways.

Within our department we use the concept of 'themes' for this integration. Themes are fields of interests within the design & research area, which focus and cluster ID Bachelor and Master projects, create links to other learning activities such as assignments and modules, and are closely connected to research areas and projects within the department. Examples of themes are Wearable Senses, Health Care and Playful Interactions. We have developed themes in order to strengthen the link between research and education, between the different research groups with their own expertise, between Bachelor, Master and PhD students and employees, as well as the link between the university, industry, commerce and other external partners. For example, since we want an authentic learning environment, almost 40% of our coaches are professional design practitioners and well over 60% of all projects



are in collaboration with an external client. By working together, sharing our expertise and learning from each other, we can raise the overall level of quality, become an even stronger community and, most importantly, design for innovative intelligent systems, products and services.

Last year we started working with 12 themes, of which two also physically integrate students and staff, education studios and research labs. They are becoming a living lab. Although this is a challenge due to the different backgrounds of our employees, which sometimes makes it sometimes hard to speak each other's language, the size of the themes (up to 10 staff members and 50 students), the close cooperation on projects and the integration of research and education, appears to have a positive influence on communication and extending the overall knowledge, although we have not yet had the time to fully evaluate the impact of using themes.

The introduction of themes has put us one step closer towards a network organisation with more responsibility for employees. Instead of a hierarchy with rules and control, the network organisation is based on flexible self-managing teams that share knowledge and expertise, and collectively come to decisions within the overall framework of the department. This type of organisation especially aims at supporting self-directed and long-life learning, stimulates creativity and innovation, and thus fits in perfectly with competency-centred learning and taking responsibility for one's own (individual & departmental) development.

Within this network organisation, employees simultaneously have different roles within education, for example being a coach, assignor/lecturer, assessor, coordinator, theme champ, member of a theme and expert, next to the roles they have within research.

In the remaining part of this book, we will elucidate the focus of our department. In chapter two we will explain in depth why and how to design for social/ societal transformation. Chapter three addresses the theoretical bases for competency-centred learning. Chapter four to seven explain the implications of this theory for the Department of Industrial Design, which is consolidated in the ID Competence Framework. Chapter four introduces the framework and explains the different competency areas and chapter five addresses the design process and the importance of reflection within the framework. Chapter six discusses the development of the overall competence of designing during the study and shows the developmental stages of growth as a designer. Chapter seven explains how this theoretical framework is put into practice through the different learning activities. Finally, chapter eight shows the mechanism of learning through feedback and our assessment procedure, which includes the showcase: the student's tool to demonstrate and communicate development of the overall competence of designing, and their growth as a designer.



Examples of themes

In the theme of **Wearable Senses** we apply the mission statement of the department with our special focus on those interactive products, systems and services that are **close to, near or on the body**. Our challenges are multiple: how to combine hard electronics with soft materials, traditional craftsmanship with innovative technology and smart textiles, functionality with fashion, value propositions with gadgets, Do-It-Yourself with manufacturing, and sewing with soldering? How do these products fit the body, measure bodily parameters and behaviour, and how give these products meaningful feedback? Wearable Senses has a strong network of partners, excellent facilities, high-end materials and the main application areas are expressive clothing and accessories, sports garments, interior textiles and interesting deviations.

Health is a significant factor for the quality of life for us human beings. The theme **Health Care** focuses on both physical and psychological health – our well-being. Health care at ID embraces designing intelligent systems, interactive products and services to stimulate and promote health and patient comfort for both at home and in the hospital environment. Renowned clients include Máxima Medical Centre (MMC), Wilhelmina Kinder Ziekenhuis (WKZ) and Philips. Skills and developments trained through projects

in the theme Health Care consist of smart textiles, physiological signal measurements, wearable electronics, monitoring, measuring movements, simulation, actuators, sensors, medical training process, user, form giving, clinical validation, etc. In summary, we aim at a unique integration of knowledge from science, design and engineering, contributing to the multi-user and multi-disciplinary nature of health care.

The theme **Discovering & Learning** explores how Situated Learning can be applied in professional support like design tools for conceptual phase, exploring data such as music or books in libraries, assisting the elderly with new technologies, and stimulating knowledge sharing in multicultural neighbourhoods.

Situated Learning is a function of the activity, context and culture in which it occurs. In this model of learning, learners become involved in a community of practice with certain beliefs and behaviours to be acquired. Learners construct their own knowledge by applying prior knowledge and experience to a new situation and integrating the new knowledge gained.

The design opportunity for the development of intelligent products, systems and services resides in the transition of the supporting

systems from fount of knowledge to facilitator. In fact, it means designing systems that teach “higher order” skills such as abstraction, reasoning, and reflection. The main challenge is to enable learners to learn how to learn by having a more open-ended evaluation of learning outcomes, and developing a cooperative and collaborative way of learning skills.

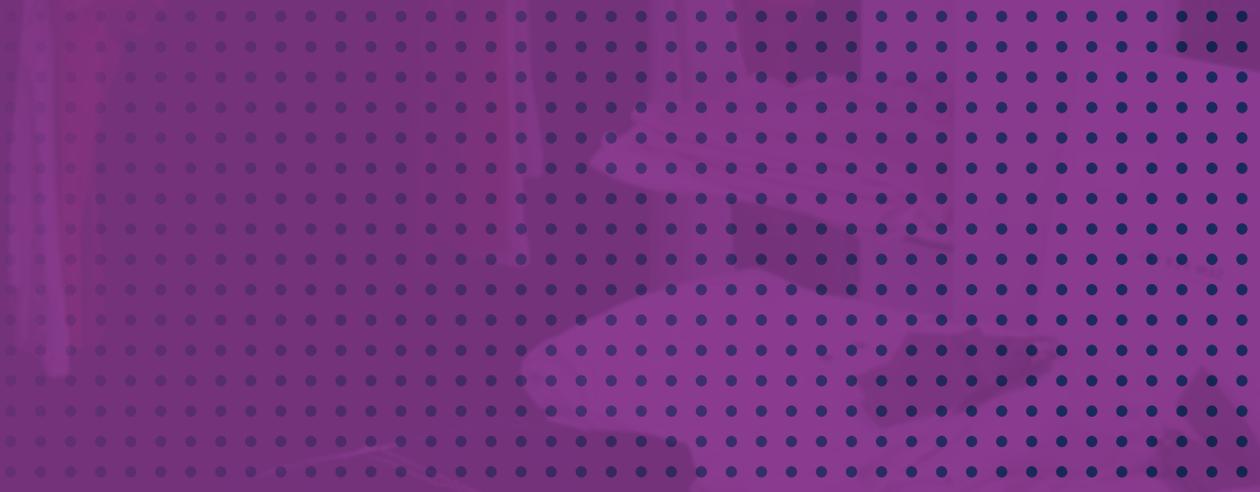
Experience design is a developing field of design. The aim of the theme **Emotions and Experiences** is to optimise users’ experiences of products, systems and services by communicating specific emotions, values and identities through design. Typical experience design projects cross multiple design disciplines such as product design, communication design and architecture. In retail for instance, a product’s packaging, the (interactive) communication media and the spatial design of a store are all involved in creating a unified user experience. Similar principles can be found in the design of novel technological artefacts in which the boundaries of products fade due to their inherent interconnectedness and pervasiveness. Optimising experiences in these cases is complex given the multitude of occurrences in which people engage with design. Thus, given an application domain, knowledge is needed to identify (a) the critical situations in which (b) desired experiences should be evoked and (c) how the body is involved in shaping them.





Chapter 2

Social and societal transformation through intelligent systems



Intertwining of design with society

Designing intelligent systems, products and services has social consequences, because they are inextricably intertwined with society. Their adaptive behaviour is based on the situation, context of use, and users' needs and desires, and the opportunities offered are of benefit to individuals, societies and different cultures worldwide. They will have a social impact as soon as they enter society. Products arise in a social context and, consequently, are a reflection of that society. Moreover, a product is a vehicle to steer society implicitly as well as explicitly, it influences the behaviour and experiences of users (Hummels, 2000; Verbeek, 2006). Open office layout and furnishing, which originated in the 1920s, enabled the ideas of scientific management, such as efficiency, introduced by Frederick Taylor (Forty, 1986). Present-day computers support our market economy and management system, where time is money and knowledge is power.

One can say that technologies have intentions; they can transform what we perceive (Idhe, 1990). For example, a microscope can enable us to see the smallest bacteria, Google Earth influences our perception of the earth, and Skype gives a different perception of social relationships at long distances. The influence and intention of technological artefacts is not unilateral and univocal, but reciprocal and dynamic. When a technological artefact is used,

it facilitates people's involvement with reality, and in doing so it co-shapes how humans can be present in the world and how their world can be present for them. The context influences the intention and interpretation of technology. For example, the telephone was originally designed as a hearing aid and consequently is differently interpreted and has a different meaning for the hard of hearing than it has for us as a communication device. Don Idhe calls this phenomenon 'multistability' (Verbeek, 2006).

One can see a similar context-dependency with the concept of 'affordance'. James Gibson, the founder of the ecological theory of direct perception, thought up this noun to complement the verb to afford. 'The affordances of the environment are what it offers animals, what it provides or furnishes, either for good or ill' (Gibson, 1986). At its simplest, one could say that an affordance is what the environment means to a specific animal in terms of action. So a chair affords sitting to an adult person, and it affords stability to a small child who wants to stand up.



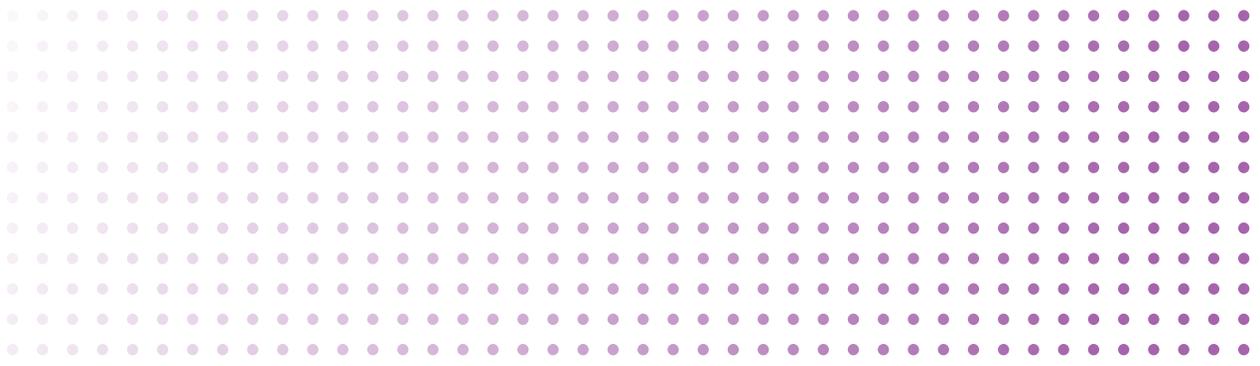
Responsibility of designers: towards transformation

In the last century, several disciplines emerged which study the relationship between products and society, such as the sociology of technology (Bijker and Law, 1992), the philosophy of technology (Heidegger, 1962; Achterhuis, 1997) and design history (Forty, 1986). Designers are not sociologists, philosophers or historians; they create and build intentional technology. Therefore, we support Peter-Paul Verbeek's notion that ***'the ethics of engineering design should take more seriously the moral charge of technological products and rethink the moral responsibility of designers accordingly'*** (Verbeek, 2006).

At the Department of Industrial Design, we believe that our design students need to take an active position in thinking about the social and moral role of design, about social and societal transformation. They should be aware of and address the mediating role of technology during the design process. Designers have to put this topic of social and societal transformation on the table despite the

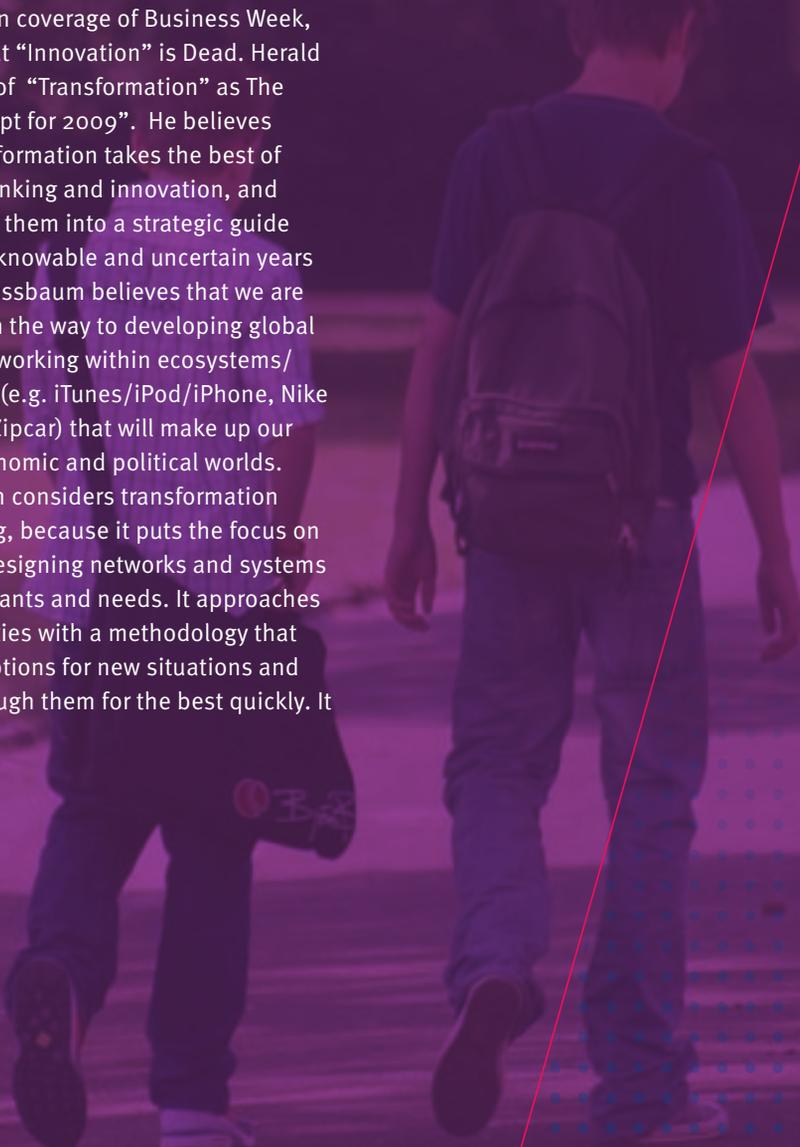
fact that it is not their sole responsibility, because designers often work in multi-disciplinary teams and because technology is context-dependent and multi-stable.

ID is not alone in this focus. In 2004 the British Design Council set up RED, a 'do tank' that uses innovative design to tackle social and economic issues. They challenged accepted thinking and used creativity in close cooperation with users who are part of the design team, to design new public services, systems and products that address social and economic problems. And they called their approach 'transformation design' (Burns, Cottam, Vanstone and Winhall, 2006). Also in 2004, Matthijs van Dijk stated that industry and, consequently, designers need to put more emphasis on true innovation based on a context-driven design strategy that evokes a paradigm shift which opens up and requires a redefinition of the interaction between humans and products (Van Dijk, 2004). Robert Fabricant, Vice



President of Creative at Frog Design, sees a shift towards design with intent that has an immediate impact on user behaviour through direct social engagement (Fabricant, 2009). And Bruce Nussbaum, editor of the innovation and design coverage of Business Week, claims that “Innovation” is Dead. Herald The Birth of “Transformation” as The Key Concept for 2009”. He believes that transformation takes the best of design thinking and innovation, and integrates them into a strategic guide for the unknowable and uncertain years ahead. Nussbaum believes that we are already on the way to developing global networks working within ecosystems/ platforms (e.g. iTunes/iPod/iPhone, Nike Plus and Zipcar) that will make up our socio-economic and political worlds. Nussbaum considers transformation interesting, because it puts the focus on people, designing networks and systems off their wants and needs. It approaches uncertainties with a methodology that creates options for new situations and sorts through them for the best quickly. It

deals with a creative society in which we are all producers and consumers of value. Moreover, it can look at our systems - education, health-care, economic growth, transportation, defence, and political representation (Nussbaum, 2008).





Technological mediation

But how does one design for social and societal transformation? What are the mechanisms that one can use? Philip Ross devoted his PhD thesis to social transformation with an emphasis on the relation between ethics and aesthetics. He studied how we can design an intelligent system or product that elicits specific values in aesthetic interaction, which resulted in the Perspectives on Be-haviour in Interaction framework, and the Interaction Quality framework, in addition to two intelligent lamp designs for AEI and Luxger, which can evoke different values in interaction (Ross, 2008). See chapter eight of his thesis for an explanation and movies at: <http://www.idemployee.id.tue.nl/p.r.ross/thesis/>

For his work, Philip Ross used the Technological Mediation framework of Peter-Paul Verbeek, which builds on the work of e.g. Don Ihde and Bruno Latour (Verbeek, 2006). Let us briefly explain Verbeek's framework that gives us a vocabulary to discuss and address social transformation.

“Technological mediation concerns the role of technology in human action (conceived as the ways in which human beings are present in their world) and human experience (conceived as the ways in which their world is present to them).” (p. 363, Verbeek, 2006).

So, technological mediation has two perspectives: experience and action/behaviour, both with their own mechanisms that we will explain further on.

Transformation of experience

Don Ihde sees two relationships for mediating human experiences and interpretation of reality.

Firstly, there is the embodied relationship in which the technological artefact becomes an extension of the human body. Heidegger (1927; Coyne & Snodgrass, 1993) calls this a ‘ready-to-hand’ tool that typically withdraws from the user's attention. For example, when looking through a pair of glasses one perceives the environment and not the glasses. The opposite of ready-to-hand is present-at hand, in which the product itself asks for attention instead of the things you want to do with the product, for example when it is malfunctioning.

The second relationship is called the hermeneutic relationship, in which a person needs to interpret (the information presented by) the designed artefact because it's a representation of reality. For example, the thermostat represents the actual temperature, so

one cannot feel the temperature through a thermostat but it supports in knowing what the temperature is and in regulating the heating.

When technology mediates our sensory relationship with reality, it transforms what we perceive by amplifying or reducing specific aspects. This transforming capability is called technological intentionality; technological artefacts are not neutral elements, they have intentions and play an active role in the relationship between humans and their world. Take for example *Scope*, designed by Bas Groenendaal (2007) in his Master's graduation project at Industrial Design. His photo camera aims at stimulating the psycho-social development of underprivileged children, especially children living in (former) warzones.

Scope uses the benefits of photography for these children, as is done within phototherapy, to enhance their feeling of empowerment, strengthen their notion of identity and the environment, and develop social skills (Sitvast, 2004). Groenendaal uses the principle of framing to give the children a different perspective on life. *Scope* is held like a steering wheel and the frame (a rectangular hole) is used to observe the surrounding world. Squeezing the two semi-rings together makes a photo, which can be downloaded and printed or viewed on a computer (small audience) or projection screen (large audience).

In terms of transformation, the frame reduces the periphery sight and blocks out certain parts of the environment, and it amplifies the frame and the world behind it. Painters and professional photographers often use this principle by creating a frame with their hands,

in order to search for interesting parts and composition, and to increase the intensity of observation.

Transformation of behaviour

The other form of transformation is coupled to action and behaviour. As already stated in the beginning of this chapter, human actions are not merely based on their intentions or the social context in which they live, but also on the mutual influence of people and the material environment. Don Ihde (1990) refers in this case to 'intentionality' of a product and to 'multistability', which indicates that people can use and interpret product differently, depending on the context. James Gibson (1986) introduced the concept of 'affordances' which are context- and species-dependent action possibilities, and Bruno Latour (1992) introduced a concept from the movie and theatre world; he uses the concept of 'scripts' to describe the influence of an artefact on human actions. For example, a ceramic coffee cup has the script to be washed after use, and a cardboard cup the script of being thrown away.

Like the amplification and reduction mechanisms for the transformation of experience, transformation of behaviour also has two mechanisms for transformation: invitation and inhibition. Let's go back to the project of Bas Groenendaal to elucidate these mechanisms and see what *Scope* invites and inhibits.



Scope, designed by Bas Groenendaal,
coached by Richard Appleby



Scope, designed by Bas Groenendaal,
coached by Richard Appleby

Due to the size of the frame and the overall doughnut-shaped camera as well as the lack of immediate feedback of the resulting photo, the frame acts as an intermediate between the photographer and the person being photographed. The frame invites to have social and playful interactions between persons on both sides of the lens. On the other hand, the size of the frame inhibits the behaviour of being an outside observer detached from the scene, as is often the case with photographers. The described behaviour was exactly what Bas Groenendaal found during a user study at an asylum centre in the Netherlands. Children started playing with the camera and were looking actively for social engagement through the frame.

The influence of the design on people's behaviour is present for both the ready-at-hand and the present-at-hand situation. Scope is an example of a ready-at-hand device and it appeared that the device influences people's behaviour, both that of the photographer as well as that of the person being photographed. But present-at-hand devices also influence behaviour. A speed pump for example, stimulates you to slow down.

