DESIGNERLY WAYS OF CARING

PROF. DR. IR. GEKE LUDDEN

UNIVERSITY OF TWENTE.

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Distinguished board of directors of the University of Twente, Dear mister rector magnificus, Dear professors, Dear project partners, Dear colleagues and students, Dear family and friends, Dear distinguished guests. Thank you so much for coming.

PREFACE

In the video that was playing when you came in you saw beans growing, and growing is what brought me to the UT almost 12,5 years ago. When I started in the Product Design group of prof Arthur Eger on a tenure track position, my assignment was to grow a research group and a research portfolio. Eventually I was successful in growing these and I will introduce them to you in this lecture. During the long years of the tenure track calm was much needed and I always found it in nature.

With long-term collaborator Thomas van Rompay of the BMS faculty, I started exploring how we can use the healing effect of nature on human beings to turn care environments into healing environments. The example you see is from a project done with Philips by PhD candidate Chanmi Kim who, based on the insights from her studies on nature, relaxation and

fluctuating needs of ICU patients, created a dynamic digital nature scene to support the recovery of ICU patients. What you see in this video is a scene typical for the region of Twente, something that is likely familiar for fragile people in the hospitals here. The scene is very calm and comforting but can also show some more uplifting elements such as the ducks or the butterflies. This project intended to contribute to lowering incidence of delirium in fragile patients by offering relaxation, activation and distraction at the right moments during the day. Chanmi created a 24h version of this dynamic video that adapts to the day rhythm in the hospital, Figure 1 shows combined stills from this video. Some of her earlier studies show promising effects so we are very much looking forward to finally evaluating this in the ZGT hospital in Almelo later this year. Designers have always used nature as a source of inspiration – using shapes, structures, working mechanics and colours of nature in design. But we can also learn from the relationships and interactions in nature and with nature.
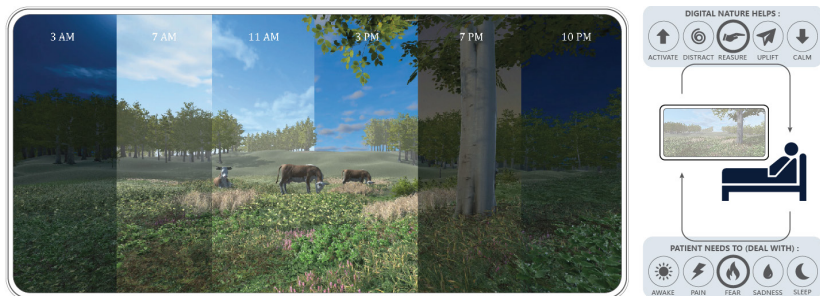

Figure 1. Combined stills from a 24h dynamic video using digital nature.

A few years ago, I read the book *Breading Sweatgrass Indigenous Wisdom, Scientific Knowledge and the Teachings of Plants* by Robin Wall Kimmerer. Robin is a botanist, author and member of the Citizen Potawatomi Nation. She writes that her aim is to restore our relationship with the world. She shares the story of 'The Three Sisters'. This is a story of interplanting; the three sisters are crops planted together in a shared space: maize, beans, and squash or pumpkin (see Figure 2). Developed through indigenous agricultural practices, these three plants protect and nourish each other in different ways as they grow and provide a nutritious diet for the people who planted them. The corn offers a structure for the beans to climb. The beans,

help to replenish the soil with nutrients. And the large leaves of squash and pumpkin vines prevent weeds from spreading and provide a natural mulch. These three plants thrive together better than when they are planted alone.

Figure 2. Three sisters; maize, beans and squash growing together.

While the practice of interplanting is now often recommended to grow vegetables in small gardens used by one family, this system was designed to nurture and sustain entire communities. The three crops care for each other in interaction, and by doing so, they cared for entire communities. The story of the three sisters and the rest of the book beautifully illustrate how living things and people are connected but also how important it is to understand connections within a system of living things to understand and create sustainable interactions. In the field of interaction design, this understanding has grown over the years. More and more, researchers in this field do not only study interactions between an individual and a product or a technology but it is emphasized that people live in interaction with the world and all living and non-living things in it – things that shape people and their behaviour, their attitudes and their values.

Before I go into that further, I want to explain to you how I understand Interaction Design as a discipline.

INTERACTION DESIGN AND CARE

While studying the history of the field and looking for definitions of the term Interaction Design by others, I found on the website of THINK design, a design agency in New Delhi, that the history of interaction design can be traced back to 4000 BC to the prehistoric Chinese philosophy of Feng Shui. They argue that similar to practices in interaction design, Feng Shui is about spatially arranging different objects to create an intuitive and user-friendly experience. I love it when people situate a relatively new discipline and practice in ancient history to give it some weight. But maybe this is pushing it a bit too far.

