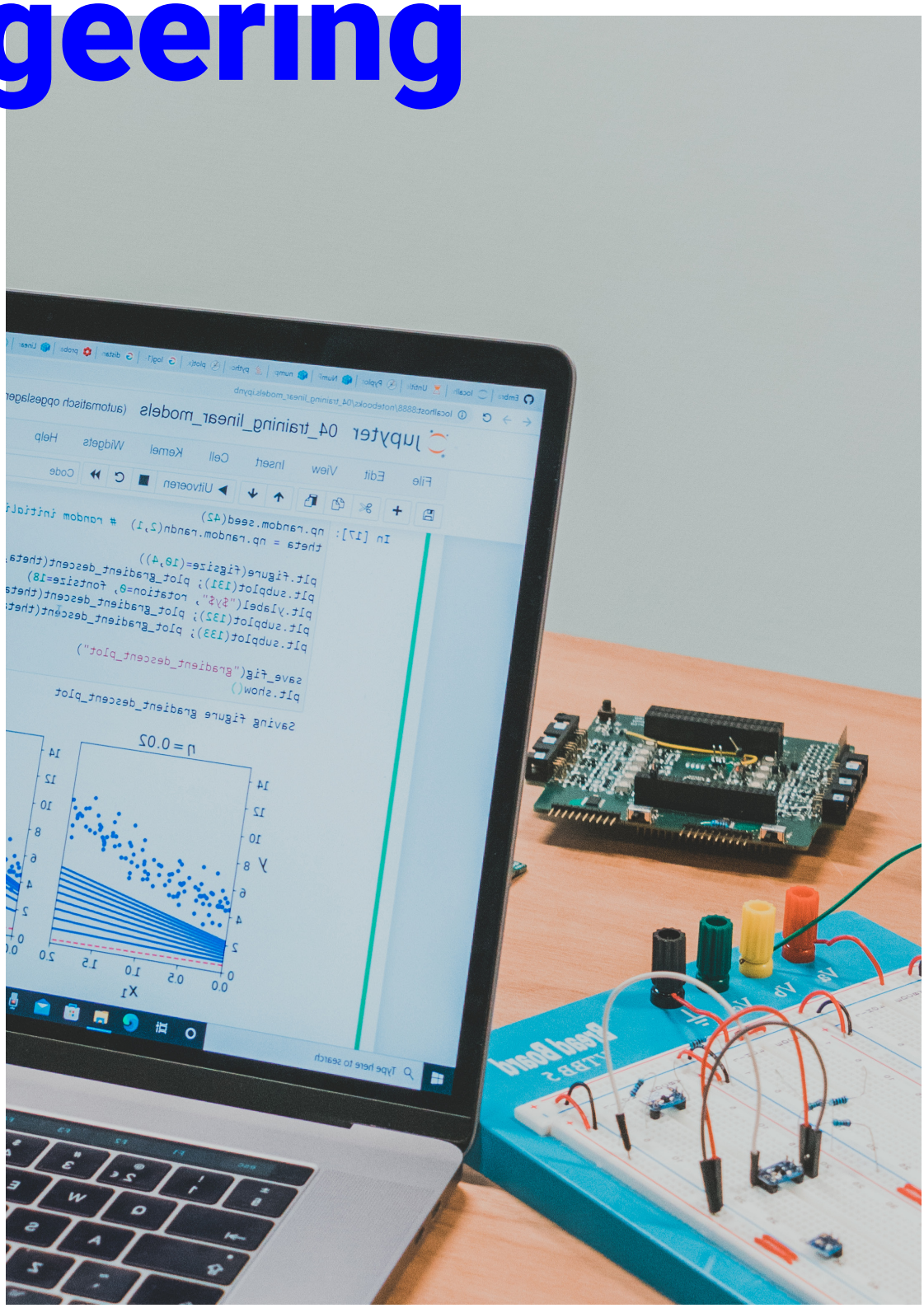
master guide
digital technology enigeering



ready to design the future?

welcome to the master
digital technology engineering

In this guide, you will find important information on the design of our master

- An overview of the entire master year, with all relevant components;
- The intended learning outcomes;
- The challenges offered in the master;
- The content of the learning lines of the master;
- The set-up of the coaching line;

Please study the information in this guide carefully to make sure you understand the design of the master and what we expect you to learn and do throughout the master years.