Materialising morality in the design process

The mediating role of technology and its influence on how people act mean that designers are 'doing ethics' often implicitly and sometimes explicitly through their designs. So how can designers and our design students incorporate this dimension in their design process? Verbeek sees two options. The minimum scenario would be to assess if the

design has undesirable mediating capacities and try to reduce or eliminate those. The second scenario would be to build in specific forms of mediation which are considered desirable.

However, the fact that technological mediation is not objective and detached from the context of use and the user - on the contrary, it occurs in the complex interplay between user and artefact - makes the prediction of desirable and undesirable very difficult. For example, is an intelligent toilet that is able to analyse the user's faeces after every visit to the toilet in order to check his health, desirable or undesirable? And what if it is placed in a factory and the management gets to know the outcome too?

Moreover, it becomes even harder when the focus is on innovative intelligent systems, products and related services which envision new and unknown transformations, because they require an anticipation of future mediation roles of technology. But products are often used in unforeseen ways and they stimulate unforeseen behaviour. So how do we deal with that kind of complexity during the design process?

We believe that it requires an integration of the two ways of analysis that Verbeek proposes. On the one hand, the designer can use his/her imagination to envision the transformation and the desired and undesired impact. In this case, the designer can also bring in his/her own value system and invite certain behaviour.

For example, within the Right through making project, Master's students developed systems and products that aim at empowering and seducing people to reach the ideals contained in the Universal Declaration of Human Rights, through 'to kalon', a synthesis of beauty and good. Their designs invite specific behaviour and amplify certain experiences and perception in order to evoke the principle of a specific article. This learning activity was done with design students from different cultural backgrounds, who together developed a vision on social and societal transformation (Trotto, Hummels, Overbeeke, Chanfanelli, Frens and Goretti, 2009). For example, BeeHugged was designed for article 25: "Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing and medical care and necessary social services, and the right to security in the event of unemployment, sickness, disability, widowhood, old age or other lack of livelihood in circumstances beyond his control."

The students translated this article in BeeHugged, a system where you can share energy with the principle of the car jump start. They designed this based on the fact that in today's Western society, the majority of people carry some sort of electronic product. When people are in need of energy, other people who have enough energy and are willing to share it can recharge them. With this system the students hope to add to a society where showing mutual care and sharing becomes a natural habit. The energy level will be visible on the clothes, and the clothing will also be the container for the energy. The pace at which energy is transmitted depends on the amount of physical contact. For example, a handshake will result in a lower transport rate than a hug.

This envisioning should be intertwined with, on the other hand, a rooting in society through close collaboration with all stakeholders throughout the entire design process. The mediation role of the design-to-be can be addressed in all phases of the design process. For example, Smart Jacket for neonatal monitoring with wearable senses was designed by Sibrecht Bouwstra in her Master's graduation project at Industrial Design (Bouwstra, Chen, Feijs and Bambang Oetomo, 2009).

Her project fits in a larger research project of TU/e in cooperation with the Máxima Medical Center for improving the health care of mother and child before, during and after delivery, with special emphasis on neonates. Sibrecht focused from the early phases of her design process at amplifying the bonding between parent and child while providing reliable health monitoring as well as a comfortable clinical environment for neonatal care. The Smart Jacket was designed in such a way that it invites skin contact and reduces the visible presence of technology. During the whole process, she kept in discussion with all stakeholders, including parents and medical staff, in order to find the desired social transformations in comparison with current neonatal monitoring.

We believe in the integration of both approaches, in which the designer not only envisions social transformations, but also explores and validates these visions together with all stakeholders in the context of use. Therefore, these two approaches play an essential role in the reflective transformative design process, which is explained in chapter four to six.



BeeHugged designed by Erica Battaglia, Veronica Cornacchini, Youyou Yang, Pak Wing Man and Jesper Schwachöfer



Prototype Smart Jacket by Sibrecht Bouwstra, coached by Loe Feijs, Sidarto Bambang Oetomo and Wei Chen



Chapter 3

Competency-centred learning

Competency-centred educational approaches like ours are rooted in recent societal developments and in the constructivist learning paradigm. Pivotal in the constructivist perspective on learning is the notion of activity: learning is an active construction of meaning by the learner. This perspective on learning has various implications for the goal we have defined for our curriculum, the way in which we have designed our curriculum and learning environment, and the role assessment plays.

Background to our approach



Our competency-centred educational approach builds on the constructivist view of learning. In addition, it emphasises the principles of: context-related learning, experiential learning, exemplary learning, self-directed learning, reflective learning, and learning by doing. Last but not least, a holistic and integrated approach also plays a central part.

Societal changes and developments have turned the 21st century into a 'knowledge age' (see chapter one). These changes have affected the professional workplace, and thus the demands placed on graduates: they need to be able to function as 'knowledge-managers' rather than 'knowledge-owners' (Dochy, Heylen and Van de Mosselaer, 2002). These developments have also affected theories about learning, such as the constructivist perspective on learning. Our competency-centred learning approach is rooted in these societal changes and in the constructivist learning paradigm. Preparing graduates for their changing role in society requires a student-centred approach. In terms of educational goals this also implies a shift from teaching a specific body of knowledge to facilitating students' ability to learn and to develop continuously: to acquire knowledge, skills and attitudes needed to perform a task or role in a specific and often complex setting.

The constructivist paradigm includes learning theories that focus on mind-world relations. The individual or cognitive theories assume the locus of knowledge construction to be in the mind of the individual learner; the social or situative theories assume this locus to be in

socially organised networks (Birenbaum, 2003). Common to both perspectives, however, is the key notion of activity: the understanding that learning and knowledge are an active construction of meaning by the learner. Furthermore, both focus on the learning process as a whole and on the interactions within this whole (Dochy, Heylen and Van de Mosselaer, 2002). Learners construct meaning by relating new information to what they already know. In doing so, they are influenced by their motivational and affective make-up as well as by their social-cultural environment (Tigelaar, 2005). We adhere to Birenbaum's reconciliatory view that these two perspectives are rather two sides of the same coin: it is the interaction between them that provides a starting point for unravelling the phenomenon of learning.

A constructivist perspective on learning has implications for the role of the student, for the design of the curriculum and assessment, and for the role of the 'teacher'. The curriculum should allow for active student participation and control, offer ample opportunity for interaction, and provide an authentic context for students' learning. Learning activities as well as assessments should allow for, or even necessitate, a holistic and integrative approach. Students need to develop the ability to reflect, to self-regulate their learning, to take responsibility, to learn from experience and to assess themselves.

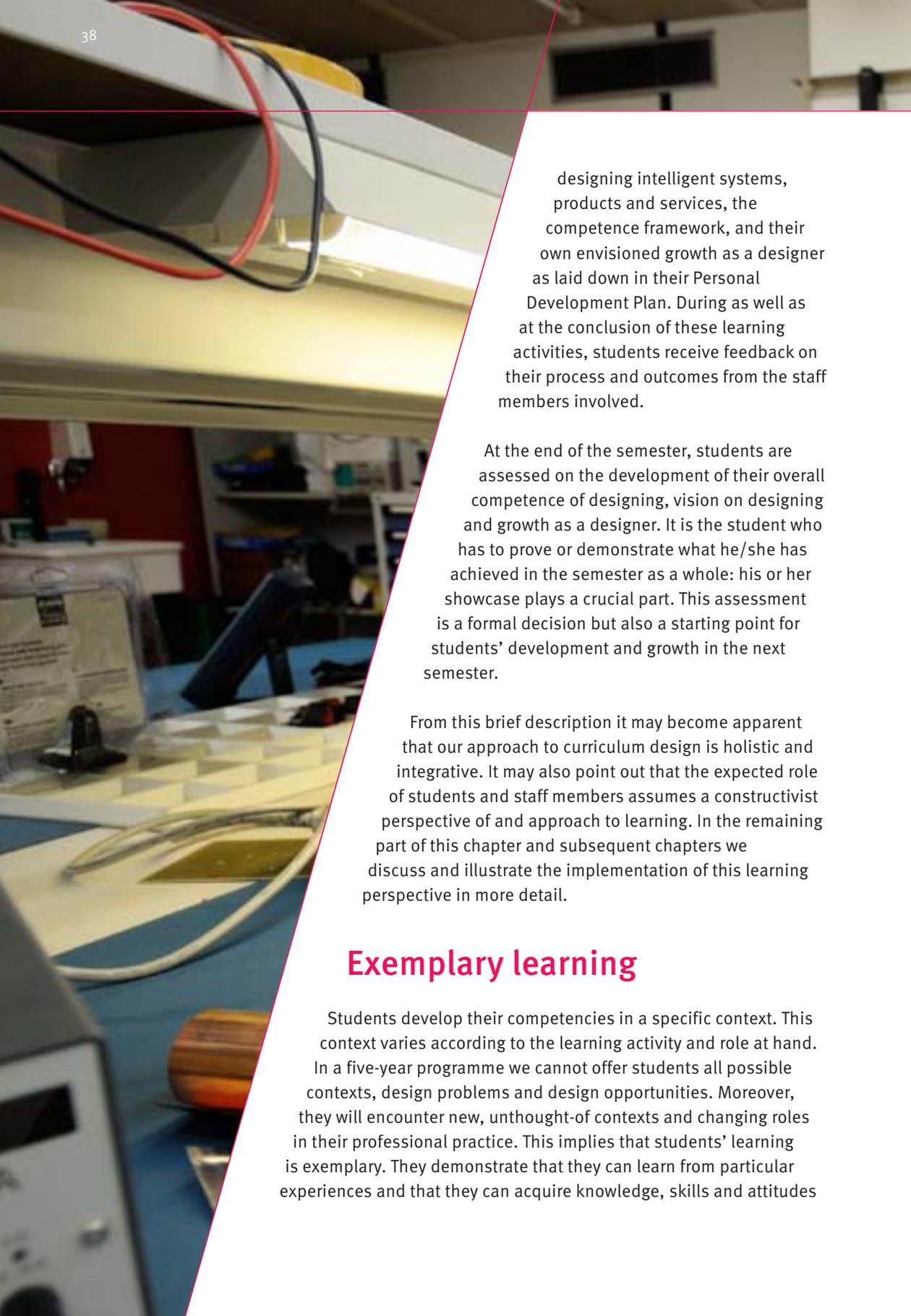
Staff members need to make a shift from teacher-focused to learning-focused, and their role needs to change from being an authoritative source of knowledge to facilitating students' learning.

This requires a shift in their personal conceptions of knowledge, intelligence, teaching and learning (Birenbaum, 2003). For staff members this paradigm shift may well prove to be quite hard because it touches upon their professional identity (Van Heijst and Van der Krogt, 2008).

A competency-centred curriculum

Our curriculum consists of fairly large course components, called blocks. A block is composed of a particular set of curricular learning activities that, as a whole, covers a full semester. So our Bachelor's consists of six blocks and our Master's of four. The learning activities vary in size, scope and purpose (see chapter seven). All types of learning activities are designed to facilitate competency development, either one competency area or the integration of all competency areas.

At the start of each semester, students select learning activities, depending on their individual learning needs. They need to take into account the required composition of the block they are going to do, the department's focus on



designing intelligent systems, products and services, the competence framework, and their own envisioned growth as a designer as laid down in their Personal Development Plan. During as well as at the conclusion of these learning activities, students receive feedback on their process and outcomes from the staff members involved.

At the end of the semester, students are assessed on the development of their overall competence of designing, vision on designing and growth as a designer. It is the student who has to prove or demonstrate what he/she has achieved in the semester as a whole: his or her showcase plays a crucial part. This assessment is a formal decision but also a starting point for students' development and growth in the next semester.

From this brief description it may become apparent that our approach to curriculum design is holistic and integrative. It may also point out that the expected role of students and staff members assumes a constructivist perspective of and approach to learning. In the remaining part of this chapter and subsequent chapters we discuss and illustrate the implementation of this learning perspective in more detail.

Exemplary learning

Students develop their competencies in a specific context. This context varies according to the learning activity and role at hand. In a five-year programme we cannot offer students all possible contexts, design problems and design opportunities. Moreover, they will encounter new, unthought-of contexts and changing roles in their professional practice. This implies that students' learning is exemplary. They demonstrate that they can learn from particular experiences and that they can acquire knowledge, skills and attitudes

in particular contexts. At the same time this shows their ability to analyse the context and to determine if and what new learning this requires on their part. In other words, this also demonstrates their potential: to analyse new and different contexts and to act accordingly. The exemplary nature of learning in a competency-centred curriculum stresses the relevance of authentic learning activities that reflect students' future work as a designer.

Experiential learning and learning by doing

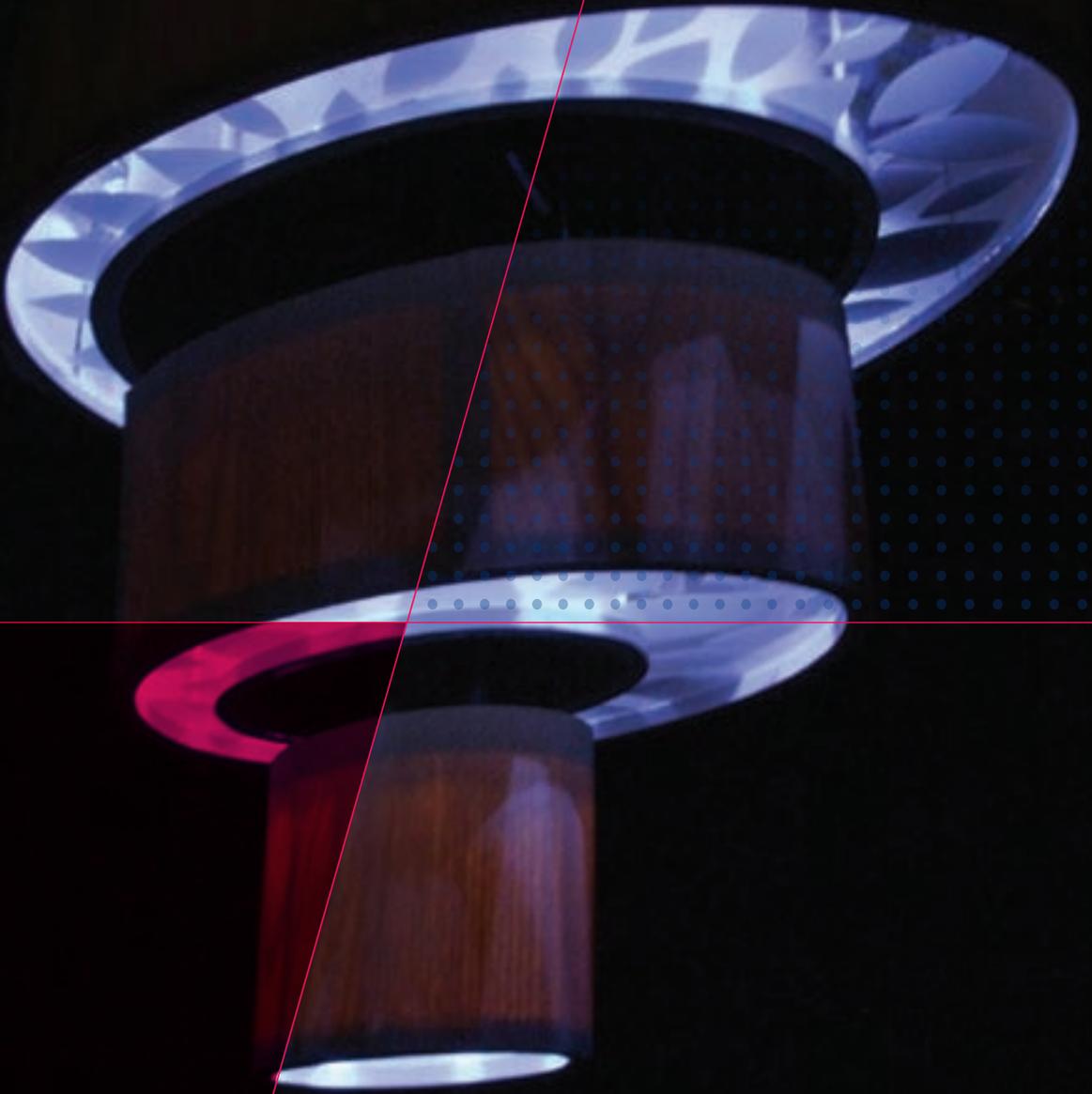
Inherent to the nature of design is learning and performing through practical application. Considered from an activity perspective this is also referred to as 'learning **by** doing' or 'studio-based learning' in the context of (more traditional) design education (Ellmers, 2009). Looked at from a learning perspective, so learning **from** doing, this is referred to as 'experiential learning' (Kolb, 1984). Learning from an experience does not occur of its own accord. It requires an active construction of meaning on the part of the learner. In Kolb's four-stage learning cycle, the stages of 'reflective observation' and 'abstract conceptualisation' enable the learner to construct meaning and build knowledge, and, by doing so, learn from a concrete experience. This implies the relevance of learning by reflecting, which is discussed in the next paragraph.

Reflective learning

Our view of reflective learning builds on the 'experiential learning cycle' (Kolb, 1984), the

'reflective practitioner' (Schön, 1983), and 'reflection in learning' (Moon, 2004). In our curriculum, students do various curricular learning activities. These activities become learning experiences by the meaning students give to them. By constructing this meaning, students build new knowledge, and relate this to existing knowledge. Reflection is a mental process that facilitates this creation of meaning and knowledge. If students articulate their reflections, for example by discussing their ideas or views with others or by writing them down, these reflections become a representation of their learning, which can be shared with others and may result in a new or transformed learning experience. As such, these reflections are an integral part of learning itself (Moon, 2004).

Viewed this way, reflection is critical thinking in retrospect: looking back and learning from it. Though the scope of his definition is much more restricted, this is essentially what Schön (1983) calls 'reflection-in-action'. It also comes close to what Kolb (1984) calls the stage of 'reflective observation' in his experiential learning cycle. This cycle contains four stages that students go through in a fixed sequence but, depending on the learner's preferred learning style, any of the four stages can be the starting point. Reflective observation is essential to learn from an experience: by observing and reflecting on a concrete event or experience, students can form abstract concepts which they test by active experimentation, thus creating a new experience. We have adopted Kolb's 'learning from experience by reflection' principle but we have abandoned the 'fixed sequence' principle: students can jump from one 'stage' (or in our terms: activities) to any of the others. Furthermore, in our view students learn



from reflecting on all ‘stages’, not only from reflection on concrete experiencing.

From Kolb’s learning cycle it becomes clear that learning from a particular experience is often not a goal in itself: abstract conceptualisation enables students to create a new and different experience, in which they build on and expand their knowledge. In order to do so, they de-contextualise the knowledge they have acquired, strip it from the context of the activity during which they achieved this knowledge, so they can expand or redefine it in a different context or activity. This anticipatory perspective of reflection, which links current learning to future learning, is called reflection-for-action.

Schön (1983) also distinguishes reflection-in-action, which is part of the activity. It occurs when something unexpected or surprising happens. Moon (2004) identifies such a learning moment as one of the instances of transformative learning, which is the most sophisticated and deepest stage of learning in her five-stage model. It is a moment “when things fall into place, a substantial new view emerges and there is a sense of intellectual excitement”.

In our approach to learning we have adopted the notions of reflection in, on and for action as described above. We also adopt Moon’s view that reflection is part of learning itself. The scope of reflection on and for action, however, can vary from a single activity to a whole design process or even students’ overall competence of designing, which represents their learning outcomes of a semester as a whole. In the ‘Facilitating learning and growth’ section of the current chapter, these reflections are more concretised. In chapters five and six

the reflections are integrated in the specific context of our learning environment and our competence framework: they are linked to the various elements in the learning activity perspective and the competence of designing perspective.

Context-related learning

What students learn is influenced or mediated by the tools and signs of their socio-cultural environment, as well as the established communities of practice which their academic discipline represents (Birenbaum, 2003). This implies that learning is context-related. It also implies that learning includes enculturation into and participation in these communities of practice, and adoption of the principles and standards shared by members of these communities.

If we want to facilitate students’ learning we should create opportunities for them to learn in an authentic context. That is why we have designed different types of learning activities, varying in the degree of authenticity. Projects, for example, and students’ showcase reflect professional practice quite strongly. In their project, students have the opportunity to experience and perform various activities and roles, to deal with a real client and to be coached by professional design practitioners (about 35% of the coaches).

Competency defined

The very notion of competency marks the shift in educational goals, which go beyond teaching specific knowledge. The way in which we have defined ‘competency’ reflects the constructivist view of learning, in which it is the learner who gives meaning to a particular learning event and, by doing so, relates this new knowledge to existing knowledge.