For me, and for how I see this chair and the IxD research group, Interaction Design merges two academic worlds – that of Human Computer Interaction (HCI) and that of Design Research. HCI as a field started with the introduction of information technology - and has evolved from a focus on usability and human factors to going beyond pure utility and efficiency to consider also aesthetic qualities of use. Design Research, on the other hand has evolved from a focus on designing for people and the interaction between people and interactive products to adopting a broader view, looking at people and things as situated in socio-technical systems. In both HCI and Design research there is growing awareness that to design for a sustainable future, we need to design not only for everyONE (the inclusive, human centred perspective), but also for everyTHING in the world, in that way including more diverse perspectives. We see this for example in efforts to create new design methodologies that give voice to non-human actors, a practice that Robin Wall Kimmerer also describes in her book. A nice example is from Australia, where Martin Tomitsch and colleagues introduced non-human personas to include nature in the participatory design of smart cities. To the non-designers in the room this may sound a bit strange or vague so I will elaborate a bit how this works. They explain that they (like other design researchers and HCI researchers) see a need to go beyond the generally used human centered design methods and adopted the term 'more-than-human' and that they use this term to refer to non-human species (animals and plants) and ecosystems. In the design of, in their case, smart urban furniture, this means that next to defining human users they also defined non-human 'users,' the study selected flora and fauna representatives that are native in the Sydney seaside suburb of Manly.

Specifically, the study considered representatives of possums, birds, bees and plants that are native to the chosen location. By considering not only human but also non-human users they could better consider concerns for the environment linked to their design choices. Other researchers in HCI have followed similar approaches also including perspectives of THINGS in their design processes. I remember fondly the workshop I organized for 4TU Design United with Marco Rozendaal and Jelle Stienstra where we tried to give voices to IoT objects to understand their interactions and relationships with people.

In quite a few of our projects we not only explore relationships with THINGS but also with the data that digital THINGS generate. In the project MOCIA (Maintaining Optimal Cognitive Function in Ageing), led by prof Aarts from Radboud UMC we look at how older adults can self-manage improvements in lifestyle related behaviour to preserve brain health. Using the concept of noticing, Lara Siering, who is doing her PhD within this project, is looking at how digital technology can help people make better lifestyle choices to prevent cognitive decline. Lara is now setting up a study where she invites people to notice their Heart Rate Variability level and how it relates to their individual behaviour but also to their social and physical environment. We use this as a case study that will shed light on how people can understand and make sense of seemingly abstract measures such as HRV (see Figure 3).
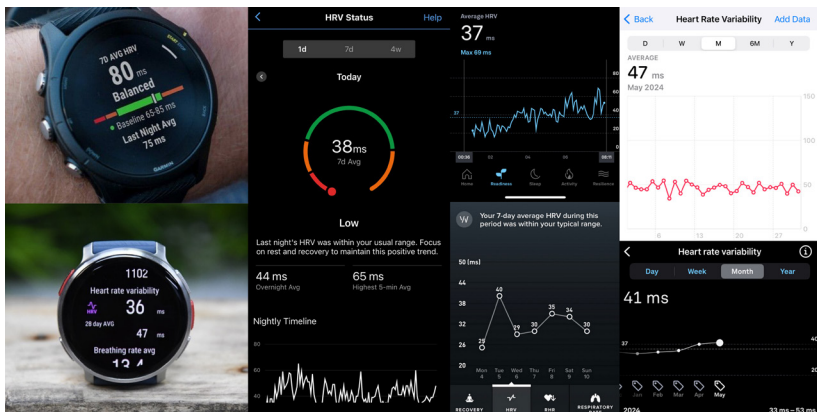

Figure 3. Representations of HRV level in current health tracking devices.

Later in this lecture I will explain more about the work we do in the group but what the examples I gave so far already show is that in technology development and innovation, where our focus is mostly on developing technology to support health and wellbeing, It matters WHAT we create - technology can improve the process of care, and can support people to self-manage their care. But it also matters so much HOW we create this technology – how we create the interactions between human and non-human things, to do this right we need to understand in what ways the technology might affect interactions between people and between people and non-human things.

The Three Sisters model I described before was not only a means for modelling a specific intercropping practice to the indigenous communities that used it. Instead it was, and is, a significant cultural and spiritual construct. The communities using it believed that the sprits of these three plants were inseparable. They were called Diohe'ko, these sustain us.
The meaning of the intercropping practice thus transcends a mere focus on functionality and efficiency. And I see a parallel here with what interaction design for me stands for. In the mission of the IxD group, we state that we want to contribute to developing a healthy and desirable future. We care about what current and future technology does to the world. It matters that we, as interaction design researchers, question our own beliefs and do our best to understand what values other people live by to include these in our design processes. In other words, we want to be responsible designers, designers and researchers who CARE.

Figure 4. Three sisters – Diohe'ko is both an intercropping practice and a cultural and spiritual construct.