If you have any questions, don't hesitate to ask.
Please, send an email to p.biekens@fontys.nl

Enjoy the reading!
The team of the master Digital Technology Engineering

01. overview of the master

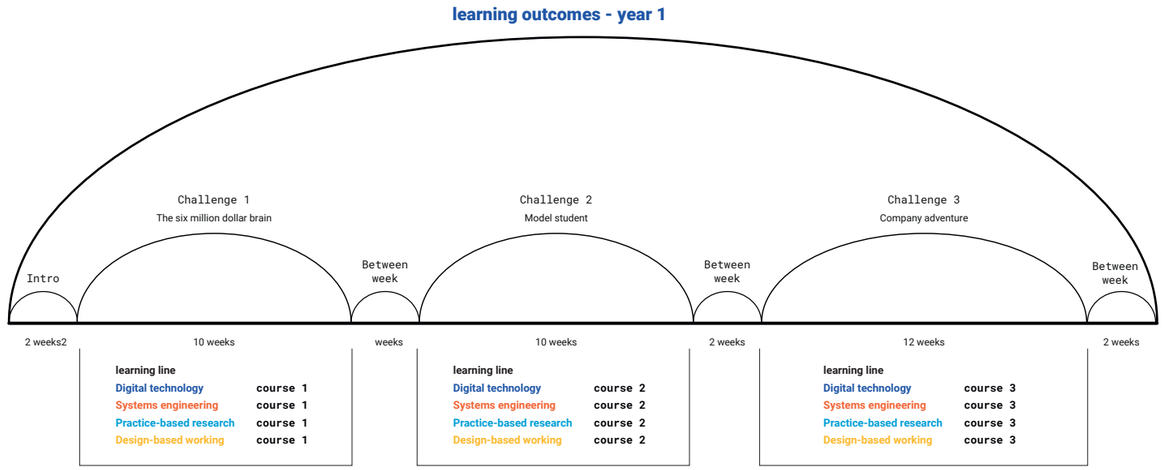


Figure: master arch plan

program structure

You will broaden your work experience during the master's program. You will build your network in the Brainport region from day one. The Master (MSc) Digital Technology Engineering takes two years to complete. The first year consists of three challenges. Supporting the challenges, a total of twelve courses are offered (four during each challenge). In the second year, you'll work on the last open-ended challenge, supported by four courses, a preliminary research phase and the graduation project. During Year 1 of the Master's three open-ended challenges are alternated with two weeks of knowledge integration, reflection and testing. These are the between weeks. For your graduation, you will work on a project at a company.

learning lines

In addition to working on the challenges and the graduation project, you will take courses offered as part of the following learning lines that run through both years of the master's: digital technologies, systems engineering, practice-based research, and design-based working.

.2

preliminary research

The preliminary research phase takes place prior to the graduation project, in which you work in pairs. During this phase, you conduct desk research consisting of identifying relevant literature studies focused on your graduation project that will be executed at a company. Finally, you set up a design approach and construct a corresponding conceptual research strategy for your graduation project. No courses are offered during the preliminary research phase, but you will receive instructions and supervision for desk research and establishing the design approach and conceptual research strategy. Prior to the preliminary research, you must receive approval for the graduation project from the study program in order to start this phase.

graduation project

To graduate from your master's program, you carry out a design-based graduation project in small teams with a substantial research component. You will work in a project group on a relevant complex design question of an organization facing digital transformation. This project group consists of students, an employee of the company for which the project is being carried out and a lecturer. You and your team members work on the design question on the basis of equivalence. You are responsible for the research component of the project and are assessed individually. During the graduation project, you receive guidance not only in practice-based research and design-based working, but also in digital technologies and systems engineering if necessary. In addition, you are guided in the application of an integrated solutions and systems approach, while leveraging existing digital technologies, and in the use of a chosen theoretical framework.

personal and professional development

The Master's in Digital Technology Engineering has its own educational culture. Personal and professional development are central to the program. During both years of the master's, you will receive individual and group supervision. We support you in discovering your talents and being able to use them in different contexts. You will have regular contact with your coach to get to know each other and to support you when necessary.

02. intended learning outcomes

Four areas of development are at the core of the Master:

digital technologies

systems engineering

design-based working

practice-based research

Each learning line provides a perspective, tool and/or method that you can use when engineering a digital technology solution. During the challenges and the graduation project, you will be expected to apply and integrate the knowledge, skills, tools and methods from each learning line.