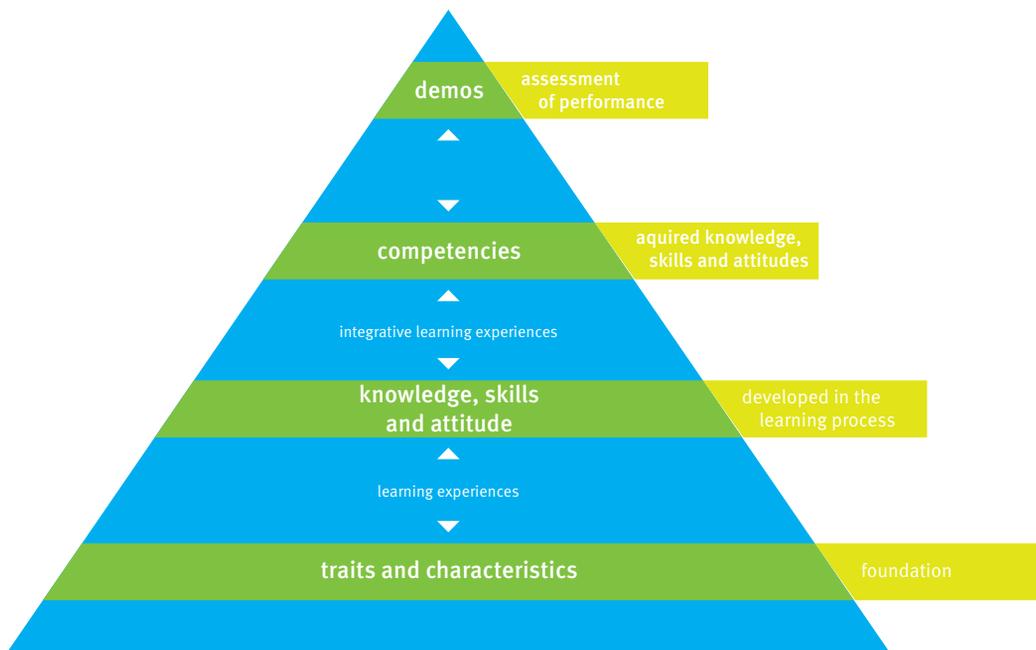
The notion of competency is defined as “an individual’s ability to acquire, select and use the knowledge, skills and attitude that are required for effective behaviour in a specific professional, social or learning context”. From this definition the role of knowledge acquisition appears: acquiring knowledge is no longer an end but a means to develop a

particular competency needed to perform a specific task or role. Put differently, acquiring a specific, well-defined body of knowledge is no longer at the core of a competency-centred educational approach. Instead, students learn how to construct meaning by performing authentic learning activities. This construction of meaning includes the acquisition of context-



related knowledge, skills and attitudes, as well as knowledge about learning: knowing why, how, when and what to learn. In our case the context is framed by the department's focus on designing intelligent systems, products and services for social or societal transformation. The conceptual learning model below clarifies the definition of a competency and its relationship with knowledge. Each rung of the ladder is considered to affect the rungs above and below. The model, including the explanation of the terms used, is taken from Voorhees (2001):

- Traits and Characteristics are the foundation for learning, the innate make-up of individuals on which further experiences can be built. Differences in traits and characteristics help explain why people pursue different learning experiences and acquire different levels and kinds of knowledge and skills.
- Knowledge, skills and attitude are developed through learning experiences, broadly defined to include study, work, participation in community affairs, etc.
- Competencies are the result of integrative learning experiences in which knowledge, skills and attitude interact to form bundles that have currency in relation to the task for which they are assembled.
- Demonstrations (demos) are the result of applying competencies. It is at this level that performance can be assessed.
- The competency definition also shows that competencies are developed in a specific context and that the assessment of competency development is performance-based.



Facilitating learning and growth

Competency-centred learning is a cyclical, highly individual and context-dependent process. This requires a holistic approach to designing a curriculum and corresponding assessment. The goal of our curriculum is to facilitate, support and promote students' development of the overall competence of designing and their growth as a designer. In order to accomplish this goal we have created a competency-centred learning environment.

This competency-centred learning environment for our students includes various mechanisms that facilitate, support and enhance students' learning and competency development at the level of a curricular learning activity as well as the semester as a whole: personal development plan, curricular learning activities, showcase, reflection, feedback and assessments. Figure xx gives a schematic overview of the relationships between the components of the learning environment.

Personal Development Plan

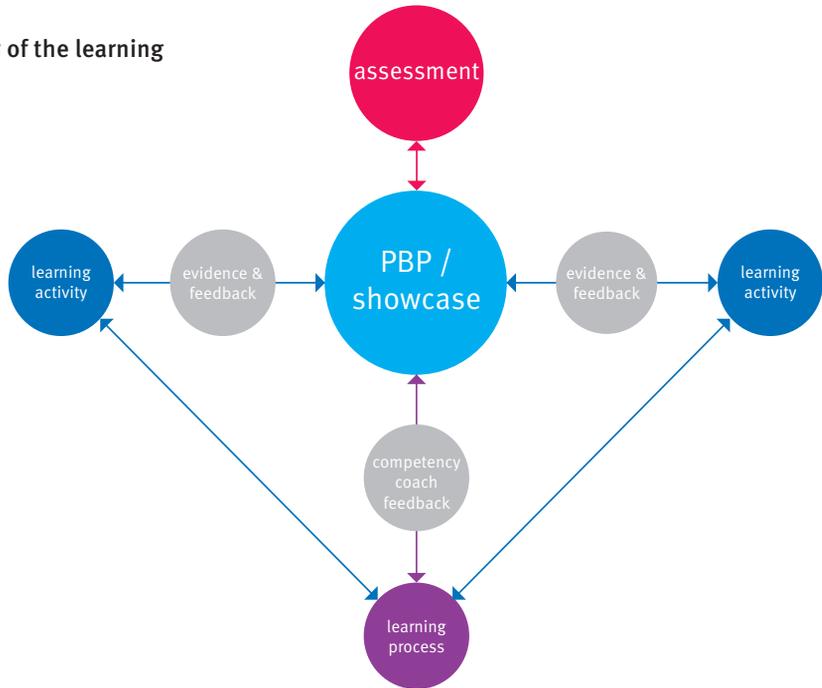
It is the students' responsibility to determine what kind of industrial designer they want to become, taking into account the department's focus on designing intelligent systems, products and services. They capture this by setting long-term goals for their overall competence of designing in their Personal Development Plan (PDP).

They manage their growth as a designer by determining what competency development this requires and what learning activities they need to select for a particular semester in order to achieve this. They include this in their PDP by setting short-term goals for that semester. Typical moments to reflect on their progress, and to review and adjust their PDP are halfway through and towards the end of the semester. At the assessment students' long and short-term goals serve as a point of reference to establish their development of the overall competence of designing and their growth as a designer.

Curricular learning activities

During the semester, students are engaged in various curricular learning activities, each with their own specific focus, scope and size, either representing individual or team work (see chapter seven for a more detailed

Schematic overview of the learning environment



explanation). Characteristic of all learning activities, however, is that students go through an iterative learning loop: a loop of competency development in a specific context. In other words, learning activities create opportunities for students to develop their competencies by acquiring context-specific knowledge, skills and attitudes.

Projects, for example, provide students with quite an authentic learning context. Students perform design activities and roles that are derived from or similar to tasks and roles in the professional practice of designing. Performing these tasks and roles is not an end in itself. It is intended to generate a meaningful learning experience: learning to determine what to perform, how to achieve this performance and why to achieve this. The 'how' refers to competencies to be developed and the 'why' to

the ultimate goal of all the generated learning experiences: contributing to and shaping students' overall competence of designing, their vision on designing, their growth as a designer, and their ability to learn. Since students' achievements within learning activities are not an end in themselves, they are not assessed separately. Instead, students receive written feedback at the conclusion of a learning activity (see above).

Showcase

Students also go through iterative learning loops at the level of a semester as a whole: their growth as a designer. The showcase plays a crucial part in this learning loop: it is the students' tool to monitor and communicate their development of the overall competence of designing and their vision on designing. The

showcase as a communication tool for a student's overall development is a pivotal element of the assessment (see chapter eight).

The showcase, often referred to as 'portfolio', is a visual, interactive and integrative representation of students' overall development. In order to create their showcase students review what they have achieved in their learning activities of a particular semester, framed in the short-term goals they set in their PDP. They examine their deliverables, feedbacks and reflections and determine how these have contributed to and shaped their overall competence of designing and vision on designing. They evaluate this overall development, with the long-term goals in their PDP as a point of reference. This evaluation results in a coherent and overall picture of what they achieved in the semester as a whole. Students link this 'top-layer' of the showcase to the evidence layer by including integrative reflections. The evidence layer contains a careful selection of their deliverables, feedbacks and reflections, which corroborates their overall development and growth.

In order to demonstrate their growth as a designer across semesters, students include a time dimension in the top-layer of their showcase. The overall development students have achieved in a particular semester (present) is fitted in with their growth as a designer up to that point (past, which refers to previous semesters) and their view of the designer they want to become (future,

which embodies the long-term goals in their PDP). The past is transformed, the present becomes the past, and the future becomes the present (see chapter eight for more detailed information on showcase).

Reflection

In the course of curricular learning activities, students reflect at various moments. The common element in these reflective moments is that they help students understand and enhance their learning. By reflecting they give meaning to what they are doing or, put differently, they articulate what an activity or experience means for their own learning or development. When performing a design activity, they capture valuable learning moments by reflection in action. During the (design) process they reflect on action by reviewing what they have achieved so far, or by connecting newly acquired knowledge to prior knowledge. They reflect for action by identifying what knowledge or skills they still need to acquire to accomplish high-quality deliverables, or to perform a specific task or role effectively; or by determining what design activity they need to perform as a next step. Students are advised to write these reflections on a regular basis, for example in a 'learning journal' (Moon, 2004); and to include corresponding visualisations of their deliverables and process. At the conclusion of a curricular learning activity they reflect on and for action as well. They look back to establish what they have achieved in the learning

activity as a whole and how this has contributed to developing particular competencies. They look forward by determining how they can put this to use or expand their development in future learning activities, either within the same or in the next semester.

In the process of creating a showcase it is also students' reflections that help them understand and deepen their learning, this time at the level of their overall competence of designing, vision on designing and growth as a designer. Students mostly reflect on action by examining what they have achieved in the semester as a whole and how this had contributed to their overall development and growth. They reflect for action by determining what to achieve in the next semester, given the long-term ambitions for their growth as a designer. But creating a showcase may also offer moments of reflection in action. When reviewing the semester as a whole, students may have valuable or surprising learning moments, for example understanding what a particular competency area is about, or seeing a discrepancy between their competency profile and their envisioned competence of designing.

The explanation above shows that, depending on the context and scope of students' learning and activity, their (written) reflections vary in the level of abstraction, detailing and specificity. Their reflections on action within a learning activity, for example, are at the low end of abstraction and at the high end of detailing. The integrative reflections in the top-layer of their

showcase, on the other hand, are at the high end of abstraction and at the low end of detailing.

Feedback

Learning, which includes acquiring and applying knowledge, is an individual process on the student's part: it is an active construction of meaning by the learner. Feedback is a very powerful way of supporting and enhancing students' learning. It provides students with qualitative information on how they learn (process) and on what they learn (results). The scope of this feedback is a curricular learning activity, the exception being competency coach feedback: this addresses students' learning and competency development process of the semester as a whole (see chapter seven for more detailed information on staff roles). Feedback provides students with an 'external' perspective, which is complementary to the 'internal' perspective of their own reflection.

During the process of a learning activity, staff members give verbal feedback on a regular basis and in a dialogue. This feedback helps students understand their process and competency development. Students can use this feedback to enhance their learning within the learning activity and achieve high-quality deliverables.

The written feedback which students receive from staff members at the conclusion of a learning activity helps them to establish what they have

achieved in the learning activity as a whole and how this contributes to their overall competence of designing. This written feedback also serves as evidence for the students' showcase and, as such, is input for the assessor (see chapter eight for more detailed information on feedback).

Assessment

The focus of the assessment is students' development of the overall competence of designing, their vision on designing and their growth as a designer. The various elements of the assessment are the end-of-term exhibition at which students show their project; students' showcase; and a meeting between the assessor and student (see chapter eight for more detailed information on assessment).

The formal function of the assessment is to decide whether or not the student is promoted to the next block, and receives 30 credits or not. In our case this is determined by the developmental stage a student has achieved, related to the block he/she has been doing.

Assessments also have a feedback function: the assessment gives qualitative information on the developmental stage the student has achieved (see chapter six for more information on developmental stages), and how the student's growth has evolved since the previous assessment. As such, this gives the student feedback on his/her ability to self-assess. Last but not least, the assessment fulfils a feed-forward function: it gives students pointers to fine-tune or adjust their long-term goals for their growth as a designer and to set competency development goals in their PDP for the next semester.







Chapter 4

ID Competence Framework: introduction & competency areas



Introduction

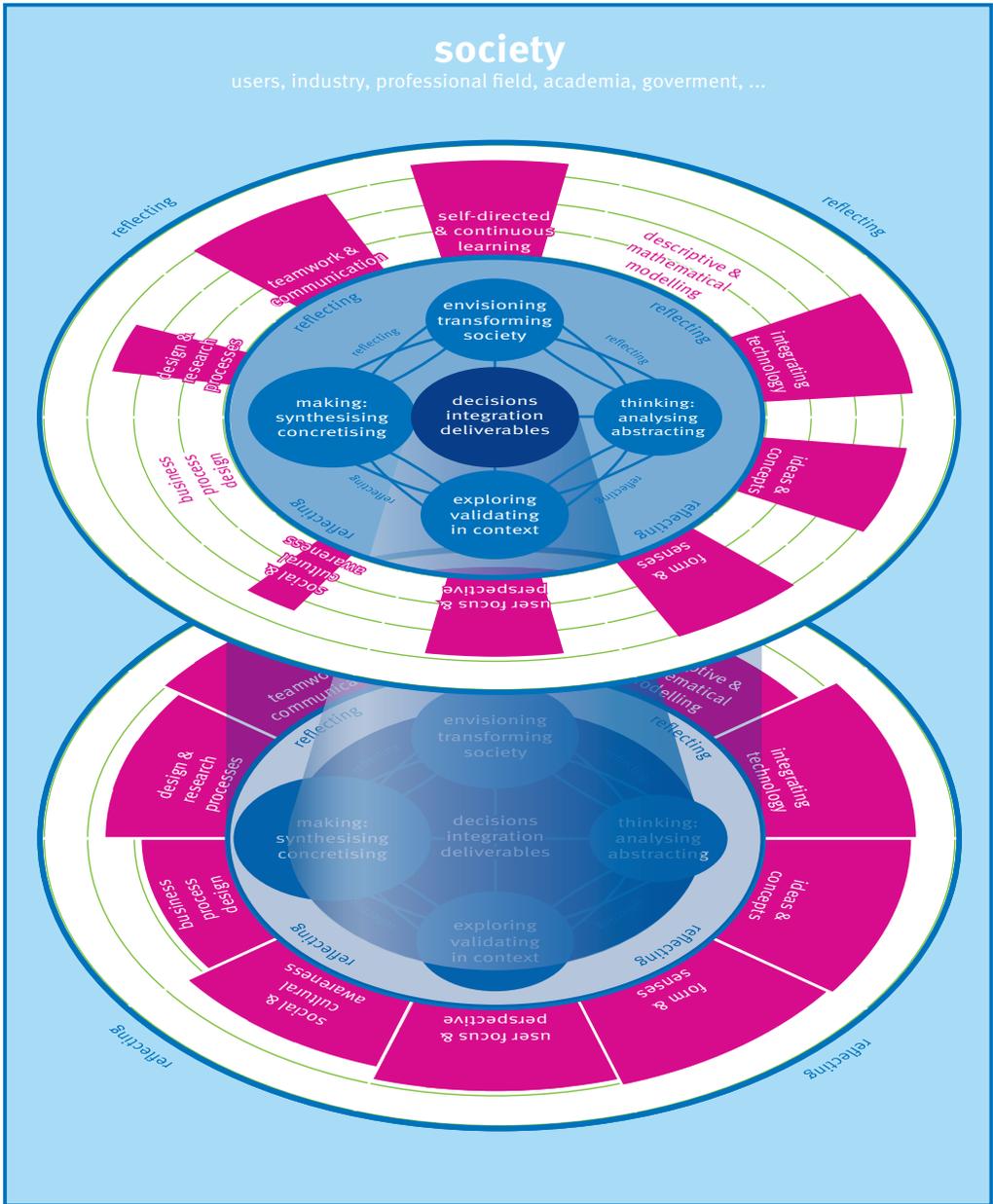
Based on the department's focus and learning approach, we have developed the ID Competence Framework. Being a student and developing through a competency-centred learning approach, puts an emphasis on activities and processes. So becoming a designer is not merely about being able to deliver qualitative excellent intelligent systems, products and related services, it is also about the process and competency of accomplishing this excellent design, and the process of becoming a competent designer.

Therefore, the ID Competence Framework tries to capture the overall competence of designing, which consists of both the process of designing and becoming a designer, and the resulting design. The overall competence of designing is shaped by the integration of:

- 1. The student's development of the different competency areas, both with respect to 'weight' (breadth and depth per competency area) and 'profile' (the contour of all competency areas with respect to depth) as well as the student's insight in their competency development. So the development of competency areas refers to process (of designing and of becoming a designer) as well as to content (the elements of a design).
- 2. The extent to which the student is in control of the activities he/she performs within the (design) process of a specific learning activity, as well as the process 'profile' of a student: the path and steps the student prefers to take in the (design) process, so which steps and in which order.

- 3. The quality of the student's overall design or the whole of his/her deliverables, including the extent to which the student's deliverables show the student's own 'signature'.
- 4. The student's overall attitude including the professional and personal attitude.

In the remaining part of this chapter as well as the next two chapters we will provide an in-depth explanation of these four elements that comprise the ID Competence Framework. In this chapter we will clarify the ten competency areas that form the bases of the ID Competence Framework. In the next two chapters we will describe two perspectives for looking at competence development. The first perspective described in chapter five looks at the four elements within a specific learning activity such as a project, an assignment, a module or a master class. The second perspective described in chapter six looks at the relationships between several learning activities resulting in the overall development of competence of designing. The student can look for behavioural patterns, 'identity' patterns of the deliverables, and growth as a designer over time while carrying out several learning activities. Growth is obtained through different stages.



■ competencies

■ process

■ deliverables

□ attitude

Ten competency areas enabling design



The ID Competence Framework includes ten specific competency areas that are involved during designing, related to the content of the system, product or service to be designed, and/or to the approach needed for the act of designing or becoming a designer. These ten competency areas are:

- Self-Directed and Continuous Learning
- Descriptive and Mathematical Modelling
- Integrating Technology
- Ideas and Concepts
- Form and Senses
- User Focus and Perspective
- Social Cultural Awareness
- Designing Business Processes
- Design and Research Processes
- Teamwork and Communication

Although all competencies have strong relationships and together are necessary for the overall competence of designing, some of these competencies can be seen as meta-competencies. These competencies are necessary for all other competencies to develop. Especially Self-Directed and Continuous Learning is an important meta-competency, but also Teamwork and Communication as well as Design and Research Processes have a meta-character. Modelling in general can be considered a meta-competency but in this framework we focus on a specific kind of modelling. We will briefly describe all ten competency areas.

Self-Directed and Continuous Learning

Take responsibility for and give direction to your own personal development, based on a continuous process of self-reflection and out of curiosity for future developments in technology and society.

Developments in society are characterised by an enormous increase in available knowledge and information, which makes it impossible for graduates to have a complete command of their academic discipline. There is just too much to know and to learn, and what you know today may well be out of date in a number of years. Industrial Design as an academic discipline, too, is susceptible to changes. Once students have become professional designers, they will be challenged to create an environment that adapts to and supports the lives of individual people. Rather than acquiring a particular body of knowledge, this requires their ability to acquire, select and use the knowledge, skills and attitudes that they need for effective behaviour in a specific context.

This, in turn, requires an attitude of openness: not only to developments in their profession and in society, but also towards the student's own performance and learning needs in professional situations. Students graduate once but they will never stop learning. The ability to learn is at the core of becoming

a life-long learner. Students should get an understanding of what learning is as an activity, discover what their preferred learning style and learning strategy is, learn how to play with various styles and strategies, and develop the skills they need to design their own learning process. This understanding should be grounded in theoretical as well as experiential knowledge.

In a competency-centred programme such as ID students need to direct and manage their own competency development, learning process and learning activities: what do they want or need to learn, and what does it take to achieve it? This requires the ability to orientate oneself on what there is to learn, to set one's own learning goals, to choose suitable learning activities (and sometimes create their own), to plan, execute and monitor these activities, to analyse one's learning outcomes in terms of competency development and to evaluate if one has achieved the goals one sets. In the end students should also be able to self-assess their competency development and growth as a designer. Needless to say, the self-management aspect of this competency only works if they take full responsibility for their own learning process.

Learning – and designing – is a process of trial and error. From making mistakes, in particular, they can learn about themselves and about designing. But this takes the courage and the ability to look more closely at themselves, their learning process and learning outcomes. What knowledge and skills have they actually

acquired, what went well in the process, what went wrong, why did it go wrong, are they satisfied with the results, are experts satisfied with their results, why not, what do the results say about their identity-building as a designer, what would they do differently next time? This ability to observe and reflect on their own learning, on the design process and on their overall development as a designer is essential to develop themselves professionally as well as personally. The ability to communicate all this will enable others to give feedback, which in turn will enable students to enhance their learning experience. Finally, self-directed and continuous learning is a competency that enables the development of the other competencies. At the same time their experiences with the other competencies provide students with specific instances of self-directed learning and as such with input for self-reflection. In this respect the development of the other competencies and self-directed learning are processes that will reinforce one another.

Descriptive and Mathematical Modelling

Being able to create and apply descriptive and mathematical models by using formal and mathematical tools, in order to justify design decisions and support the design of complex, highly dynamic and intelligent systems.