Let's zoom in on what care means here. And for that I will use the broad definition of care by Joan Tronto as explained by Maria Puig de la Bellacasa in her book Matters of Care: "Care includes everything that we do to maintain, continue and repair our world so that we can live in it as well as possible. That world includes our bodies, ourselves and our environment, all of which we seek to interweave in a complex, life-sustaining web."

I see two things in this definition that I would like to highlight: the first part **Everything we do to maintain, continue and repair our world so that we can live in it as well as possible** – for designers (for me, anyway) resonates with the definition of design. We can mirror this with how Harold Nelson and Erik Stolterman explain that Design differentiates itself from other scientific disciplines in their book 'The Design Way – creating Intentional Change in an Unpredictable World'. Nelson & Stolterman state that design is about bringing things into the world that have not existed before. It is about creating the not-yet-existing, creating the not-yet existing to change our world into a more preferred one.

In the second part of this definition, **That world includes our bodies, ourselves and our environment, all of which we seek to interweave in a complex, life-sustaining web**, I see reflected the earlier notion that explains the importance to see and to seek connections between living and not living, human and non-human entities in the world to be able to live well.

Design scholars have explained that to do both things, creating the not-yet-existing and seeing and seeking connections, designers use designerly ways of thinking and doing. And because doing these things together also means to CARE, I would like to propose here three distinct designerly ways of caring that emerge from the projects the IxD group is involved in. In many of these projects where our designerly ways of working become especially apparent by working closely together with other disciplines. Our designerly ways of caring come with design approaches that the IxD group will nurture and grow in the future.

DESIGNERLY WAYS OF CARING

Most projects we work on in the interaction design group are situated in the system of health and healthcare. We no longer see health as a complete state of mental and physical wellbeing (as the WHO 1948 definition said) but as the ability of an individual to adapt and self-manage, in light of the physical, emotional and social challenges of life". This definition was published by Machteld Huber and colleagues in 2014 (Huber et al, 2014). Our current healthcare system is under pressure. We face the challenges of an ageing population, more people living longer with chronic diseases and as a result we have to deal with staff shortages. The introduction of healthcare technology, that allows for self-management of health, a focus on prevention, ageing in place and following therapy at home is often presented as contributing to the solution for these challenges but it brings its own challenges.

Our health and healthcare system is very complex, and to better understand our design and research contributions in such a system I have found it helpful to look at different levels in this system that we can study and that we can design for. The micro, meso and macro level. The micro level is looking at the individual, relations between people and things, the meso level is the level of groups and communities and the macro level looks at society and the environmental level. This is a categorization often used in sociology and in business sciences and one that we adopted for the 4TU programme Pride & Prejudice to better understand the influences at play at different levels on people's health behaviour.

In this project it helped us to understand the influence of elements at different levels on people's health and we also adopted it to prevent intervening on one level while the other levels exert a counter effective influence. Think, for example of how we may want to use a digital diary to track what we eat and get help making healthier choices, but we are still tempted to make an unhealthy choice when we are on our way home and smell fast food at a train station or when we see the chocolate bars at the cashiers' desk while we buy our groceries. This example illustrates that to make changes in such complex systems it is often not enough to look at just one level of such a system. We also built on this insight in the project Healthy Living as a Service (HLaS), led by professor Claudine Lamoth from

University Medical Center Groningen, where we work with so-called fieldlabs, communities of people in a certain environment, and where we look at all levels of a system to find how we can best support people in making lifestyle changes (see Figure 5). PhD candidate Naomi van Stralen is now starting her first study to understand what values play a role for people in thinking about their health.

society

community

individual

Figure 5. Project Healthy Living as a Service looks at all levels in a system to support lifestyle changes using technology.

Looking at the project portfolio of the Interaction Design Group, the methods and concepts we use in the different projects, I noticed three

designerly ways of caring that are situated at these different levels of the system of health and healthcare. I will now walk you through them with examples.

## CARING FOR VALUES AND DIVERSITY – THE INDIVIDUAL LEVEL

At the individual level, we consider people, things and their relations. The things we bring into the world of a person must match the values and abilities of that person. To come back to the definition of care, we must understand how we can **maintain, continue or repair the world** so that a specific individual can live in it **as well as possible**. Questions here are how we can embed values in design and how we can understand how another person views their health so that we can design solutions fitting that view. Coincidentally (or maybe not), both examples I will mention here are about Women's health which is also a research pillar within the TechMed Centre at UT aiming to address knowledge gaps, specific unmet needs and unresolved problems in various life phases of women.