Each learning line is a development track and has corresponding learning outcomes. These learning outcomes are a concrete description of what you should be able to do at the end of each year of the Master's. Therefore, there are two sets of learning outcomes: one set for the first year and one set for the second year. To graduate, you must master all 12 learning outcomes. At specific moments in the Master's we assess whether you have achieved the learning outcomes at that time.

Each learning outcome consists of two parts: a generic description of the learning outcome and specific indicators. The indicators describe on a more concrete level what you should be able to do and form the basis of all exams in the Master's. In each exam (assessment) we assess whether you have mastered the indicators.

03. open-ended challenges of the master

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wicked problems and small wins

Considering the role that people, processes and partnerships play in the digital transformation, it is crucial to understand the definition and the impact of a wicked problem on organizational processes and society. As originally defined by Churchman (1967) and Rittel and Webber (1973), wicked problems refer to a class of social problems that are ill-defined and continuously changing; where many actors are involved with conflicting values; and where, because of the high levels of interconnectivity, today's solutions often turn out to be tomorrow's problems. The evaluation of wicked problems inevitably involves a paradox of trying to judge solutions for problems that have 'no solutions' and for which 'additional efforts might increase the chances of finding a better solution' (Rittel & Webber, 1973, p. 162).

04. requirements of the master

diploma and language requirements

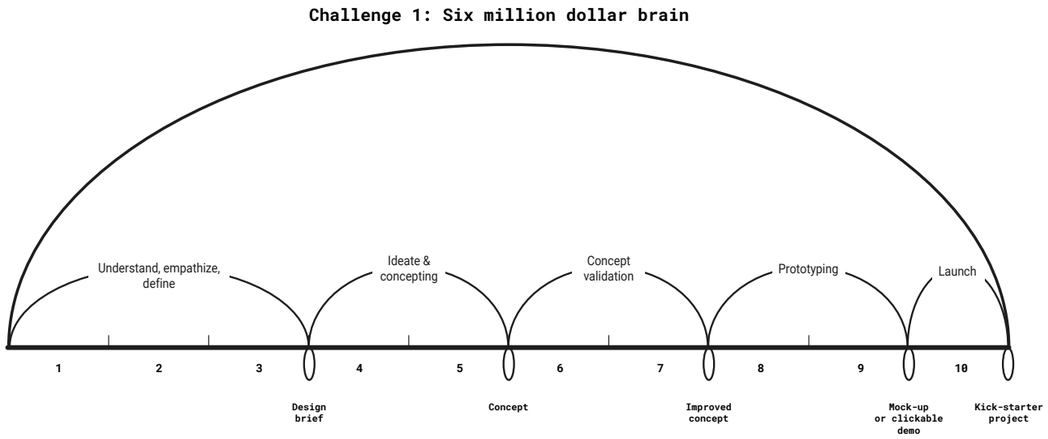
1. A bachelor's degree in either Engineering, ICT or Technical Physics.
2 . A suitable English language qualification (IELTS)

05. level of the master

difference Fontys University Master and Technical University-Master

The master's in digital technology engineering leads to the Msc degree. There are two types of master's programs in the Netherlands: professional master's programs, offered by Universities of Applied Sciences, and scientific master's programs, offered by Academic Universities. Although both types of master's programs lead to the same level (7), there is a difference in orientation. Professional master's programs are more oriented towards practice-oriented research, while scientific master's programs are more oriented towards research in the academic world.

challenge 1: the six million dollar brain



Number of students per group: 2-3
Complexity from 1-5 (5 highest): 1 > context: design for yourself

context

Developments in AI and robotization are going very fast. More and more often we see computers that can perform tasks better than humans. This has major consequences for the job market, for the way we make decisions and ultimately for our happiness in life. We also see a - perhaps even more worrying - development in which we increasingly translate human characteristics into computer terms. Recognizing emotions then becomes categorizing facial expressions. Or writing articles becomes predicting the next word. Perhaps the solution to these problems lies somewhere in the cooperation between man and machine, just like Lee majors, the six-million-dollar man: a perfect fusion of technology and man.