Designers operate in a complex world. In this context of complexity our students are encouraged to design innovative systems, products and related services. Technology transforms the experience and behaviour of users in unforeseen ways. In addition, problems are usually ill-defined and opportunities often unlimited. All this makes the decision-making process difficult and conditional, based on the information present at that time. An academic design engineer needs to develop insight and apply powerful tools that help to take appropriate decisions. Developing their analysis and abstraction skills, as well as their descriptive and mathematical modelling competency helps students unravel principle patterns and mechanisms in this complex reality, and explore the potential impact of their design decisions.

Understanding and mastering methods and tools for descriptive modelling

enables students to describe relationships between parameters resulting in systems behaviour. The next step is mathematical modelling to describe this behaviour in mathematical relationships. For engineers, understanding and learning mathematical models is the foundation for simulation and optimisation. These enable exploration of the desired and undesired capabilities of technological mediation that occurs in the complex interplay between user and artefact, as explained in chapter two. Instead of using trial and error methods, students need to explore systematically and get insight: what are the crucial properties of especially highly dynamic and intelligent systems and products that benefit from mathematical modelling? During the design process the results of these types of modelling can be compared with prototype tests and analyses.

Integrating Technology

Being competent in integrating technology means being able to explore, visualise, create and demonstrate innovative concepts and experiences using technology, as well as analysing the technical and economic feasibility of complex designs in which technology is integrated. Moreover, one needs to understand scientific writings and be able to communicate with engineers and researchers of another discipline.

Designing interactive and intelligent systems, and building prototypes requires training in choosing sensors and actuators, object-oriented design, algorithms, circuits and mechanisms, and integrating them in the

overall competency of designing. Next to synthesising and concretising, developing one's analytical and abstraction skills to determine the technical and economic feasibility of a design can be done through informed judgements through calculations, maths items and appropriate math tools, as well as generating sufficient knowledge that enables you to read further and go into depth on technological, design-related issues.

Designers typically work in multi-disciplinary teams. This, and the fact that intelligent systems can overstretch at some point the skills and knowledge of Industrial Design students, requires students to understand scientific writings and be able to communicate with engineers and researchers of another discipline. Thus understanding E, I and W as disciplines and being able to cooperate with the E, I and W engineers, which may require reading specifications and datasheets, documenting hardware and software, and finally awareness of computer science and artificial intelligence.

Ideas and Concepts

Develop visions, innovative ideas and concepts through creativity techniques, experimentations and the translation of research.

Ideas and concepts are initiated through different ways of doing and thinking according to your attitude, influences and experiences such as: empathic thinking (concerned with feeling and sensing your way), associative thinking (compares and makes connections with different objects, places and experiences), thinking with your body and

hands (e.g. sketching, physical modelling, the choreography of interaction), different analysis and selection processes to select and match the best design, and observing the flow of experience and actions as a part of the concept-forming process.

The process of generating ideas to develop into selected concepts is a major step. It is essential to practise your ability to generate and select ideas, as the key to producing effective design concepts. Train and obtain quality through quantity. Ideas are born from your experiences, observations and interactive imagination with physical/graphical objects and products.

Both non-explicit and purposeful observations provide natural conclusions about the immediate human/space/object relationships – basically ‘the world around us’. The development of solutions needs to be guided by a vision, in general about transformation from our current reality to a new one through an intelligent system. We encourage students to search for innovative solutions that are meaningful and valuable for users and our society, which means that it is important to train envisioning: what kind of society do we want to have, what kind of social change does the product to be designed need to have. This means that this competency area is related to competency area ‘Social Cultural Awareness’, e.g. ethical aspects of what it means to intervene in people’s lives, and historical awareness. As an industrial designer you need to have a variety of activities and tools for the process of ideas generation, concept development and vision development.

Form and Senses

Experience and develop through doing and abstraction, aesthetical (physical) languages that connect thought and interactive form, in order to communicate specific properties of the design concept.

The world is inherently meaningful for us, i.e. we perceive the world in terms of what we can do with it, and by physically interacting with it we access this meaning and we express meaning. Vision, hearing, touch, taste and smell all affect our reactions to objects, spaces and the physical world we inhabit. In the past, aesthetics focused on the appearance/ static form of products, where form is the arrangement of a set of elements – these can be visual elements comprising the shape, size, or colour of an object, it can be a set of sounds arranged in time, or it might be a series of smells selected to create a specific effect. With the shift towards interactive products, nowadays aesthetics focuses on (the beauty of) dynamic form and interaction, which includes static form. Because interaction creates meaning, it can stimulate designers to explore, study and design the relationships between a variety of aspects such as sensation, dynamic character, story, rich adaptive and tangible interaction, interaction style, experience, emotion, function, form and semantics.

User Focus and Perspective

Understand human characteristics, goals and needs, the context of use, and create empathy with users throughout the design process. Design user-system interaction for user experiences.

Insight into characteristics, goals and needs of human beings is indispensable for designers in order to create intelligent systems, products and related services that improve the quality of life. The designer needs to have knowledge about the cognitive limitations and capabilities of human beings (what they can learn, remember and how they think, etcetera). Likewise, the designer needs to know about human emotions and attitudes, as well as about human perceptual-motor skills.

Finally, people have different personalities, are members of age groups, cultural groups, social groups, all of which influence their requirements and needs, and the way they interact with systems and products. Understanding and mastering methods for user research and testing will enable you to create empathy with the users and obtain feedback about your proposed solutions, so that you can optimally tune intelligent systems, products and related services to the characteristics, goals and needs of human beings. Knowledge about how to design the user interface and the skills to do so will enable you to create engaging user experiences.

Social Cultural Awareness

The focus of our education at ID is on designing intelligent systems, products and related services for social and societal transformation. Therefore, you need to learn to drive the design process from an awareness and understanding of developments in society, envision your designs in society, place the development of systems in a broader perspective, and take position in and evaluate the impact and mediating role of a system, product or service on society.

Industrial Design is inevitably part of the larger human society and culture. Global society is developing at a breathtaking pace. Mega trends such as ageing, globalisation, new technology and issues such as scarcity of resources, political power, economic and demographic development, play an important role in what the world will be like in the future, and inevitably influence each undertaking in life. A designer needs to develop a keen bird's eye view on this continually changing cultural landscape, turning observations and knowledge into intelligent systems which match the needs of societies and cultural communities, as well as enabling social transformation. This inevitably incorporates ethical and philosophical questions related to taking responsibility for society and the notion of "good" design. In order to be able to transform the behaviour and experience of people, as well as society as a whole, and create the designs of the future, students need a clear understanding of the past, including design history.

Designing Business Processes

Bringing new products to users in a global market of a dynamic international industrial context requires knowledge of industrial business processes.

This competency area covers the topics that relate to bringing new products to users in a global market using a dynamic international industrial context. It focuses on (structures of) industrial business processes that are currently used to bring high-tech products to the market under the influence of a continuous influx of new technology with a high degree of uncertainty of future user profiles. Moreover, the system or product is not finished when it leaves the production line, nor when it leaves the shop. Intelligent products are a never-ending story. Students are able to model, analyse and (re-)design business processes for the successful introduction into the market of intelligent systems, products and related services. They understand that a range of products might be needed for long-term business success, and they are able to design product architectures that last several generations of products and/or allow for a family of products to be introduced efficiently into the market. They are aware of the role(s) of different players in a business network and of the effects of different cultures on (communication and information in) often globally distributed business processes. Designing products and designing business processes have many similarities, including the competencies needed for this activity, where designing business processes has a strong focus on the industrial context.

Design and Research Processes

Master the design process and the research process, and adjust these processes to the demands of the task at hand.

An Industrial Designer should be able to run the design processes efficiently and effectively, to reflect on different kinds and different ways of designing, and be able to choose an appropriate design strategy for their design challenges (with a strong emphasis on the focus of his department). Therefore you need to understand what kind of activity designing is, how it differs from other human activities, and which abilities you should develop to become a designer. A successful design is highly dependent on a thorough research process as a ‘knowledge builder’ and ‘information gatherer’ about the subject domain. Specific research and design processes are planned and organised according to the nature of the design subject and context; these can be quite different and need to be considered carefully according to the required project deliverables.

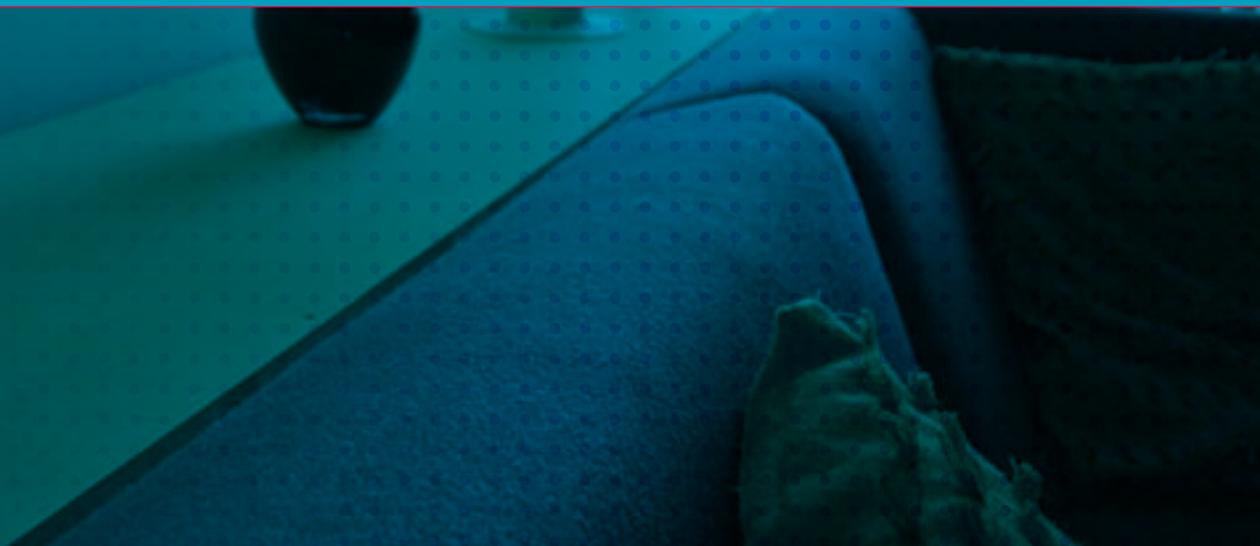


Teamwork and Communication

Work together towards a common goal using all strengths within a team and communicate opinions, ideas, information and results clearly and convincingly.

Design projects by nature involve many different stakeholders and experts, where designers can play a leading role in the assimilation and integration of many different parts of the project. The focus on intelligent systems, which might become very complex, urges designers to cooperate with other experts. Inevitably, this requires special skills and experiences to work in multidisciplinary teams, which are often internationally based. Teamwork is about working together, where the whole is of more value than one person working alone. Teamwork is about understanding the differences between people, how to work together towards a positive goal and most of all, teamwork is about good communication and project management.

Communication has different faces and goals. One can communicate internally (within oneself), for example with visualisations/physicalisations to enhance imagination and reflect on action. One can also communicate externally with team members, clients, experts, users, any interested audience, etc. to show and discuss design-related issues. The type of communication, e.g. presentations (e.g. oral, graphical), discussion or written reports, can be dependent on the type of activity and audience. It involves clarity, inspiration and passion, convincing others, distilling the essence, selling one's ideas, by using (body) language, gestures and materials. Understanding and being able to manipulate aspects such as structure, grammar, language and terminology, appropriateness for the reader/listener, gestures and body language, purpose, atmosphere and context can support one's message. It also requires one to act as a professional within the realm of Industrial Design.





Chapter 5

ID Competence Framework: learning activity perspective

As stated in the previous chapter, one can have two different perspectives on competence development, short-term and long-term. The first, short-term perspective focuses on a specific learning activity such as a project, an assignment, a module or a master class, and addresses within that learning activity the student's development of specific competency areas, of process activities, of deliverables and of overall attitude. This perspective is explicated in this chapter. More information on the different learning activities within the Department of Industrial Design can be found in chapter seven. The second, more long-term perspective looks at the relationships between several learning activities over time, resulting in the development of the overall competence of designing. The student can look for his/her behavioural patterns, a vision on designing, and growth as a designer over time based on a set of learning activities. This perspective is addressed in chapter six.

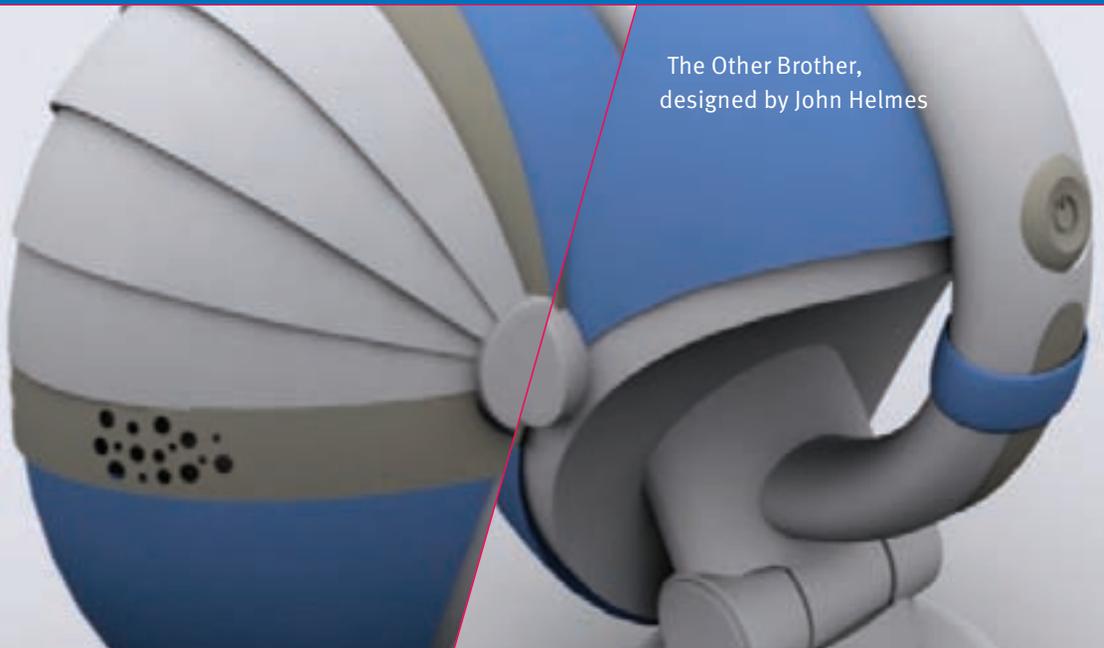
Learning activity perspective

Within our competency-centred learning approach, students select a variety of learning activities such as a project, an assignment, a module or a master class, which represent particular tasks and roles. Learning activities are not an end in itself but a means to generate learning processes, and facilitate competency development in a specific context. So, learning activities are not a target but a gate that opens up the knowledge, skills and attitudes needed by students in order to develop their competencies. The deliverables which students produce in the context of the various learning activities are tangible proof of developing one or more competencies.

As design projects aim at integration of different competency areas, and thus are a very important activity for developing the overall competence of designing, we will explain

the learning activity perspective using the Master's graduation design project by John Helmes, called *The Other Brother*. This semi-autonomous device captures images and video of spontaneous moments in the course of everyday life. It is a situated, tangible object for life-time capturing purposes (Helmes, Hummels and Sellen, 2009).

The framework shows the four elements of the overall competence of designing. The different competency areas are represented in magenta, the process in blue, the deliverables in dark blue and the student's attitude in white. Moreover, the overall context, the society in which the whole process takes place and the designs-to-be will function, is represented in light blue. We will subsequently elucidate all elements, starting with the competency areas.

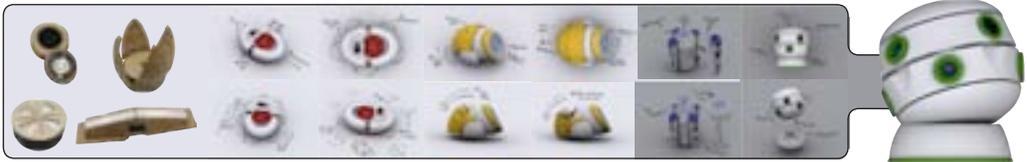


The Other Brother,
designed by John Helmes

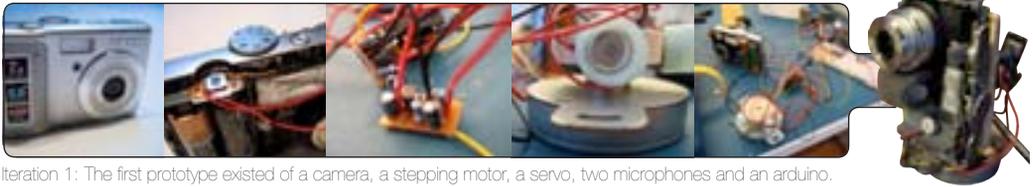
Competency areas

The ten different competency areas are explained in the previous chapter. The framework shows both the ‘weight’ (breadth and depth per competency area) and the ‘profile’ (the contour of the competency areas with respect to depth). Let us look at the sample project by John Helmes. For this project, John developed almost all competency areas, but not in identical ways. Within some competence areas he developed many aspects

covered by that area such as Ideas and Concepts, Form and Senses, and Teamwork and Communication. He used, for example, a variety of ways to develop ideas and concepts, as well as evaluating and selecting them. He scrutinised the aesthetics of both the appearance of The Other Brother and the aesthetics of interaction, not only the ways to interact with the device, but also the influence of context on its behaviour. With respect to Teamwork and Communication, he developed himself as a valuable team player of the multi-



Exploration: (interactive physical) Sketches and 4 different concepts were made to specify the design goals.



Iteration 1: The first prototype existed of a camera, a stepping motor, a servo, two microphones and an arduino.



Iteration 2: Confronting users with iteration 1, the functionality was extended and the aesthetic changed.



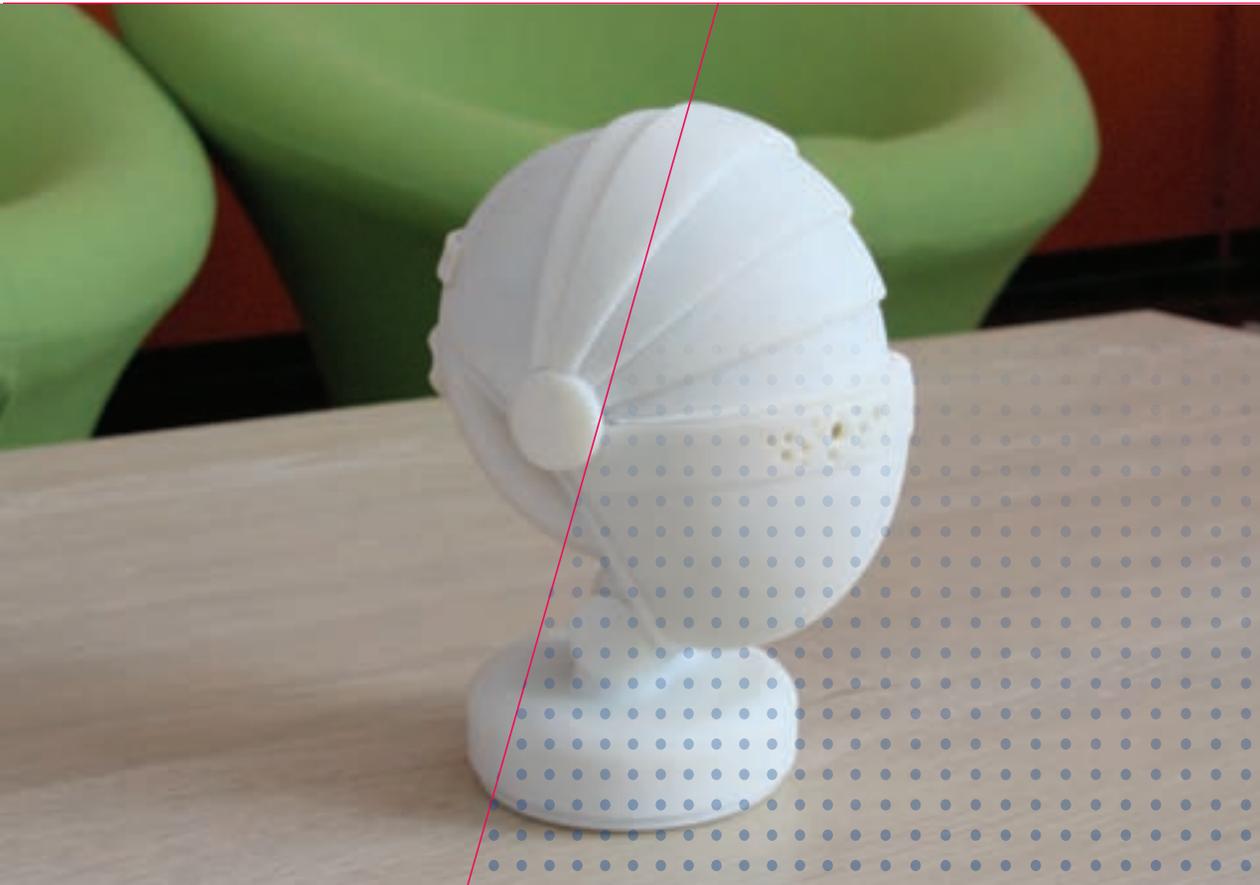
Iteration 3: After conducting a diary study, a third iteration was executed to finalize the design.

disciplinary setting at Microsoft Research in combination with the setting at the TU/e, both of which have their own values and way of working. This required subtle skills as well as excellent visualisation skills to communicate his ideas. With respect to other competency areas, he addressed fewer aspects, sometimes even one or two aspects such as for Social Cultural Awareness, and Design and Research Processes.