In the Compassionate technology project, led by prof Matthijs Noordzij from the BMS faculty, we see compassion as a central value. You could say that in this project we try to repair the world of mental healthcare, which needs repairing because it is expected to adopt technology that is not designed according to this value which leads to rejection and frustration for both clients and care providers, therapists in this case. Benedetta Lusi works as a PhD candidate in this project and looked at how compassion could be designed in blended care, where technology and people collaborate to deliver care. She also explored the specific case of designing a self-care package for people after abortion (see Figure 6). The care package consists of three elements that are designed for open ended use, which entails that people can tweak the use of the package to their liking. They can for example, using stamps, find the words for what they experience and using the printer, they can find stories of others who have experienced abortion.
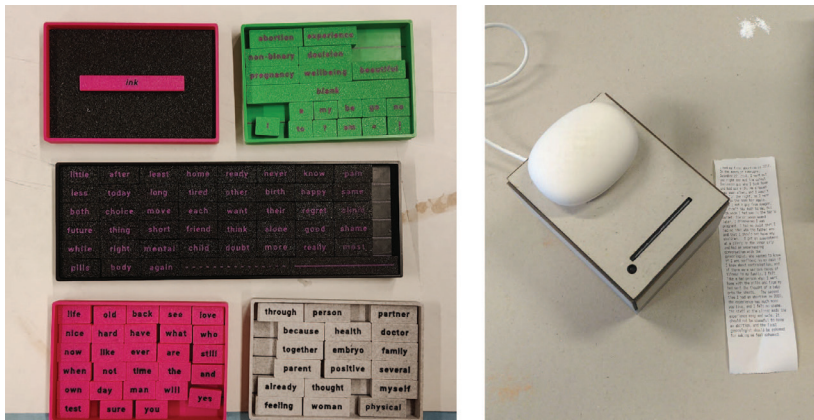
Figure 6. Care package designed for self-care after abortion.

In collaboration with lector Karin Dijkstra of Saxion University, lectorate of Smart Health, PhD candidate Danique Hofstee works on data representation in women's health. That the world of women's data, and how it is used needs repairing was illustrated recently in a Dutch TV show, Buitenhof (Buitenhof, 10 maart 2024). Here, Huib Modderkolk talked about his book 'Dit wil je echt niet weten' (Modderkolk, 2024) and explained how in the US data from mobile applications that women use to track their menstrual cycle is used in court as proof of having had an illegal abortion. While this is terrible enough, privacy issues are not the only issues with the use of women's health data. Health data in general is often visualised in graphs and dashboards, forcing people to interpret information about their health via numbers. Several studies have shown that these visualisations do not necessarily make sense to people, leading to misinterpretations about health and possibly bad health decisions. To better understand how women view their health and are aware of health information they experience, Danique used the method of bodymapping, she asked women to fill a diary for two weeks and visualize in creative ways how their body felt and how they interpreted certain health data they collected (Figure 7 shows three examples). By staying closer to people's experiences, we will work on finding alternatives for designing health data and to make it meaningful and understandable for different groups of people.
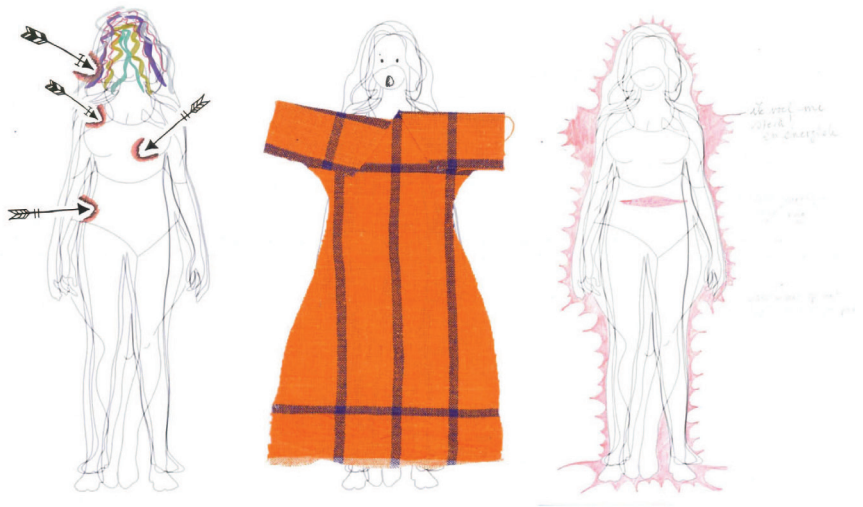
Figure 7. Body maps are used to understand how women experience health and health data.

CARING FOR ROLES AND RESPONSIBILITIES – THE SOCIAL LEVEL

At the meso level we consider relations between people and between people and non-human entities. In life and in healthcare we find situations where sometimes one person cares for the other, where a person uses a technology to care for another person and where people care for their communities and their environment, both with and without technology. Questions here are if and how technology can take over or support people in caring roles, how to design for responsibility in care, and how to design for engagement with health and technology supporting health.