Reaching depth within a competency area refers to developing a particular aspect of a competency area several times, in various contexts. It relates to the complexity one can deal with in a new setting. Although the perspective discussed focuses on one project, John's development over the years is visible

in his stage of growth as a designer. The five magenta circles represent these stages of growth going from blank (inner circle) via awareness, depth and expertise to visionary (outer circle). More information about these stages can be found in chapter six.

In total, the profile of his competency development says something about his competence as a designer within this project; the stage of development for the different areas indicates his expertise and the quality of The Other Brother. Moreover, it probably says something about his preference to develop specific competencies for this important final Master's graduation project, which is an important vehicle to get his Master's degree.



The importance of processes for ID

Being a student and developing through a competency-centred learning approach, puts an emphasis on processes. So becoming a designer is inextricably bound up with delivering qualitative excellent intelligent systems, products and related services, the process and competency of accomplishing this excellent design, i.e. the process of designing, and the process of becoming a competent designer. These two aspects are especially addressed in the meta-competency areas ‘Self-Directed and Continuous Learning’ and ‘Design and Research Processes’.

Because we consider these processes extremely important, we have developed a specific process that is based on the department’s educational foundations: the reflective, transformative process (RT process). This process can be used for both settings: the act of designing as well as the course of becoming a designer. Moreover, due to this importance, we have decided to emphasise these processes deliberately in the ID competence framework in addition to the competency areas. This way we can stress the importance of specific aspects of the process. Moreover, the meta-competencies also address other aspects that are not included in the RT process.

The learning activity perspective focuses predominantly on the process of designing. Therefore we will provide an in-depth explanation of the reflective, transformative design process (Hummels and Frens, 2008). Before doing so, we will first reflect on the necessity to develop such a process.

Design processes

Both in literature and practice, one can find many design processes, all emphasising different aspects of the design process. Dorst (1997), for example, compares two influential paradigms of design methodology, namely one in which design is seen as a rational problem-solving process (Simon, 1970; Roozenburg and Eekels, 1991), and one in which design is seen as an activity involving reflective practice (Schön, 1983).

The rational problem-solving process, which was introduced by Simon (1969), can be described as ‘... *the search for a solution through the vast maze of possibilities (within the problem space) ... Successful problem solving involves searching the maze selectively and reducing it to manageable solutions.*’ (Simon, 1969 in Dorst, 1997). In order to find these solutions, the designer goes through basic design cycles which use four design activities:

analyse

synthesise

simulate

evaluate

In 1983 Schön introduced the reflective practitioner to stress the importance of the training of practitioners in the profession and to link the design process and task in a concrete design situation. The implicit 'knowing-in-action' is important, but this hard-to-formalise knowledge is difficult to teach. Therefore, he introduces reflection-in/on-action, in order to train and guide the 'knowing-in-action' habits. In this process the designer goes through four steps:

naming

the relevant factors in the situation

framing

the problem

moving

towards a solution

evaluating

the moves

The rational problem-solving process and its derivatives are used frequently not only in the industrial (product) design world, but also in the human-computer interaction field and the user-centred engineering and design field, such as the model of human-centred design activities as specified in ISO standard 13407 (Markopoulos, MacFarlane, Hoysniemi and Read, 2008). This model has comparable phases, although they are clustered differently and they put a large emphasis on participation of users:

Identify need for human-centred design

Understand and specify context of user

Specify the user and organisational requirements

Produce design solutions

Evaluate design against requirements

System satisfies specified user and organisation requirements

Understand and specify context of user



Fallman (2003) distinguishes three approaches: a conservative, a romantic and a pragmatic approach. The conservative approach has its philosophical base in rationalism and has similarities with Simon's process. Design is seen as a scientific or engineering endeavour. The design process is supposed to advance gradually through a series of structured steps from the abstract (requirements) to the concrete (resulting design) (Löwgren, 1995). The romantic approach gives prominence to the role of the designer who is seen as an imaginative mastermind, a 'creative genius', an artist equipped with almost magical abilities of creation. The process is seen as a 'black box', because the designer is not interested or able to explain how the final design came about. The process itself is guided by the designer's values and taste with respect to quality and aesthetics (Stolterman, 1994). The pragmatic approach gives importance to the position of the design project. Instead of being related to science or art, this approach sees design as a form of hermeneutic process of interpretation and creating meaning. It is closely related to Schön and sees designing as a reflective conversation with the materials of the design process.

There are many more design processes, coming from a business perspective, for example, or from informatics and mathematics. For example, the new product development (NPD) process that focuses on the complete process of bringing a new product or service to market. This process focuses predominantly on the different stages from idea generation

and screening, to concept development and testing, to business analysis and testing (beta and market) down to technical implementation and commercialisation. The design of intelligent systems, products and services has strong implications for this process. One important consequence of the development of strongly innovative products is a growing market uncertainty regarding 'if', 'how', and 'when' users can and will adopt such products. Often, it is not even clear to what extent these products are understood and interacted with in the intended manner. The perception of the user and the designer may be completely different. As indicated in chapter two, the technical mediation of a device or system and the transformation of a person's behaviour and experience is a context- and person-dependent process, which requires a specific role for users in the design process (Koca et al., 2008).

What all these processes reveal is that they are a representation of reality, and they amplify as well as reduce certain aspects of the process, either the focus on reflection, or the user, or the business aspects, and so on. The educational foundation of ID requires, in our opinion, a process model that amplifies and reduces the elements clarified in this book; a process that can be used for the design process as well as for the process of becoming a designer. With our reflective transformative process we do not aim at negating the existence and value of other used design and developmental processes. In many cases other processes can even be incorporated in the RT process, due to the open character. Nevertheless, we want to offer our

students a process that supports developing their overall competence of designing in the field of intelligent systems, products and related services, their vision on designing and their growth as a designer, and emphasise the important aspects of our educational approach.

In the following sections we will elucidate the three implications for the RT process based on the department's educational foundation.

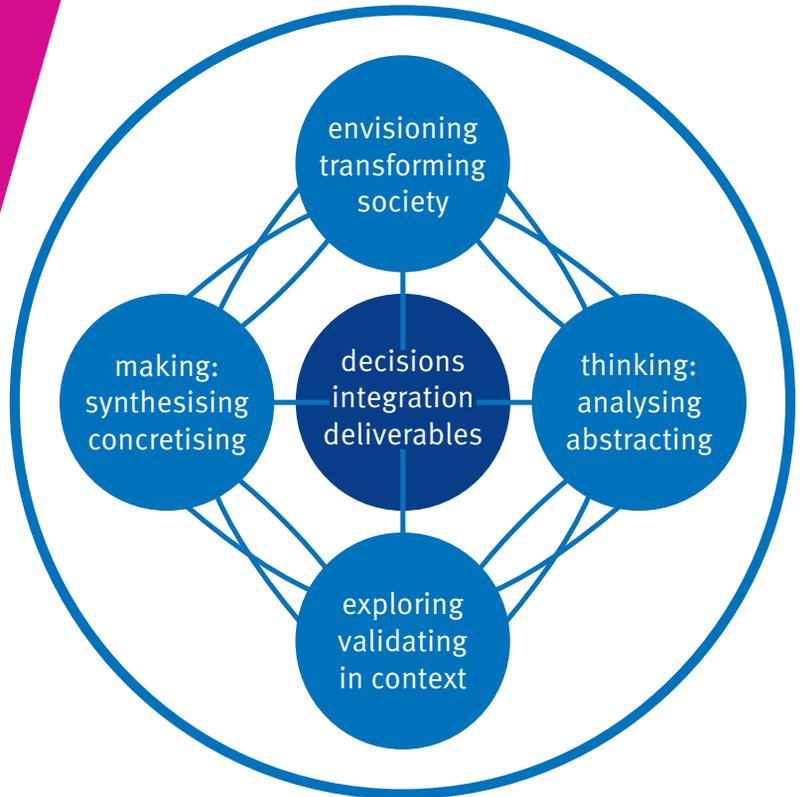
Given the perspective of this chapter on learning activity, we will focus on the design process. In the following chapter we will focus on growth as a designer. At the end of the current chapter, we will explain the RT design process itself, again exemplified with John Helmes' project.

Reflective, transformative design process

When looking at the department's foundation with respect to focus and educational approach, we see three implications for the RT design process (Hummels and Frens, 2009):

1. As stated earlier, we educate students who are able to apply new technologies in innovative, daring and preferably beautiful ways, driven by a design vision of how our (social) world could be in the (near) future, and based on explorative studies and solid research with users in the social-cultural context. This requires a **central place for creating a vision on social and societal transformation** in the design process that we teach our students, as well as a **central place for exploring and validating with users in the context of use**.
2. Competency-centred learning is a highly context-and-person-dependent process. A different context asks for different competencies and different students will prefer different competencies and develop them differently. Therefore, our students create their own programme. The character of this education model and the notion that "the designer" and "the context" do not exist, ask for **diversity of design processes or flexibility within**.
3. Competency-centred learning gives equal weight to knowledge, skills and attitudes, and stimulates students to learn by doing. It is about learning and performing through practical application, while simultaneously acquiring theoretical skills.

The reflective transformative design process, with the different activities that designers use during a design process



Both aspects are bridged by reflection on action. This approach fits the profession of industrial design perfectly. Consequently, the design process we offer the students should be holistic and give **equal weight to knowledge, skills and attitudes throughout the process and stimulate reflection.**

Therefore, we have created a flexible and open design process, the “reflective transformative design process” that addresses these three aspects (Hummels and Frens, 2008).

Developing design solutions in the centre of this model can be seen as a process of taking decisions based on too little information. The breadth of the solution domain and the interdependence of individual solutions, the

design brief and vision make it impossible to determine beforehand if a decision is the right one. Therefore, we consider design decisions conditional.

The process knows two axes: vertically we distinguish drives and horizontally we distinguish strategies.

Drives (vertical axis)

We view the design process as a process where insight into the design opportunity and solution domain is achieved by continuous information gathering. Next to the design solution itself we see two drives for information gathering.

The first drive is information gathering to direct the design decisions through the designer's vision (top circle). We stimulate the development of innovative solutions to transform the behaviour and experience of users and society as a whole. Therefore we encourage students to create a vision on transformation from our current reality to a new reality through an interactive/intelligent system. We encourage students to search for innovative solutions that are meaningful and valuable for users and our society. In the beginning of the project this vision might still be small and captured implicitly in the project brief. During the process, the vision can be developed and sharpened. Competency area Social Cultural Awareness has a natural inclination towards this activity, which doesn't mean that this activity isn't important for the other competency areas, nor that the other activities are not important for Social Cultural Awareness.

The second drive is information gathering to explore and validate design decisions in society with users (bottom circle). Because meaningfulness, value, technological mediation and social transformation are person and context-related issues, the possibilities and solutions have to extensively explored and tested in society. These two drives are closely related to the Technological Mediation framework of Peter-Paul Verbeek, as described in chapter two, for example during analysis to predict the desirableness and undesirableness of the materialised morality of design solutions. Competency area User Focus and Perspective has a natural affinity with this activity, which again doesn't mean that this activity isn't important for the other competency areas, nor that the other activities are not important for User Focus and Perspective.

Strategies (horizontal axis)

The drives are incorporated within two strategies that generate information and that reciprocally provide focus for each other. These strategies are indicated as the basic activities that are central to academic thinking and action, consisting of analysing, synthesising, abstracting and concretising (Meijers, Van Overveld and Perrenet, 2005).

The first strategy revolves around design action, both synthesising and concretising, such as building experiential prototypes (left circle). Synthesising is the merging of elements into a coherent composition for a specific purpose. It goes from small to large. Although designers often think of sketching and prototyping as synthesising activities, the result of synthesising can also be, for example, a theory or a descriptive model. When concretising, one applies a general viewpoint to a specific situation or case. This action goes from large to small. This strategy produces experiential information for the other activities in the design process.

The second strategy revolves around academic thinking: analysis and abstraction (right circle). While analysing, one unravels events, problems or systems into smaller subsets with a certain intention. So the activity goes from large to small. Abstracting does the opposite, going from small to large. It aims at making a viewpoint such as a theory, model or statement, relevant for more cases by bringing it to a higher aggregation level (Meijers, Van Overveld and Perrenet, 2007). Academic thinking produces a more formal kind of information that (again) feeds into the connecting activities. Both strategies are equally valuable and should frequently alternate throughout the entire process.

Dependent on the person, context, or phase within the design process, students determine where they start, how often they swap from one activity to another, and the order of the activities. This way the process supports flexibility and individuality. Moreover, the model actively supports reflection in, on and for action. The mental activity of giving meaning to a learning activity and, by doing so, building new knowledge that relates to existing knowledge is called reflection (Moon, 2004). An in-depth explanation of reflection can be found in chapter three.

When performing an activity within a circle, a student reflects on action. An opportunity for reflection on and for action occurs every time the student switches activities. Therefore, we stimulate frequent changes from one activity to another. This could help novices in design to train their reflective practice. The activity of reflection is indicated in the model by the lines between the mutual activities, and between the activities and the deliverables. Reflection on and for action can also be related to the entire learning activity on a higher level. This is represented in the model by the reflection line of the outer circle.

Visualising one's own process

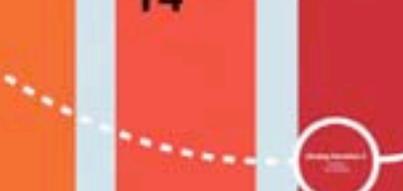
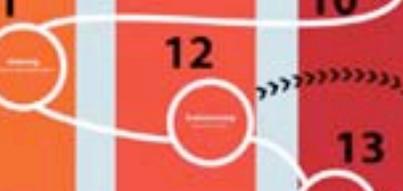
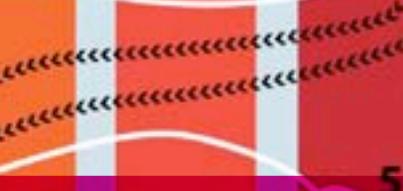
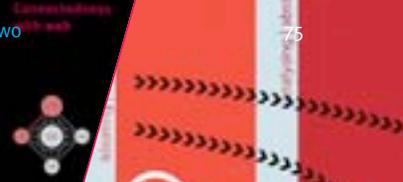
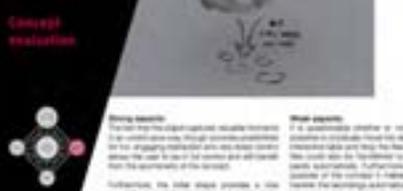
If students articulate their reflections, for example by visualising all the steps and discussing their ideas or view with others, these reflections become a representation of their learning, which can be shared with others and may result in a new or transformed learning experience. As such, these reflections are an integral part of learning itself (Moon,

2004). We explicitly encourage students to document their process in a schematic way. For example, groups of Master's students within the User Class experimented with this visualisation and developed their own way of representing their design and learning process (based on a previous version of the RT design process). They translated the five circles to columns and placed every activity in a column and indicated the relationship between the activities.

There is not one way for doing this. It is also related to the skills of the students and their preference for a certain way of learning (see Kolb in chapter three). For example, one could also work with photos in combination with notes and a visualisation of the RT design process.

Preference and stage

Similar to the representation of competency areas, the activities in the design process also show a 'profile', based on the size of the circles which indicate the student's preference and skills for this activity. This is often related to the amount of time spent on this activity too. When looking at the process of John Helmes, one clearly sees his preference and skills on the making side. He produced dozens of physical sketches to enhance his imagination and creativity, as well as boost his vision on designing in the context of his project. The quality of deliverables was also very strong in relation to the time spent on this project.



The different steps taken to design The Other Brother

A visualisation of the RT process of designing Object+, an open-ended game object for skaters, made by Eva Hopma, Floris Kimman, Bram Knaapen and David Menting



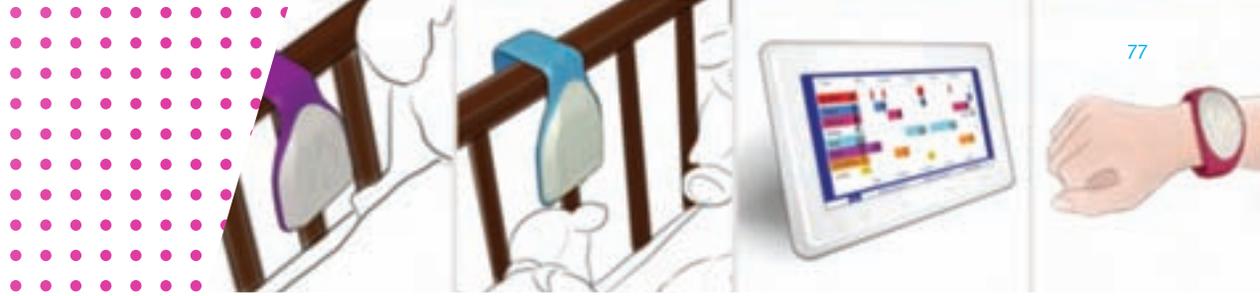
Deliverables

The third constituent element of the overall competence of designing is the quality of the student's overall design or the whole of his/her deliverables, including the extent to which the student's deliverables show the student's own 'signature'. Throughout the process, the decisions in the middle circle can have different forms: e.g. implicitly or explicitly, verbally or written down, or even physicalised. John's project showed many physical deliverables and even three working prototypes. But he made many more decisions and produced many other deliverables such as the outcomes of several user studies, a project report, a presentation, a file for a patent, and an accepted paper for the TEI'09 conference (Helmes, Hummels and Sellen, 2009). The deliverables are strongly linked to the other elements in the framework. They represent, for example, his strength in specific activities (e.g. making). They also indicate the importance of the variety of competency areas for the design of intelligent systems, products and services.

Professional and personal attitude

A competency is defined as "an individual's ability to acquire, select and use the knowledge, skills and attitude that are required for effective behaviour in a specific professional, social or learning context". Attitude is an integral part of a competency. Due to the importance of the student's attitude, we have explicitly visualised it in the framework, as the (white) ground layer for all other activities and development of competencies and deliverables. The attitude can refer to the professional attitude. Students are considered junior employees, so they are expected to contribute to a professional learning and working environment. This means that they need to act responsibly for their own learning programme as well as for their working hours. We would like students to benefit fully from our workspaces and expertise, which implies being at the department for all work-related activities. Being here full-time gives students the opportunity to share experiences





and knowledge with other employees, which enables expertise and community building at the individual and departmental level. Being professional also means well-prepared meetings. If students have an appointment with either fellow students or senior employees, they have to determine in advance what they want to get out of this meeting, in what way they would like to make use of the other employee's expertise. What does this require in terms of preparation (retrieving information, phrasing specific questions, etc)?

In addition, when using ideas, theories, visuals or graphics from others in their own writing, students need to learn to use the proper way of referencing and citation.

Finally, most students have their own workspace in the space where their theme is located. We expect all students to use their workspace as an employee. We want our learning environment to communicate a professional working atmosphere for all employees (including students), but also for external people or clients who often come in.

Next to a professional attitude, the students also have their personal attitude, which is related to aspects such as intrinsic motivation, passion, being critical, being in control, responsible and working independently, while on the other hand asking for help and respecting the expertise of others.

Society

Although not a separate part of the overall competence of designing, the actors in the context of the learning activity, including users, industry, professional field, academia and government, play an important role in a learning activity and set the boundaries, although social and societal transformation can play with these boundaries.





Chapter 6

ID Competence Framework: competence of designing perspective & stages of growth as a designer

The remaining perspective to be discussed refers to the development of the overall competence of designing during the entire study. The elements are the same, only the interpretation can differ. Moreover, this chapter will elucidate growth as a designer through the different developmental stages.

Competence of designing perspective

Competency areas

The development of the different competency areas is attained by the whole set of learning activities during the consecutive semesters and blocks. This means that the breadth of the competency area is the sum of all aspects developed during all learning activities. Depth is gained by repetition of aspects in different contexts. It relates to the complexity one can deal with in a new setting. Thus competency development is not a checklist; if someone has done it once, it doesn't automatically mean that that aspect is in the bag and can be ignored thereafter. The essence lies in gaining insight in their competency development.

Especially the Self-Directed and Continuous Learning aspects are crucial for this perspective. It forms the core for growth. This also requires reflection on and for growth. Therefore, this perspective shows a reflection line around all other elements. The IDentity weeks focus in particular on this kind of reflection on and for action. These weeks occur three times per semester. At the start the students reflect on what they have achieved in the previous semester in terms of overall competence of designing and their vision as a designer, and use this information for their Personal Development Plan (PDP). Halfway the semester, students start adapting their showcase for that semester. They reflect on what they have achieved in their learning activities so far, as related to the goals they set in their PDP. Towards the end of the semester, students make a second round in adapting their showcase for that semester and

preparing it for the assessment. They reflect on what they have achieved in their learning activities so far, as related to the goals they set in their PDP. They do not only look at the past semester but also at their history and their plans for the future.

Processes

The design process remains important in this perspective, and performing learning activities several times in a different context reveals patterns of approach. Some students are more inclined to start from a making strategy, whereas others prefer to have a strong analytical strategy. As often, the truth is somewhere in the middle. Both strategies are equally valuable and should frequently alternate throughout the entire process. This strongly relates to becoming a designer and the kind of designer one becomes.

In this perspective of the competence of designing and growth, the upper circle containing envisioning and transforming society now refers to the student's vision on designing. And the lower circle gives a societal reference for one's actions and development.

Looking at John Helmes' processes over the year, one can see a clear emphasis on making through tangibility. He is currently teaching his colleagues at Microsoft Research Cambridge the benefits of this strategy and the actual know-how to use this strategy, and by doing so he is developing his own competence of designing.

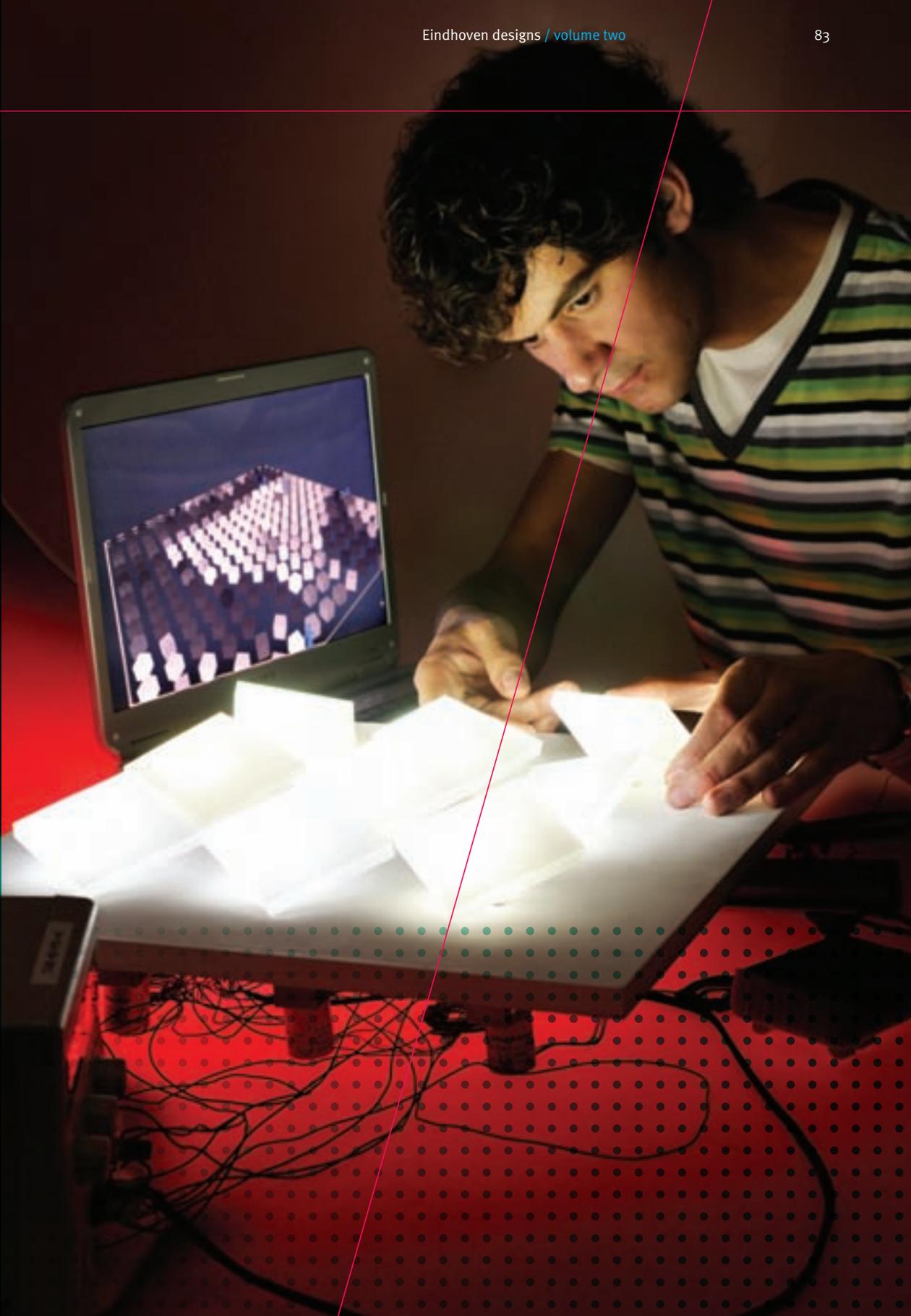
Deliverables

The total of all deliverables gives an impression of both the qualities of the designer as well as his/her vision on designing. The deliverables are strongly linked to the process and competency areas. When looking at the different deliverables, the student can find patterns that indicate his identity. For example, John Helmes' overview of his projects over the last years shows a clear preference for subtle interaction with small devices that try to enable or capture intimate moments. For example, ReVive is a small autonomous, organically shaped robot, which can add lotion to treat acne on a person's back. It finds its own path to cover the area that needs treatment. Fida is a small spherical object that allows a child to capture emotionally intense moments and communicate emotions indirectly to the parent. The emotional message takes the form of a spoken message, a colour, a personal note or a combination of the three. It can be left in various (personal) places, thus providing a platform to trigger intimate communication in both positive and negative situations. Finally, the Other Brother is a little robot-like device that captures sounds, images and video of spontaneous moments in the course of everyday life. It is triggered by sound and rotates towards the sound source to capture footage. The Other Brother is

designed as a situated, tangible object for life-time capturing purposes and enables people to re-experience these moments in a playful way. Seeing the relationships between his competency development and deliverables helped him to formulate his Master's graduation project and sharpen his identity, which he is further developing in his current position at Microsoft Research Cambridge.

Attitude

The attitude necessary to become a designer with an ID, TU/e flavour is not substantially different from the attitude needed for a single activity. In all cases, the student will need an active and responsible attitude. If a student is not pro-active and doesn't take things into his/her own hands, he/she will have a hard time in Eindhoven. In general, all coaches and experts at ID are more than willing to support the student in the learning process, but the student needs to be in control. In general, this means that a coach or lecturer puts more time into relatively good students than in relatively poor students, which is the opposite in most traditional learning approaches.



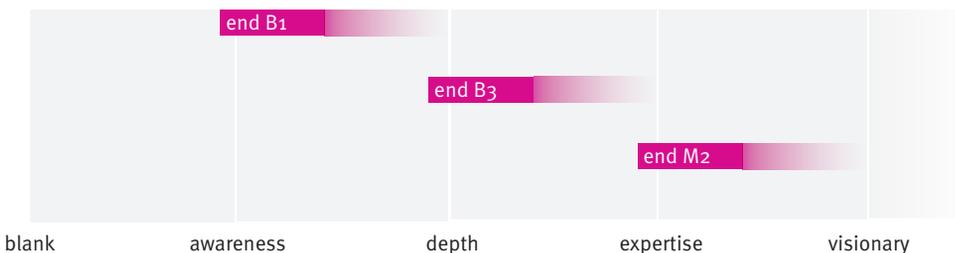
Stages of growth as a designer

Students perform learning activities that yield particular deliverables. In order to achieve these deliverables they need to develop particular competencies. These deliverables and related competency development contribute to the development of the students' overall competence of designing, and to their growth as a designer. This overall development requires thorough understanding and integration of the ten ID competency areas.

Lawson and Dorst (2009) indicate that learning to become a designer is strongly related to design expertise. In his theory about scientific revolutions, Kuhn (1962) suggests that advances in science come with paradigm shifts and leaps. It seems that advances in learning follow the same pattern. The student widens his/her scope with a variety of thinking and making styles, which offer more opportunities for tackling design situations. So he/she enlarges his/her repertoire. This development is hardly ever continuous and uniform, but follows a pattern of jumping from one plateau

to the next. Once a skill is learned, the student seems ready for the next leap forward to a level of unconscious effort where it tends to be transparent and automatic. Lawson and Dorst (2009) explored the generic model of expertise by Hubert Dreyfus (2003). This model knows six distinct levels of expertise: novice, advanced beginner, competent, expert, master, and visionary. Within the department of ID we have worked, right from the start of the department, with developmental levels of expertise, although one less than Dreyfus. In the remaining part of this chapter we will explain the five stages we use at our department.

For the students' overall development we distinguish five developmental stages: Blank, Awareness, Depth, Expertise, and Visionary. These stages are represented in the ID competence framework by the five magenta circles. In the figure showing the five developmental stages they are visualised as growth of ID competence framework. The figure below shows which stage students are expected



to have reached at the end of the first and the last year of the ID Bachelor's programme as well as the last year of the ID Master's programme. The gradients in this figure show that excellent students may well achieve beyond the expected stage.

Stage 1 Blank

When students enter our department they are like blank, unwritten pages with respect to our view on designing, educational model and ID competence framework. For them the design process is probably just a phrase, a set of unknown activities: one big blur. They do know that our program is competency-centred, but the majority of them do not have the slightest idea what the notion of competency means and what the ID competence areas entail.

Stage 2 Awareness

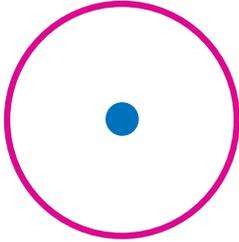
In the first year, students have performed a number of assignments and projects. They have received their first feedbacks, and have written their first reflections on their learning experiences within learning activities, deliverables and competency development achieved. They have built a showcase twice, in which they reflect on their overall competence of designing, on their design process(es) and their growth as a designer. At the end of their first year, students demonstrate awareness of what the ten ID competence areas entail as related to their own work, what their own overall competence of designing is, what their

own growth as a designer is, how competency development contributes to overall development, and what a design process may constitute. They have built awareness with respect to interactive systems.

Stage 3 Depth

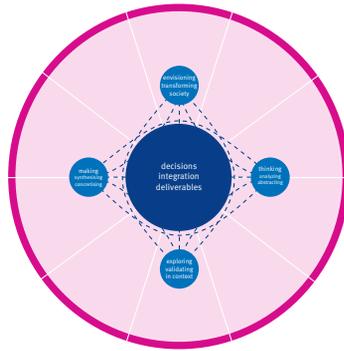
Depth is the expected stage for Bachelor's graduates. Students have years two and three to achieve this. The stage of depth is characterised by knowledge and skills building, including experiential knowledge as well as theoretical knowledge. Students demonstrate depth in particular competency areas and in their academic skills as a designer: making (synthesising and concretising) and thinking (analysing and abstracting), next to emotional and social skills. Depth also shows in their ability to integrate, and their professional attitude and responsibility as a designer. In their reflections they connect competency areas to one another and establish connections between competency areas, the overall competence of designing and growth. They have gained experience with the activities within the reflective, transformative design process, and with jumping from one activity to another while reflecting on the previous one. They demonstrate understanding of this design process as a whole. They have built an awareness of intelligent systems and demonstrate depth in interactive systems. Their showcase communicates (the beginning of) a clear vision on designing developed over time.

society



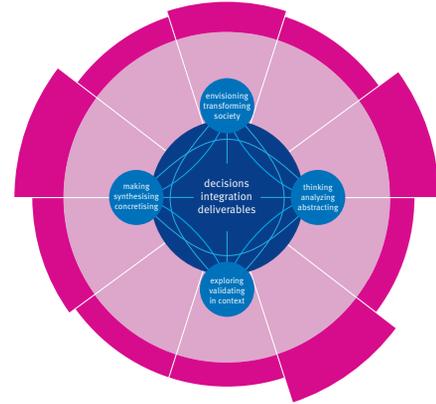
blank

society



awareness

society

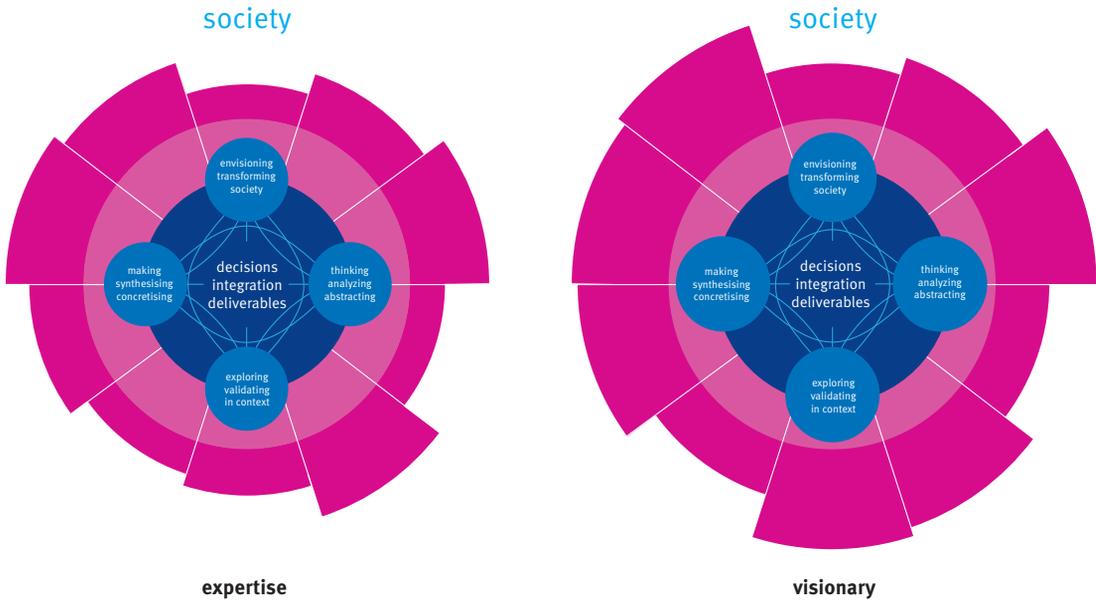


depth

Stage 4 Expertise

Expertise is the expected stage for Master's graduates. When students have achieved this stage, all elements of the ID competence framework have merged and are inextricably intertwined in all activities. They demonstrate expertise building in the overall competence of designing, in growth as a designer and in particular competency areas, while showing depth in others. Expertise in particular competency areas shows in the quality of students' deliverables and in their ability to discuss and communicate their expertise to others. Expertise in growth as a designer is reflected in students' showcases and their view of designing in their reflections. This expertise is demonstrated, too, in their

integration of interactive and intelligent systems into their design. Expertise in the overall competence of designing is reflected in their ability to integrate various approaches in their design process (design, engineering and social science). It also shows in their ability to jump comfortably back and forth between the activities within the reflective transformative design process, reflecting on the steps they take, and trusting their senses. They demonstrate an academic level of designing.



Stage 5 Visionary

Visionary is the stage that excellent Master's graduates may have started to develop. For many graduates this is the stage they will work on and arrive at after their graduation. Dorst (2004) defines this stage as follows: *"The world discloser or 'visionary' consciously strives to extend the domain in which he/she works. The visionary develops new ways things could be, defines the issues, opens new worlds and creates new domains. To do this a visionary operates more on the margins of a domain, paying attention to other domains as well, and to anomalies and marginal practices that hold promises for a new vision of the domain."* In the Bachelor's as well as the Master's course,

a strong emphasis is put on envisioning for societal transformation, and students are stimulated to develop their own vision on society. When a designer has reached the stage of visionary, all his/her designs breathe this overall vision, which has become the salient aspect of his/her identity, and this visionary expertise is recognised by other experts in and outside the field of industrial design.



Chapter 7

Learning activities and staff roles

Within our competency-centred learning approach we offer a variety of curricular learning activities to reflect professional practice. This includes the experience with and performance of different tasks and roles. In order to enable students to become unique designers, we give them the opportunity to address their individual learning needs. This implies a shift in staff roles. We offer at least seven different learning activities: projects, assignments, modules, classes, minors, workshops and IDentity weeks.

Students have different ways of learning and different needs for developing their competencies. That is why we do not have one fixed programme for all students (supply-oriented). Instead, we develop various types of curricular learning activities, each with their specific characteristics (e.g. authentic versus constructed context, focus on competence of designing versus specific competency areas, individual versus teamwork). Our students are responsible for determining what to learn and which learning activities suit best (demand-oriented). This implies that all our learning activities are ‘electives’. Students’ selection of learning activities is framed within the department’s view on designing, the ten competency areas, and the overall focus on intelligent systems, products and related services.

As junior employees, students are required to perform learning activities that represent authentic tasks and roles. In addition, they need to do a particular amount and type of work per semester, for example four assignments and a project for the second block of the first Bachelor’s course year. By making a Personal Development Plan at the start of each semester, students determine per type of learning activity the ones that provide the best opportunity to develop their competencies and overall competence of designing. So learning activities are not an end in themselves but a means to generate learning processes and facilitate competency development in a specific context. To put it differently, learning activities are not a target but a gate that opens up the knowledge, skills and attitudes needed by students in order to develop their competencies.

In terms of students’ learning, this implies that process and output are equally important. Students’ focus should not be on completing the learning activity successfully (task-orientation), but on exploring opportunities for competency development that enable them to accomplish high-quality deliverables. The deliverables which students produce in the context of the various learning activities serve a double purpose. Wanting to achieve high-quality deliverables triggers competency development in breadth as well as depth. Breadth refers to developing all aspects covered by a competency area as much as possible; depth refers to developing a particular aspect of a competency area several times, in various contexts. At the same time, the deliverables which students accomplish are tangible proof of having developed one or more competencies. As explained before, students’ achievements within learning activities are not an end in themselves so they are not assessed separately. Instead, students receive written feedback at the conclusion of a learning activity.

In terms of the ID Competence Framework, the various types of learning activities address different goals. Assignments and modules, for example, mostly facilitate development of one or two competency areas and some of the activities of the design process. A project or internship, on the other hand, offers students the opportunity to develop and integrate the full range of competency areas and design activities. Ultimately, however, students’ competency development is meant to feed and enhance their overall competence of designing and their vision on designing. Students’ showcase and the assessment process reflect this interaction between the learning activity perspective and the overall competence of

designing perspective (see chapter five for more detailed information on these perspectives): the focus is on students' competence of designing and their vision on designing, backed up by the quality of students' deliverables and competency development achieved in learning activities, rather than on the successful completion of separate learning activities.

Staff members in various roles facilitate, support and enhance students' learning

and development. Staff roles include competency coach, project coach, expert, assignor, module/class lecturer and assessor.

In the sections below we briefly explain the particulars for each type of learning activity. Organisational and planning-related information on learning activities is to be found on our intranet (<http://w3.id.tue.nl/nl/intranet/>). This chapter concludes with more detailed information on the various staff roles.

Projects

Projects are the backbone of the ID curriculum. Within the projects, students develop their competencies in an authentic context, often including a real client. Projects allow for integration of the competencies into a design process, integration of research processes into the design, and interaction between the learning activity perspective and overall competence of designing.

Throughout both the Bachelor's and the Master's course, students do projects that are related to one of the Themes. Though projects may vary in focus, they all enable students to develop and integrate their competencies as well as their overall competence of designing, to develop and express their vision on designing, and to experience their growth as a

designer. There should be room for students to explore: experiencing success as well as living down a poor performance. As these projects are the backbone of the ID curriculum, they get a much larger part of 'dedicated time' than assignments or modules, for example. A typical Bachelor's project takes up 60% of dedicated time per semester whereas the final Master's project is a full semester. We want students to be able to experience different views and expertise. One way to achieve this is by cross-coaching. For example, during the semester, first year Bachelor's students work with their main coach but with at least one other coach from the Theme that is coaching the same project.

Bachelor's projects

The focus of first-year projects is on awareness of the design process and the competency areas. A first-year project consists of several parts, with a 'fresh start' for every part. Students can use their own results from a previous part or, if necessary, the results of another student or team. Distinguishing several parts in a project allows students to experience the various activities and phases of a design process (for example by using the 1:10:100 method) as well as to see the relationships with the various competency areas. The 1:10:100 process is an iterative design process that may refer to time, for example: 1 day-10 days-100 days for subsequent design iterations, but also to focus, for example, on variety in users: in the 1-phase the product or prototype is for the student him/herself or a very limited number of people, in the 10-phase the product or prototype is for a selected group of high-contrast users, and in the 100-phase a larger group of selected users is given a product for "normal" use (Brombacher, Funk, Karapanos, Koca and Rozinat, 2009). Given the focus on awareness, students should get acquainted with different Themes by varying the Themes they choose for their projects. A first-year Bachelor's project also provides students with the opportunity to work and learn individually as well as in a team.

Projects in the second year focus on integration as well as on in-depth experience with and knowledge of the various activities in the design process. Likewise, depth should be reflected in the quality of students' deliverables and in their competency development. Despite the overall theme of

depth, second-year students are advised to broaden their scope and choose their projects from Themes they have not yet been involved with. Like first-year projects, projects in the second year are partly teamwork and partly individual work.