As a first example I would like to mention one of my long-term favourite projects. I started working on this with UT colleague Angelika Mader, Hellen van Rees from Saxion University and dr. Boony Thio from MST. The team has grown substantially over the years. You can see that we have worked on this for quite a while now when you compare the picture you see here of my daughter Robin wearing one of the first prototypes with how she has grown since then – and also by noticing how the design and the prototype has evolved since then (see Figure 8). The project Wearable Breathing Trainer, or BRISH as we named the trainer, is an example of

a technology designed to support therapy at home. In this project we study how a technology, in this case a wearable, can support children to practise breathing training at home. The situation is an example of bringing care to the home environment, which comes with changes in the responsibilities in the care journey and with questions about how to design both a valid and effective technology but also one that engages people in care while acknowledging these changed responsibilities. In our efforts to understand how such a technology could be embedded in current care practices, Panton, one of our project partners, helped us create a patient journey that was discussed with children, their parents, child physiotherapists and paediatricians (see Figure 9). Based on this journey we could better define the role of BRISH in the care pathway and work on the next step in technological development.

Figure 8. BRISH, wearable breathing trainer. A wearable supporting children to practise breathing training at home.
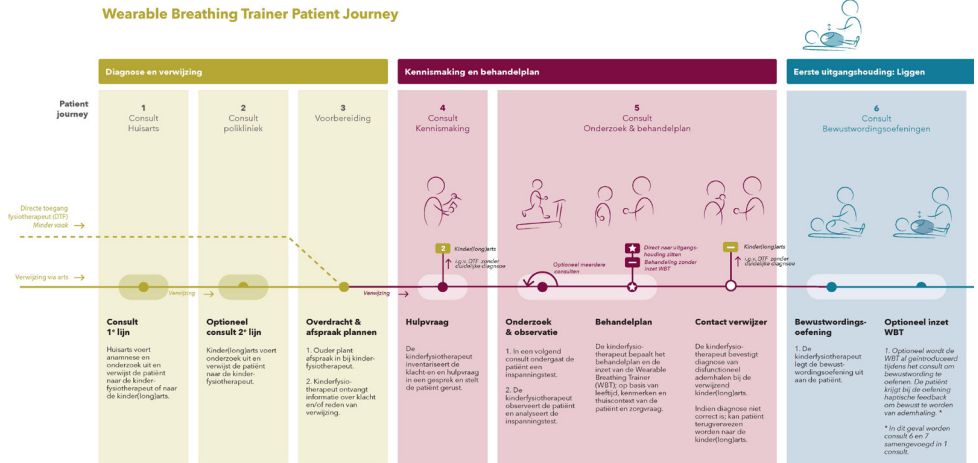
Wearable Breathing Trainer Patient Journey

Figure 9. Section of the patient journey of BRISH.

The second example in this category, the NWO Zwaartekracht project Stress in Action, led by Brenda Penninx from VU University started only a year ago and will run for the coming 9 years. Merel van den Berg is the PhD candidate in this project who works in the IxD group and while the larger project is defining stress, studying how to best measure stress responses as well as the effects of stress on our physical and mental health, Merel's work has a very different contribution. Merel studies the effect of digital tools that measure stress responses (often wearable technologies) on peoples' experiences. And she is setting up a study to understand the effects of certain values embedded in the design of such tools. She already found, for example, how embedded values make people feel responsibility for managing their stress responses. Failing to acknowledge that stress responses are not solely and individual responsibility but dependent on social interactions and our environment. She is planning to use value-oriented mock-ups, early prototypes that provide alternative, views on wearable devices for stress monitoring and management and that embed important values. We have experience with such mock-ups from other projects. Figure 10 shows an example: a continuous monitoring device for in a hospital environment that embeds the value privacy.
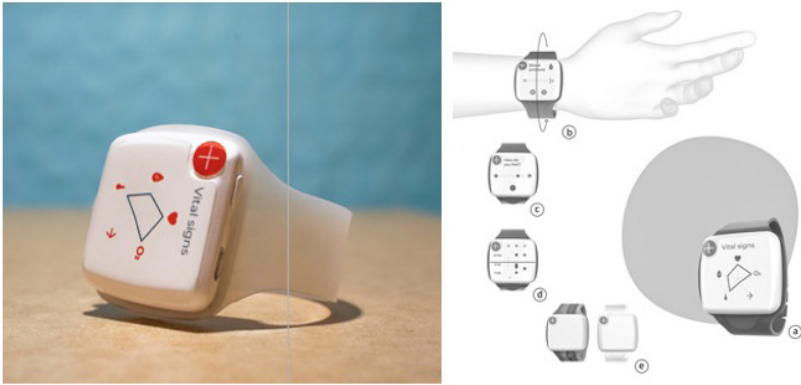
Figure 10. Mock-up of a continuous monitoring device that embeds the value privacy. Design and images by Ruben Peters.