The focus of the third-year project or final Bachelor's project (FBP) is a continuation of in-depth experience with and knowledge of the design process. In addition, the FBP should reflect students' vision on designing. With the minor and FBP combined, students should demonstrate the stage of depth for their overall competence of designing and their vision on designing, and corresponding deliverables and competency development. Contrary to the final Master's project, the default for an FBP is an off-the-shelf project. Excellent FBPs are included in ID'xx (e.g. ID'09), the yearly exhibition which shows all Master's graduation projects and a selection of excellent Bachelor's and Master's projects.

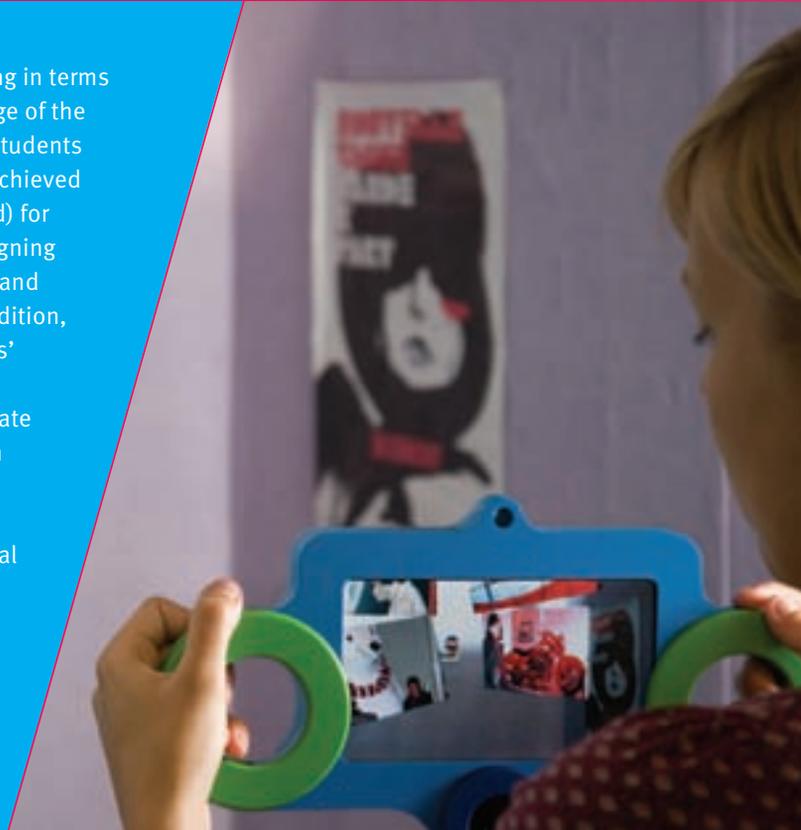
Master's projects

First-year Master's students do two projects which, as a rule, are individual: a designer-oriented project and a design-researcher-oriented project. Both types of projects are off-the-shelf, offered by the Themes. The focus of these projects is expertise building in and control over the various activities in the design process, backed up by a corresponding quality of deliverables and competency development. Students' process and deliverables should convincingly express their vision on designing.

Second-year Master's students only do one project, their individual Final Master's Project (FMP). The focus of the FMP, too, is a



continuation of expertise building in terms of experience with and knowledge of the design process. With their FMP students should demonstrate they have achieved the stage of expertise (or beyond) for their overall competence of designing and corresponding deliverables and competency development. In addition, the FMP should breathe students' vision on designing. As a rule, students put forward and elaborate their own project proposal for an FMP, again related to one of the Themes. Master's students, too, are advised to look for an external client for their FMP. Master's students present their FMP at our exhibition ID'xx.



Assignments and modules

Assignments are learning activities for Bachelor's students. They represent 48 hours of individual work (as a counter balance to the team work in projects). Modules are learning activities for Master's students. They represent 40 hours of either small group or individual work. The scope of an assignment and module is mostly one or two competency areas. Compared to the authentic context of projects, assignments and modules are more constructed by nature.

Assignments provide Bachelor's students with the opportunity for either awareness building of a particular competency area, for in-depth competency development or, in some cases, for the acquisition of specific knowledge and skills. Likewise,

modules provide Master's students with the opportunity for expertise building in particular competency areas or, in some cases, for the acquisition of specialised knowledge and skills. This competency development enables or enhances development of the overall competence of designing and vision on designing. It may enhance students' competency development in the projects. Assignors and module lecturers facilitate and support students' learning and competency development from an expert point of view. They also help students to put the competency areas involved into the wider perspective of the design process and the competency framework.

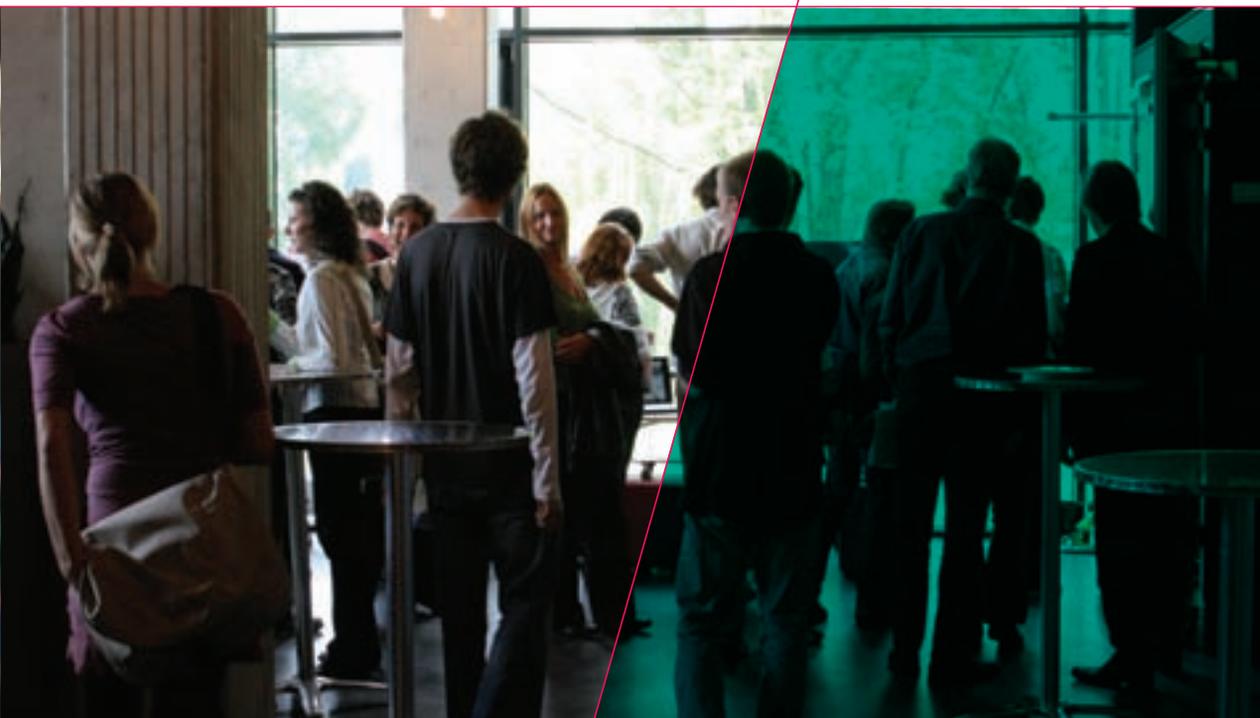


Classes

Classes are learning activities for Master's students in the second block of their first year and/or first block of their second year (blocks M1.2 and M2.1). They represent six full weeks of either small group or individual work, scheduled as three times two weeks. The scope of a class is mostly the area of one and sometimes two or more capacity groups.

The context of students' learning in classes is more constructed (as opposed to the authentic context for projects). Given their size, classes provide students with the opportunity for extensive expertise building in one or more competency

areas with a clear connection to the overall competence of designing and vision on designing. This expertise building also enables and enhances students' competency development in the FMP. The class lecturers facilitate and support students' learning and competency development from an expert point of view.



Minors

Minors are learning activities for B3.1 students. Students' choice for a particular minor depends on their learning goals for the first block of the third year (block B3.1) as well as the purpose each of these minor types serve.

Throughout the TU/e, third-year students are required to take a minor. The minor semester consists of academic training (three credits and organised centrally) and the minor itself (27 credits). Students can either take a deepening or broadening minor, or a minor that facilitates a smoother entrance into a Master's at another TU/e department or university. Depending on what ID students want to achieve in the third year as a whole, they can choose one of the following minors:

- An exchange at a university abroad, with which ID has a bilateral agreement. This deepening minor is an option for students who want to gain experience with learning in another educational model or culture, or if they want to acquire expertise that is not available at the ID department or the TU/e.
- An internship at a design office, a company, an R&D or design department of a large company in the Netherlands or abroad. This deepening minor might be an appropriate choice for students who want to gain 'real-life' experience with design projects, experience the difference between learning at ID and learning in a professional setting, or gain experience with learning and working in another culture.
- A minor program at one of the other TU/e departments or at one of the other Dutch universities of technology (Delft and Twente). Students may opt for this broadening minor if they want to acquire expertise that is not available at the ID department, if they want to gain experience with another educational model or if they want to use the minor programme to prepare for a Master's programme at the department or university involved.
- A free minor programme within or outside the TU/e. For this type of broadening, minor students compose their own programme and submit this to the Board of Examiners for approval. It is an option for students who want to acquire specific knowledge or expertise, either outside the scope of or related to industrial design.



Workshops

Workshops are short activities intended to introduce particular topics that help students develop their competencies within the context of their project.

Workshops are comparatively short learning activities. Their size may vary from a few hours to a full day. Workshops provide students with an introduction to various topics, for example information brokering, design processes, reflection, group dynamics, creating a showcase, mathematical modelling, electronics or a theme-related topic. These introductions are meant to initiate and support students' competency development within the projects. Workshops can also provide students with specific expertise, either linked to a particular competency area or to a Theme.

IDentity weeks

IDentity weeks are 'vertical' activities for all ID students. In these weeks students' activities focus on their personal development, on their learning and development process, and on their overall competence of designing.

ID weeks occur three times per semester: at the start, halfway and towards the end of the semester. The first ID week is intended for students to reflect on what they have achieved the previous semester in terms of overall competence of designing and their vision as a designer. In order to do so, they review their previous showcase and assessment. They include the outcomes of this review in their Personal Development Plan (PDP) to determine or adjust their long-term goals for their growth as a designer. Based on these long-term goals, they set short-term goals for their development in the coming semester and choose a set of learning activities with which they can achieve their competency development goals.

In the ID week halfway through the semester, students start with their



showcase for that semester. They reflect on what they have achieved in their learning activities so far, as related to the goals they set in their PDP. They relate this to the competency areas and select the deliverables that illustrate their competency development best. They take into account the feedback they have received so far, which includes final written feedback and verbal feedback from the exhibition. They also reflect on how their competency development so far has contributed to their development of the overall competence of designing (activities and parts of the design process gone through so far) and their vision as a designer. They (re)design the concept and structure for their showcase of that semester; they write reflections and include the visualised learning evidence in their showcase as much as possible (for the past as well as the present

dimension). If applicable, they adjust their PDP for the second half of the semester and possibly their envisioned design process for the remaining part of their project.

In the ID week towards the end of the semester, students essentially repeat the process they have gone through in the second ID week. They reflect on what they have achieved in all their learning activities, relate this to the competency development they planned to achieve, and reflect on how this has contributed to their overall competence of designing and vision as a designer. They select the learning evidence that proves their development best. They process reflections and visuals in the past, present and future dimension of their showcase.



Staff roles

Our constructivist perspective on learning and our competency-centred approach imply a shift in educational goals. This requires a shift in staff roles: from teaching specific knowledge to facilitating, supporting and enhancing student learning.

For each staff role the central question is: what do students want or need to achieve, what is required for this and how can I support and enhance their process and results, given my specific staff role and professional expertise? The various roles are briefly discussed below.

Coach

Coaches play a crucial part in facilitating, supporting and enhancing students' competency development and growth as a designer. Since we aim at creating an authentic learning environment, about 40% of our coaches are design practitioners.

The scope and focus of the coaching role may vary: either competency development over a semester as a whole (competency coach, CC), or a curricular learning activity such as a project (project coach, PC) or a minor (exchange, internship). In most cases, coaching includes both perspectives: for a given group of students a staff member performs both the role of CC and PC.

The role of competency coach focuses on the process of students' learning and competency development. Within our framework this is the competency area Self-Directed and Continuous

Learning, and the overall competence of designing and growth as a designer. Students discuss their PDP with their competency coach, the progress within their learning activities, the relationship between work results and competency development, the integration into their overall competence of designing and vision on designing, and the creation of their showcase to communicate all this. Competency meetings are mostly individual (between CC and individual student) but may also be in small groups (between CC and several students). The CC gives students feedback from a holistic, competency development point of view.

The project coach supports students in the context of the project, which students either do in teams or individually. So project coaching includes team and individual coaching. The focus of project coaching is the design process, project management, team processes and the quality of the deliverables. This includes the students' development of separate competency areas in the context of the project as well as the interaction between the competency areas and the activities in the design process. The PC gives students feedback from a design process perspective.

Coaching third-year students who do a minor is similar to project coaching; although there is an essential difference: these students are not at the department but at another university or department, or in a company. This makes it 'distant coaching'. Minor students also have a coach at the university or company concerned, the organisation coach. For the TU/e coach this

implies a strong focus on and support of students' competency development. This TU/e coaching role is also referred to as faculty coach.

Assignor and lecture

Assignors and lecturers facilitate, support and enhance student learning in the context of specific learning activities: assignments, modules and classes. These learning activities mostly address one or two particular competency areas, though classes also address the interaction between the outer and inner circles. Assignors and lecturers support and enhance students' acquisition of specific knowledge and skills, framed within a particular competency area as a whole.

Within this context, assignors and lecturers perform the role of expert. They support students in achieving awareness or depth (assignments), or expertise (modules and classes). They also provide students with pointers as to how to transfer a particular approach or view to projects or other learning activities, so students can build up awareness, depth or expertise in various contexts. At the scheduled meeting with students, they discuss 'content' (specific knowledge and skills), relate this to the competency area(s) as a whole, and give students feedback on their progress and achievement within the assignment, module or class. Assignors and lecturers provide students with feedback on the quality of their deliverables, (design) process, competency development and attitude from an expert point of view.

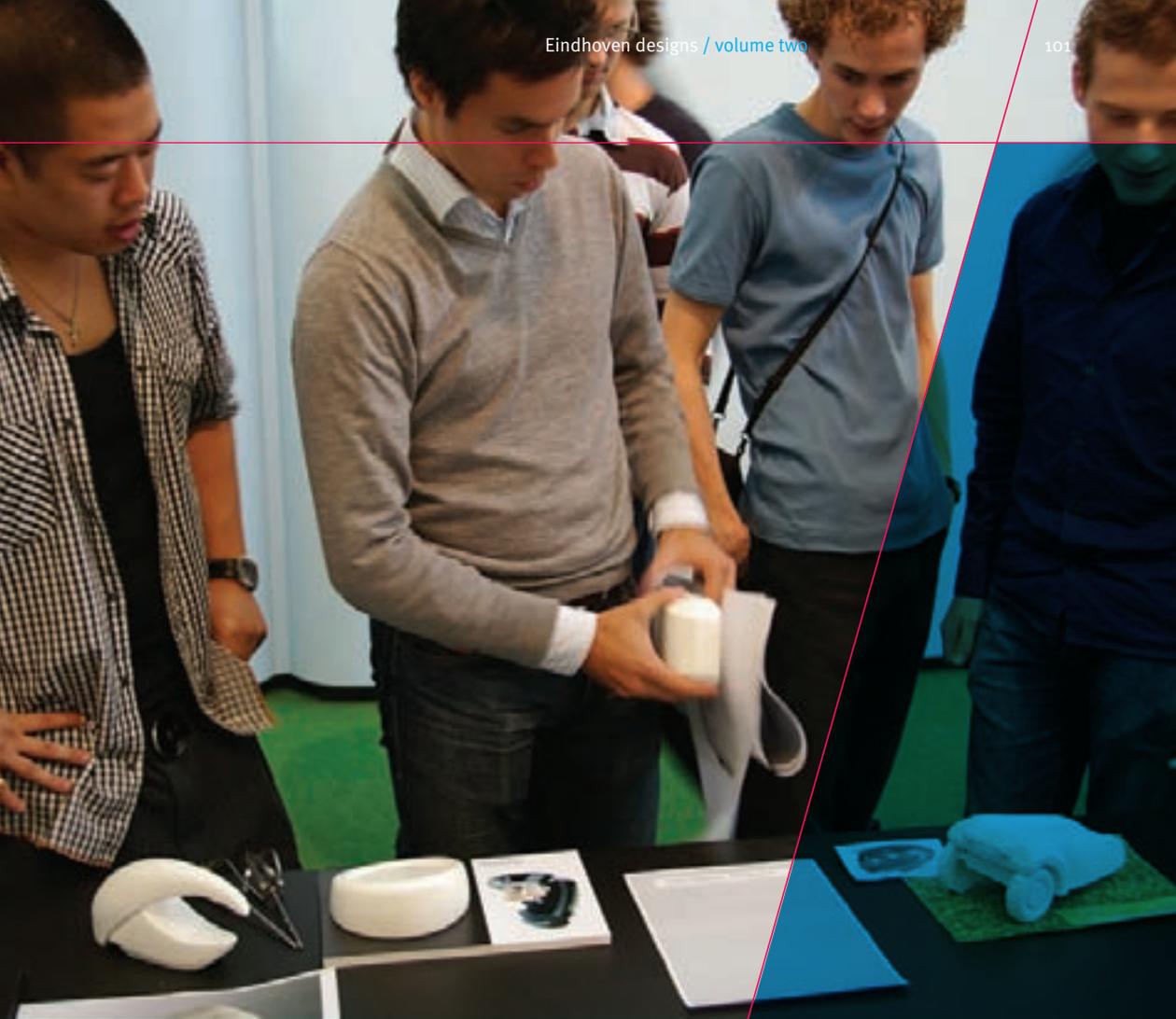
Expert

The role of expert is comparable to the role of assignor or lecturer. An essential difference is that experts do not have their 'own' learning activities in the programme.

Instead, students themselves have to contact them if they need consultancy from an expert, mostly in the context of the project they are doing. Students should only contact an expert after thorough preparation so they can get the most out of their meeting with the expert and do not claim time for vague questions or for information they can easily retrieve themselves. From the second year onwards, students should really involve experts in their projects to achieve depth or expertise in particular competency areas and in their deliverables.

Assessor

The role of assessor focuses on evaluating the developmental stage which a student has achieved at a particular moment, framed by the student's history as a designer (development up to that point) and the student's ambitions (long-term-goals for growth as a designer). The perspective from which a staff member performs this role is holistic and independent. Independent in this context means that the assessor has not been the student's coach in the semester concerned, so has not been involved in the process of the student's development. The assessor examines the student's



development of the overall competence of designing, vision on designing and growth as a designer, as shaped by what the student has achieved in the learning activities of the semester concerned. The assessor determines what a student has achieved and what developmental stage this represents (assessment of learning), and relates this to the next developmental stage (assessment for learning). The assessor takes a formal decision on the student's progress in the programme (promotion to next block or not); and gives feedback on the student's overall development from a holistic point of view (see chapter eight for more information on feedback and assessments).



Chapter 8

Feedback, assessment and showcase

Students' learning, the learning environment and the assessment need to be aligned with one another. In our case this means that the way in which we approach assessment should be highly consistent with the constructivist perspective on learning. In order to achieve this we aim for a balance between 'assessment of learning' and 'assessment for learning'.

Traditionally, assessment is considered to have a formative and a summative purpose. The **formative** goal of assessment is to provide qualitative information that facilitates, supports and enhances students' learning process and achievement. This formative purpose is also referred to as 'assessment **for** learning'. This notion stresses the interaction between assessment and learning: the focus is not only on the outcomes of learning but also on the process of learning. We use the notion of '**feedback**' for this. Given the goal of feedback, typical feedback moments take place during a learning activity rather than after the conclusion of an activity.

The **summative** goal of assessment is to collect information on the students' achievement in order to take a formal decision on the student's progress in the programme. This summative

purpose is also referred to as 'assessment **of** learning': the focus is on the result of learning, not on the learning itself. We use the notion of '**assessment**' for this summative or decision-taking function. Given the focus of our assessment, a typical assessment moment occurs at the conclusion of a semester.

The way in which we have implemented feedback and assessment creates a balance between assessment for learning (facilitating learning) and assessment of learning (decide on the student's progress). During the semester, students receive feedback on a regular basis and from various staff members whereas they are only assessed once, at the end of the semester. An assessment tool that serves both the assessment of and for learning is a showcase, or more commonly referred to in an educational setting as 'portfolio'.

Feedback

As indicated before, feedback is a very powerful way of supporting and enhancing students' learning. It provides them with qualitative information on how they learn (process) and on what they learn (results). Put differently, feedback helps students understand what their learning is about, give meaning to what they are doing, and construct knowledge.

The scope of most feedback is a **learning activity**, the exception being competency coach feedback, which addresses

students' process of competency development over a semester as a whole (see chapter seven). The focus of feedback is on the quality of students' deliverables, their design process, the competency area(s) they have developed within the learning activity, and their professional as well as personal attitude. With respect to the design process, the feedback addresses issues such as the quality of the performance of the various



(design) activities, the ‘path’ students choose (which activities and in what order), the extent to which they connect the activities to one another, and the extent to which they are in control of their (design) activities as well as the process as a whole. The point of reference for this feedback is the objectives of the learning activity concerned as well as the goals which students themselves set for their competency development.