## CARING FOR POWER AND IMPACT – THE SOCIETAL AND ENVIRONMENTAL LEVEL

At this last level, the macro level, we look at interactions and relations within society and with the environment; the life-sustaining web that supports us. An example from healthcare that shows how we sometimes neglect this level and that has received some media attention lately is how we have organized our hospital care – focusing on curing the individual while producing enormous amounts of waste that negatively effects our environment. In two recently started projects we look closer at design approaches that can be used for this level. These research lines are made possible by the sectorplan Ontwerpende Ingenieurswetenschappen. A plan I worked on with representatives from four other universities and that describes how we see the future of design research in a changing society. A society that needs designers to think and act as changemakers. There are two assistant professors in the IxD group that work on this sectorplan.

One of them is Jodi Sturge, Jodi works on transformations and challenges in our healthcare sector from a health systems' and built environment perspective. In healthcare environments where technology is more present, human-building interaction changes. Understanding how technology can change interactions will inspire the design of care environments, be it hospitals or home environments, technology integration and changes in care practices (see Figure 11).

Figure 11. The design of hospitals is changing. Left: van Gogh, Dormitory in the hospital in Arles, 1889. Right: Care at home, Medoma.com.

The other UD in the sectorplan is Jairo da Costa. Jairo is using different systems approaches to design better systems that can contribute to solving societal challenges (see Figure 12). His work aligns with the impact programme Planetary Health of the TechMed Centre and the Climate Centre at UT where we focus on better understanding the relations between human health, environmental well-being, and the healthcare system. For example, Jairo will look at the effects of climate and healthcare pollution on human health and will develop solutions that consider the impact on both human and natural systems.
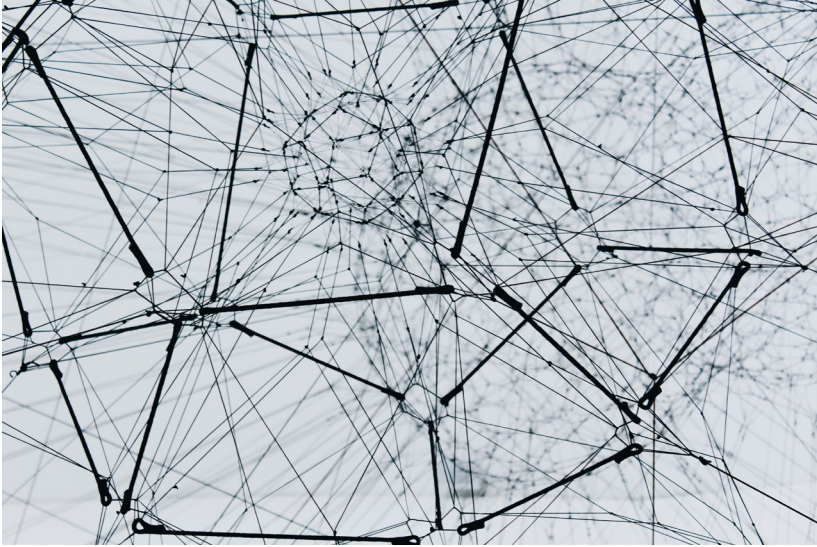
Figure 12. Systems approaches to design can contribute to solving societal challenges. Art installation by Studio Tomás Saraceno. Photo by Alina Grubnyak on Unsplash.

All these projects use design research methods, approaches and tools that help us understand situations and enable us and other to change them into preferred ones. Some of these methods and tools have been used for some time, some have been developed more recently and all of them will further develop and mature in coming years. Two years ago, I published a paper with Lex van Velsen and Christiane Grünloh of Roessingh Research & Development about limitations we saw to how Human Centered Design practices were and are used in the development of eHealth technology. In the discussion we wrote about three types of methods that could help us move beyond these limitations: Value sensitive design, Citizen science and Systems design. Today I see that we use and nurture these methods in many of our projects and I am looking forward to seeing them grow. Figure 13 summarizes the designerly ways of caring and the design approaches we should nurture and grow.

Designerly ways of caring

Caring for values and diversity

Caring for roles and responsibilities

Caring for power and impact

Design approaches to grow

More than needs and wishes
Value-Sensitive Design

More than consulting end users
Citizen Science

More than humans
Systems Design

Figure 13. Designerly ways of caring and design approaches we should nurture and grow.

In most projects we zoom in and out of levels in the system. To understand the healthcare system of today and to work on and envision the healthcare system of the future we must look at the people and things, adopting different roles, moving in and out of built and natural environments (see Figure 14). Like what we saw in the system of the three sisters, the interactions at the micro level contribute and have effect on the interactions at the meso level which together shape the macro level. I think you will understand from what I have been saying so far that we still have a lot of work to do.

*Figure 14. Our healthcare system with people and things in different roles.*

Over the last 30 mins or so I have already mentioned some of the people who work on research projects of the group. I also want to speak a bit about how and what we teach but before I do that, we will watch a short video that introduces the complete team – Here are my colleagues in the IxD lab and our vision on teaching and research (IxD lab, 2024).