Whether or not feedback facilitates, supports and enhances students’ learning depends on various factors: frequency, timing, purpose, communication, and last but not least, acceptance by the learner. Since we distinguish two different purposes for the

feedback related to learning activities, we use two communication media: verbal and written feedback.

In order to facilitate, support and enhance students’ learning within the learning activity concerned, staff members give students specific feedback on a regular basis **during** the learning activity. This **verbal** feedback helps students understand their design and learning process, their competency development, the relations between the design activities and the competency areas, and the relations between their process, competency development and deliverables. Students can use this feedback to determine what they have achieved so far and how to proceed

within the learning activity; identify areas for which to acquire new knowledge or skills; enhance the quality of their deliverables; and achieve the goals they set for their competency development. This feedback also enhances the meaningfulness of the learning activity: it supports students' reflection in and on action, and creates a link between what students have achieved so far and what they still want or need to learn and achieve within the learning activity. This meaningfulness is optimal if the feedback is specific and timely, so if it directly follows the behaviour. For this purpose verbal feedback is most effective, in a dialogue and discussion with the student. Giving feedback consists of two steps: first the feedback-giver gives a factual, objective description of what he/she observes: this is like providing the student with a mirror. Then an interpretation or evaluation of this observation follows: what does this mean? It is this interpretative part that needs a dialogue between the feedback-giver and the student together. In this dialogue the feedback-giver can check whether the feedback has 'landed' and the student can ask for clarification. Mutual agreement is a requirement for acceptance and action

on the part of the student. Discussions support students' understanding of, amongst others, the competency areas and sharpen their critical thinking. Dialogues as well as discussions provide students with an external perspective, which is complementary to the internal perspective of their own reflections.

At the conclusion of a learning activity, after they have presented or handed in their deliverables, students receive **written** or 'final' feedback. Here the same two-step principle of 'factual observation first and evaluation next' applies. The purpose of this written feedback is to facilitate, support and enhance students' learning across learning activities. It is intended to help students determine what they have achieved in the learning activity as a whole, how they can expand and enhance their learning in other learning activities within the same semester (transfer) and how these achievements contribute to their overall competence of designing. In the latter sense, written feedback provides them with input for reflections in their showcase. This written feedback also serves as evidence for the students' showcase and, as such, is input for the assessor.



Assessment

Assessments are performed from a holistic as well as constructivist perspective on learning. They are not about what students accomplish in separate learning activities, but address the developmental stage which students have achieved in the semester as a whole, as well as their growth as a designer compared to the previous semester. Moreover, it is the student who has to demonstrate this: by constructing a meaningful and coherent ‘picture’ of his learning and design achievements.

Focus and scope of the assessment

The **focus** of the assessment is the integrated whole of students’ development of the overall competence of designing, their vision on designing and their growth as a designer, as communicated through their showcase and underpinned with evidence. This integrated whole is represented in the visualisation of our competence framework (see chapter four) and is explained in more detail in chapter five. Students’ competence of designing is shaped by the integration of their competency profile; their ability to go through and shape their design process; the quality of their overall design, of the whole of their deliverables; and their overall professional and personal attitude. Determinants for students’ vision on designing are the extent to which students have defined this, express it in their design process and deliverables, and use it to direct their overall development. Students’ growth as a designer is reflected by the

evolution of their overall competence of designing and vision on designing over time, so across semesters: how does their current development compare to their past and give direction to their future?

Although the assessment focuses on the integrated whole, we would like to stress that the **scope** of the assessment is wider: the assessment also takes into account how this whole is shaped by the various parts, how these separate parts themselves have evolved, how the connections between the parts have evolved, and how they contribute to the whole. It is the connections between the parts, together with the development of all the parts, that shape a student’s ‘picture’ as a whole.

The **formal or summative function** of an assessment is to take a decision on the student’s progress in the programme and to assign credits or not. In our case this decision is determined by the developmental stage which a student has achieved for his or her overall competence of designing and vision on designing, and whether or not this is the expected stage, given the block he/she has been doing. The point of reference for this decision is our model of five developmental stages: (Blank) - Awareness - Depth - Expertise – Visionary (see chapter six for more information). Another point of reference is the student’s Personal Development Plan.

Assessments also have a prominent **feedback function**. They provide students with an evaluation of their overall development as a

designer over the past semester, framed in their past development and envisioned future development. This may confirm, modify or reject what students themselves communicate through and conclude in their showcase. In this respect, the assessment is also feedback on the students' ability to self-assess. In addition, the assessment gives feedback on the separate parts that make up the whole, such as students' competency development profile. Last but not least, the assessment fulfils a feed forward function: it helps students fine-tune or adjust their long-term goals for their growth as a designer and set competency development goals in their Personal Development Plan for the next semester.

Components of the assessment process

In the assessment two parties are involved: the student and an independent assessor. Independent means that the assessor has not been involved as a coach in the student's development process during the semester. The process of an assessment comprises three components. Each of these components provides the assessor with information from a different perspective:

- The first component is the **end-of-term exhibition**. Here students show their project, framed in their overall development. They exhibit visuals about their project, including the process, as well as tangible deliverables. In addition, they 'pitch' their project to visiting students and staff members, including their assessor. The assessor has the opportunity to enter in a dialogue with the student and to ask explanatory as well as probing questions. The exhibition provides the assessor with extensive information about the student's project. In addition, the assessor gets information on the student's design process, his or her approach and attitude towards designing, and vision on designing. These exhibitions also create a platform for a dialogue between 'peer-reviewers'. This may contribute to a frame of reference at the departmental level: what do we consider to be an adequate or typical second-year bachelor project, for example, or what illustrates a particular developmental stage best?
- The second component is the **showcase-review**. The assessor goes through the student's showcase, which gives information on the integrated whole of students' development of their overall competence of designing, vision on designing and growth as a designer. The showcase also demonstrates students' competency development and the quality of their deliverables as achieved in separate learning activities, and how these have contributed to the students' overall development and growth. The central questions to be answered from this showcase review are: (1) what overall picture emerges in terms of the student's overall competence of designing and vision on designing (observation). If the emerging picture is somehow diffuse, the assessor contacts the student's competency coach for clarification; (2) which developmental stage does this represent (evaluation); (3) what is the student's growth compared to the previous semester (observation) and to what extent does this represent an acceleration (evaluation); (4) to what extent has the student achieved (or, in case of excellence, has gone beyond) the expected developmental stage, given the block he/she has been doing (evaluation); and (5) can the student be promoted to the

next block or not (tentative decision). The assessor processes the outcomes in an assessment form. The showcase review – and possibly the exhibition – may have raised particular questions or topics, which can be addressed in the third step.

- The third and last component of the assessment process is a **meeting between assessor and student**. This meeting gives the assessor the opportunity to either get clarification or discuss particular aspects or parts of the showcase in more detail. This way the assessor can fine-tune his/her evaluation of the student's development and growth, and check the tentative verdict. For the student this meeting is an opportunity to demonstrate his overall development and growth in a different way: verbally as opposed to the visual/written communication in the showcase.

Assessment as decision-making

The formal decision that needs to be taken is whether or not the student can be promoted to the next block, and whether or not he/she will get 30 credits. There are three potential decisions: (1) the student is not promoted and does not get any credits. This is expressed by a 'Hold' or H-verdict, which means that the student has to do the same block again, but with different learning activities;

(2) the student is promoted and gets 30 credits. This is represented by a 'Promotion' or P-verdict; (3) the student is conditionally promoted. This is captured by a 'Conditional' or C-verdict. The student does not get the 30 credits yet but can earn them at the next assessment by fulfilling the conditions.

This formal decision is arrived at in two steps:

- As a first step the assessor takes a **tentative** decision, based on the exhibition, showcase review and meeting with the student;
- The second step in the decision-making process is the assessor meeting. Here a group of assessors discuss their tentative verdicts and the ground(s) on which they arrived at these verdicts. These meetings are arranged in such a way that the student's competency coach is among the participants. If applicable, assessors also discuss whether and why students qualify for 'excellence'. This discussion may result in a modification of some of the verdicts and corresponding adjustments of the justification. It is the assessor who, at this meeting, decides on the **final** verdict for the students he/she has assessed, taking into account the preceding discussion. These assessor meetings also serve the purpose of ensuring a common view of the developmental stages for the competence of designing and increasing the validity of the assessments.

Showcase

Developing competencies is a cyclical, highly individual and context-dependent process. It is a dynamic and ongoing process that takes up quite some time. A showcase is an adequate tool to assess students' development of the overall competence of designing. The showcase our students need to create is interactive and integrative: and throughout their showcase written reflections and visuals need to be in balance. This showcase provides a common framework but at the same time it is open enough to allow for individual differences. In addition, it enables the assessment of process (designing and learning) as well as results, so assessment for and of learning. Last but not least, a showcase is also a tool for students to monitor their learning and development. It is their tool to prove and communicate their development of and growth in the overall competence of designing and their identity as a designer.

In the course of a semester students essentially go through iterative learning loops on two levels: a loop of competency development in each learning activity they do, and a loop of growth as a designer over the semester as a whole: their growth in the development of their overall competence of designing and their vision on designing. This corresponds to the two perspectives of the ID competence framework: the learning activity perspective and the competence of designing perspective. In students' showcase these two perspectives are represented as the 'underlying evidence layer' and 'competence of designing or top-layer', respectively, as we will explain in the following sections.

Learning activity: 'underlying evidence layer'

Each learning activity yields deliverables, written feedback from experts (such as assignors, lecturers and coaches) as well as the students' own reflections. In these reflections they look back on what they have achieved for each learning activity (reflection on action) and how this will direct and shape their future development and activities (reflection for action). This is indicated in the ID competence framework by the blue circle around the learning activity. In their reflections students address the four elements that comprise the overall competence of designing, as explained in chapters four and five: their competency profile and development, their process, the overall quality of their deliverables and their overall attitude **as achieved within the learning activity concerned**. In their reflections they also address the written feedback they have received.

For the 'underlying evidence layer' of their showcase they select the most relevant deliverables, feedback and reflections, that is, the ones that show the essence of their development and learning process in each learning activity. They also write a more condense and integrative reflection about the learning activity as a whole, if necessary. In addition, they decide which deliverables they include in full, as downloadable parts of their evidence (a project report, for example),



Snapshot showcase
Bram Knaapen



Snapshot showcase Emin Sinani

and which deliverables they include as visual evidence only. Clarifications of their process can be conveyed by visuals and/or reflections. As a whole, this 'underlying layer' provides evidence for their competency development and profile, their (design) processes, their deliverables and attitude (personal and professional).

The word 'layer' should not be taken too literally. The interactive showcase does not

necessarily need to contain a visible hierarchy and structure in which the evidence of learning activities is placed as a sub-layer one can link too. The actual representation can be done in many ways. For example, Master's graduate student Bram Knaapen shows the activities in time with small linkable circles. Second year Bachelor's student Emin Sinani, on the other hand, shows all these aspects as links in one 'chapter', arranged by the specific learning activity.

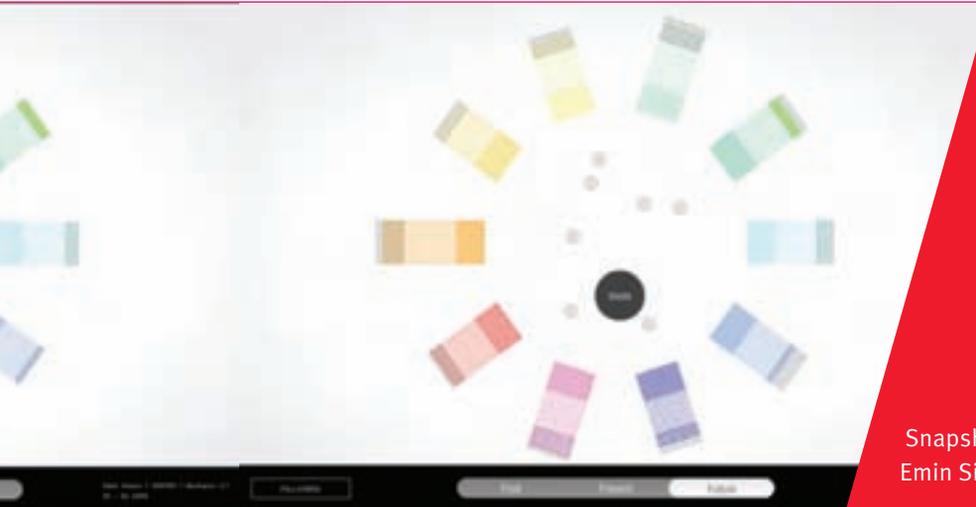


Competence of designing / growth as a designer: ‘top layer’

Students review all the deliverables, feedbacks and reflections from their learning activities to determine how these have contributed to and shaped the development of their overall competence of designing and their vision on designing. This review should result in a coherent and overall picture, the ‘top layer’ of the showcase; again a metaphorical expression and not per definition a real layer in the showcase. This ‘top layer’ is composed of the ‘patterns’ in their competency development and profile, the quality of their deliverables, their (design) processes and attitude. It is a careful selection from their deliverables, complemented with integrative reflections on their development of and growth in their overall competence of designing and their vision on designing. Students can and should also include additional visuals, so visuals that are not part of their ‘underlying evidence layer’. This overall picture needs to be underpinned

with evidence and information in the ‘underlying layer’ from their learning activities: deliverables, written feedbacks, process and reflections. This means that students connect the ‘underlying evidence layer’ to the ‘top layer’, physically as well as content-wise (connected evidence should corroborate particular aspects of the top layer). They need to integrate the different parts into a whole. The ‘top layer’, too, is interactive and integrative, with a balance between written reflections and visuals.

Students’ showcase needs to communicate their evolvement of ‘their’ picture as a whole: from past through present towards future. Students demonstrate ‘evolvement’ by framing their current growth and overall development (present) in the five-stage model from blank to visionary, and by fitting this in with their history as a designer up to that point (past) and their view of the designer they want to become (long-term goals for the future as well as short-term goals for the next semester). They are also required to demonstrate their growth and development as an integrated whole. This implies that they reflect on and



Snapshots showcase
Emin Sinani

visualise relationships, for example between learning activities, and how these relate to the development of their overall ‘picture’. In their showcase they need to communicate how their overall competence of designing and vision on designing are shaped by their competency profile and development, the control over and path of their design process, the overall quality of their deliverables and their overall attitude.

An annotated example

As may have become apparent, the showcase should reveal a variety of relationships, which requires modelling of the structure of a showcase. What is related to what in which way over time? We will use the showcase of Emin Sinani to discuss this woven web of relationships presented through a balanced mixture of visuals as well as text. We do not claim that this is

the prototypical showcase, or ‘the’ template students need to use for building a showcase. We merely use it to explain how students can play with the different elements of growth and competence of designing, if they see them as dimensions that can be used interactively.

The homepage of Emin’s showcase shows the different elements he uses as categories in his showcase: goals, approach, work, growth and identity (middle picture). Moreover, he shows his competency development for all ten areas. The showcase uses time not merely as a separate page, as is done in most showcases, but it takes time as an interactive dimension that can be altered separately. This means that, when shifting the slider to the left, you can see the competency development of the past and the overall categories (identity, growth and highlights) used for this time frame. Due to the student’s use of different colour tones for development, you can see in an instant where and how



he has developed his competency areas or aims to develop them in the future (right picture). It is about relationships, in this case between time and competency development.

Competency development pops up again in the category 'goals'. These pages show his competency development again but emphasise the relationship with the goals set for the semester by means of his Personal Development Plan and the evaluation at the end to see if these goals have been met.

Another relationship can be found at the learning activity level. Here, you can select different aspects of a learning activity, in this case his second-year Bachelor's team project "Living in a fantasy". Emin uses six categories to convey his development, namely obtaining **information** (which is a short introduction to the learning activity), **goals** for the learning activity, **reflection** on that specific activity and for further development based on the insights from this learning activity, **project coach**

feedback (on the project), **competency coach feedback** on the process and competency development, and, finally, the downloadable parts of the deliverables/evidence of the learning activity. In the upper right corner you can see again the overall development of the competency areas he addressed within this learning activity. By making the connection with the competency areas on the page itself, both physically and content-wise, these relationships become easily accessible.

Despite the clear and transparent structure, this showcase is also missing certain aspects. In the 'reflection' sections, Emin addresses the various competency areas. As explained in chapter five, (integrative) reflections on the process itself and the different steps taken, are also important. So which specific steps did Emin and his team take in the process of this learning activity, to what extent were they in control, what were their drives and strategies, and what did they learn from their process? Although this showcase does not include



Snapshots showcase
Emin Sinani

all potential relationships, the attempt at visualising a few is already very good for a second year Bachelor's student (block B2.1). So what kind of relationships can be further explored when building a showcase? The relationship between the deliverables and the student's vision on designing can be fairly easily made with visuals of the results, e.g. the prototypes of different projects as was shown when exemplifying John Helmes' project in chapter six, in combination with an overall integrative reflection. But also the

other relationships described above can be made profound, as long as the student explores the possibilities of working with different (in)dependent parameters that, by changing one of them, reveal their patterns and relationships. Thinking in this way can help to reflect on the different iterative learning loops, and help to formulate and communicate the integrative reflections in combination with a pallet of visually presented deliverables.

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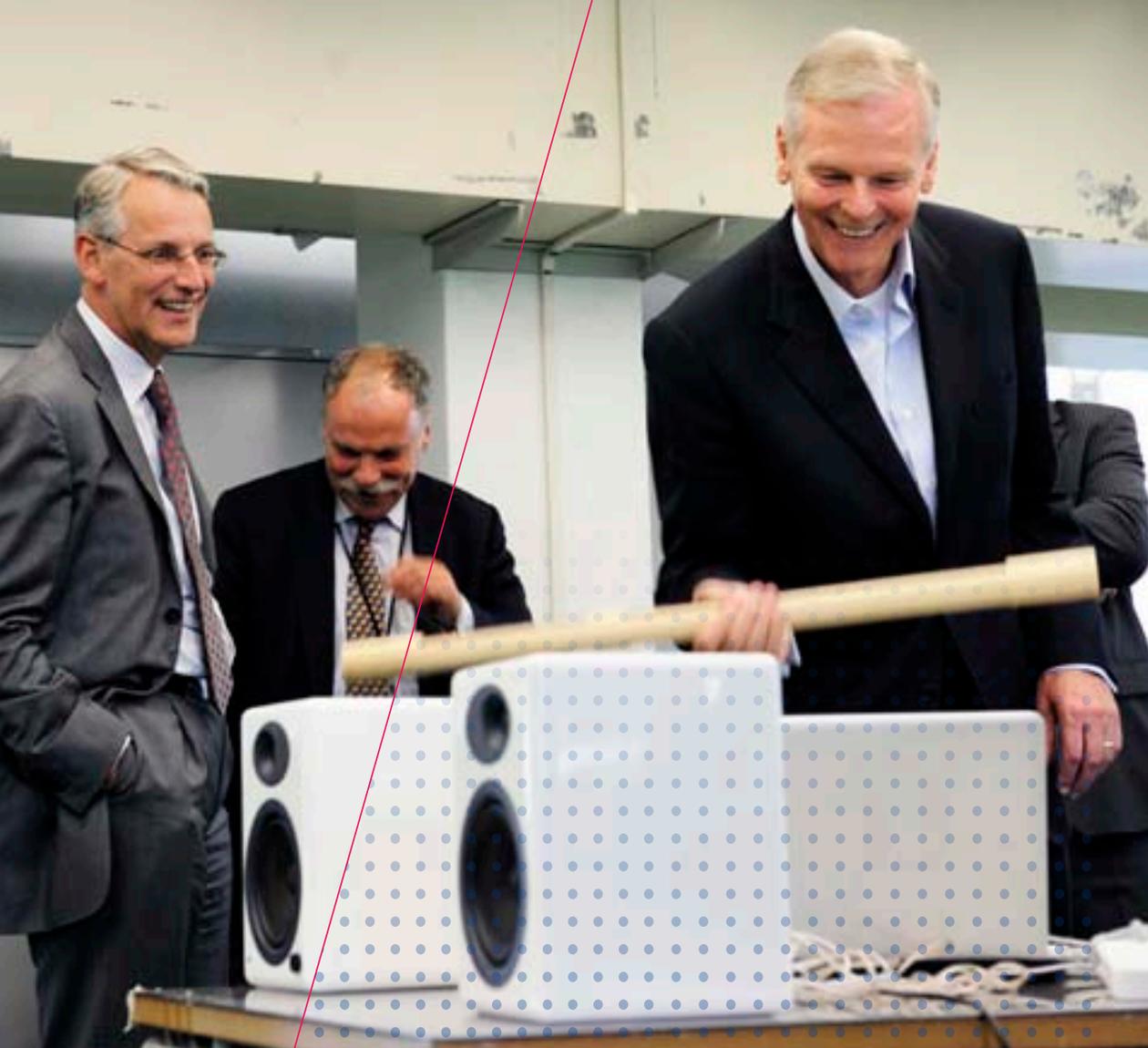
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