DESIGN EDUCATION

In the previous and in the video, I have talked about the aim of design to create Intentional Change in an Unpredictable world (this is also the subtitle of the book by Nelson and Stolterman I referred to before). For this, designers need both methodological rigour and creativity. These two things are sometimes seen as incompatible, but I don't think they are. The difficulty lies in understanding and learning when to use what and I see this as one of our greatest challenges as design educators.

Not long ago I was listening to a podcast about food and wine (ok, to be perfectly honest, for me not many days go by without listening to a podcast about food and / or wine….. (in Figure 15 you see some pictures from my Instagram feed), but in this particular podcast called 'De vegan lekkerbek', Jigal Krant (who is a cook and author of cookbooks) discussed with Eke Mariën (who is also a cook and well-known for his knowledge about chemical processes of cooking) and Remy Harrewijn (sommelier at Chateau Amsterdam) how knowledge can help but can also stand in the way of intuition and creativity when creating a dish, or a wine. The conversation left me wondering about this balance between knowledge and intuition, are they really opposites? Or is intuition also fuelled by knowledge? Cooking is essentially making a combination of ingredients and processes to transform them into a new whole. The parallel between cooking (or making wine) and design has been made before. It was with good reason that in 2022 at the Conference of the Design Research Society one of the keynote speakers was Andoni Luis Aduriz, one of the most influential chefs of our time. His two-star restaurant Mugaritz closes for four months a year, so that the team can devote all their time and attention to creating new ideas. It is a place where food finds new forms, stimulates all the senses and is eventually much more than a meal. To be this creative, knowledge, of ingredients and of processes is essential. For designers I think the same holds true: knowledge about design methods, materials, and production processes is essential. Next to knowledge about people, data, societal principles and human technology interaction.
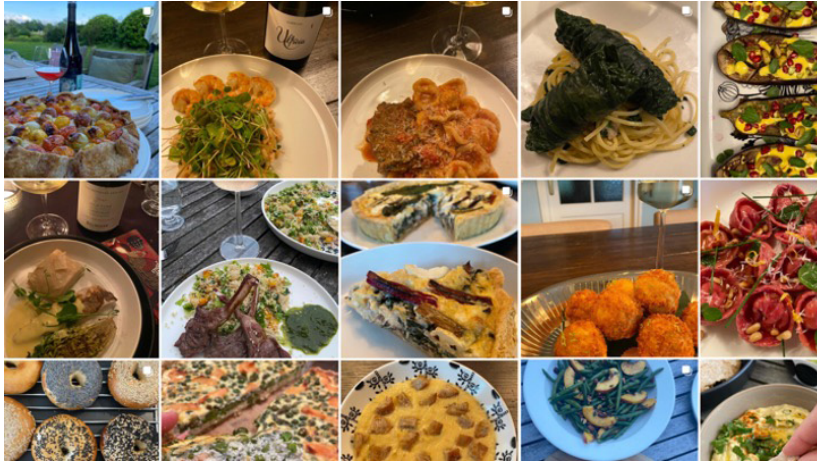
Figure 15. My personal Instagram feed – food, wine and creativity.

Over the last years, a large team of colleagues has worked on revising the programme of the Industrial Design Engineering (IDE) bachelor. It was a challenge to merge all the ingredients and processes related to IDE into a coherent whole. We all look at IDE at least a bit differently, we often disagreed and struggled, but we also found joy in envisioning what this new curriculum could bring students and how it could help them shape their unique identity as Industrial Design Engineer. The process of this revision forced us to critically reflect on how and what we are teaching, how that aligns with a changing (and unpredictable) world and to make choices that do justice to the Industrial Design Engineers of the future. In other words, we were designing. Topics that often came back in discussions with colleagues outside of our ideas about the content of the program were responsibility and professional skills. I think that next to learning how to write academic papers and how to work in a team, sensitivity, empathy, and compassion are essential qualities here. We can teach our students responsibility in caring for the people and the world we design for, we can teach them how they can understand and work with parts of the world that are unfamiliar to them, and we can teach them how to deal with that in creative ways. In our new curriculum we will work with development coaches that support students in reflecting on their role and skills, so that they can become the responsible change

makers our society needs. Figure 16 shows that to do this, we envision lighthouses at the end of every module, signalling moments to reflect and what has been learned and look ahead to what can be learned.
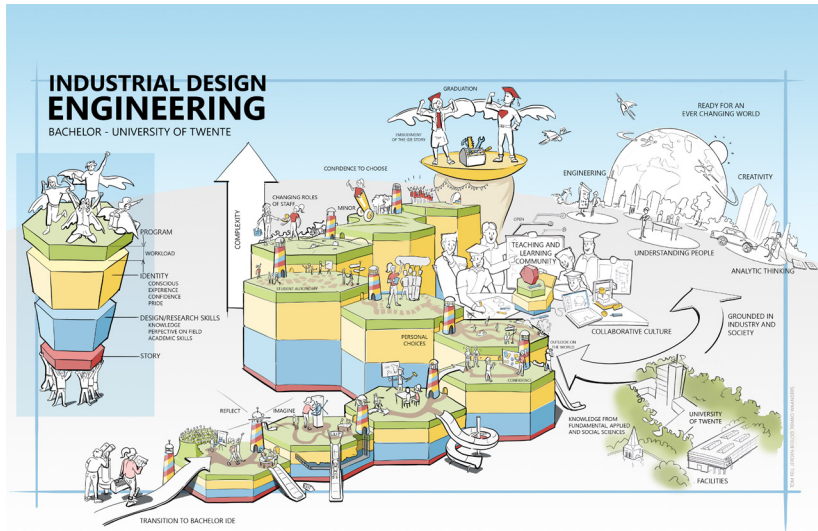

Figure 16. The IDE curriculum with lighthouses as moments for reflection.

Another important discussion we had in the curriculum development team was about design methods and approaches, you have heard in what I have said before that using methods and developing methods is an ongoing process. Students need to know about the history of method development in design and they need to practice different methods because it helps them understand their value, what they bring and cannot bring. Once you are fluent in using the standard methods you can really start playing around. For the development of the design field, it is essential that we educate designers and design engineers who eventually, and with that I mean in their masters and perhaps during their PhDs, can play around with methods, understanding what new methods we may need. I hope we are providing the foundations for that in the revised bachelor IDE.

THANK YOU FOR CARING

Today's inaugural address for me marks an important moment in my academic career. Growing up, I never dreamt of being a professor. I wanted to be a ballerina, or a pâtissier. Creative professions, that require attention to detail and sensitivity. Qualities that are very useful in the daily life of a professor in Interaction Design. And I have only found the path to this profession because so many people cared. And I want to thank you for caring.

When I graduated from the master Industrial Design at Delft University of Technology it was Kay Morel, my supervisor who pointed me to a vacancy for a PhD in the VIDI project of Rick Schifferstein, because I showed an interest in research. Five years later, during the laudatio after receiving the PhD diploma, Paul Hekkert, my promotor, characterised the start of this PhD as a moment where I had no clue about what I was getting myself into. I think today definitely proves you right Paul. But you and Rick prepared me well, thank you. After the PhD I found inspiration and the best community of colleagues at the Telematica Instituut, later called Novay. Thank you for a safe landing in Twente. Then, at UT, Arthur Eger and Wouter Eggink gave me the chance to land back in university. I started in the Product Design group together with Thomas and we still enjoy working together and always come up with new ideas. Thank you, Thomas, for your friendship and inspiration. In the difficult first years of the tenure track, I also found inspiration through interactions with Vanessa Evers and Peter-Paul Verbeek who both supported me and helped me believe in myself. And I have so many more people to thank at UT, thanks to all my colleagues in the department of Design, Production and Management, and to everyone in the IxD group, I admire and am continuously inspired by your enthusiasm and creativity. Special thanks to Kara, Yannick and Tom for your visual support for this lecture. At the Engineering Technology faculty, but also at DesignLab and at the TechMed Centre I also found colleagues that supported and inspired me, thank you Geert, Nico, Bart, Herman, Frank, Sabine, Monique, Matthijs, Saskia, Dennis, Randy, and many others. And thanks to national and international collaborators outside of these UT circles for the cross-over and 4TU projects we do together.

But the seeds for all this were planted through interactions with family and friends. Een klein stukje in het Nederlands om hen te bedanken: Dank aan

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En dan de drie mensen hier op de voorste rij: Merijn, al 25 jaar mijn rots in de branding. Dank voor al je steun! Jonathan en Robin, ook jullie ben ik veel dank verschuldigd. Ten eerste omdat jullie zijn wie jullie zijn: mooie, grappige en zelfstandige kinderen. Jonge mensen die hun eigen pad aan het vinden zijn. Dank Jonathan, dat je zo'n heerlijk slapende baby was, zodat ik mijn proefschrift kon schrijven. Dank Robin, dat je het prima vond om naast mij te kleuren als ik weer eens een onderzoeksvoorstel schreef. Dank ook dat jullie, nu je wat ouder bent, mij met beide benen op de grond houden, en tot de orde roepen als ik weer eens te betweterig doe.

Figure 17. Beans with words to spread the words of this lecture.

When you leave the room, we have a small gift for you. You can take one of the bags that will be there and inside you will find two very special beans. Beans that speak when you grow them, and they speak important words. Beans that I hope that when you grow them will remind you of parts of this lecture. Beans that I hope you will share with each other. You can find instructions on how to do that inside the bag. I hope that you will spread the words.

Ik heb gezegd.

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