Is this also achievable for our cognitive capacities? We don't know our way around anymore, but we use our navigation system. We don't calculate by heart, we use our calculator, and we don't look at the sky but at rainfall radar app.
What's next? Can we use data to help understand ourselves? Can we use data to lay a foundation to become better, smarter, happier students?

challenge

Create a meaningful data visualization, using tools and/or programs, for yourself as a student, that allows you to better understand yourself and to become a better student. For example, can your data insights enable you to study more effectively, perform better, feel more energetic or experience less stress.

process

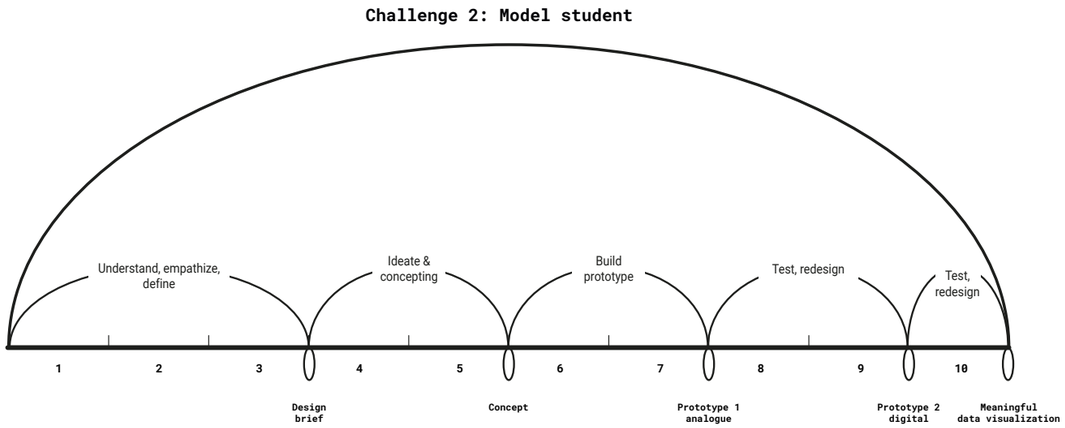
During this challenge you will discover how to use data to better understand yourself. You will collect data, extract it, transform it and try to make sense of it. You will learn to think about it on two levels:

1. What is technically feasible?
2. What does these data mean? When does it help me to better understand myself? What are the pitfalls and how can you avoid them?

requirements

1. General: Show that you have analyzed the wicked problem, set the conditions for governance, and explain why the result is a small win.
2. Digital Technologies: Gather and process data to develop your data visualization from experimenting with analog/digital media to a final, digital prototype. Show awareness of the limitations and negative impact of your data visualization. Attention: your result is input for you or fellow students for challenge 2.
3. Practice-Based Research: Translate the insights from your research into a visual language that gives value and meaning to the used dataset.
4. Design-Based Working: Create a visualization of your design process using the GROOW toolkit. Create at least 3 concepts, and a lo-fi prototype of your final concept.
5. Systems Engineering: Define the value of your digital prototype, derive technical and user requirements for your digital prototype and give a definition of use cases on where and how your digital prototype can be used.

challenge 2: the model student



Number of students per group: 2-3
Complexity from 1-5 (5 highest): 2 > design for your peers

context

It's not easy being a student these days. The study pressure is high, the expectations are high and it's not just about the studies. Social life also must be interesting, social media feeds have to be managed as if you were a rock star yourself and more and more work has to be done to pay for it all. This results in a situation where we see that students are more and more likely to experience stress, study delays or even burnout.

Self-help books are abundant, and people seek refuge in spirituality and the alternative circuit. The reasoning behind this is that if students understand themselves better, they can effectively improve themselves.

For students to truly understand themselves more, collecting data about them is indispensable. We saw this in challenge one. Data can help you understand yourself, but can it also understand others? And more importantly, how does data as a fuel for neural networks enable other students to improve themselves in terms of their academic performance, happiness or well-being?

challenge

You will develop a prototype that helps other students become better students (or studying individuals), supported by the use of Neural Networks.
Some examples:

- I subscribe to all the trendy social networks, but I get too much input from push notifications and messages. I cannot concentrate on myself and am constantly forced into a confrontation with others. My neural network manages the notifications on my phone, so I experience less pressure from the online world.
- My phone registers my screen time, my Fitbit measures my sleep. My neural network advises me on my phone usage to help me sleep better.

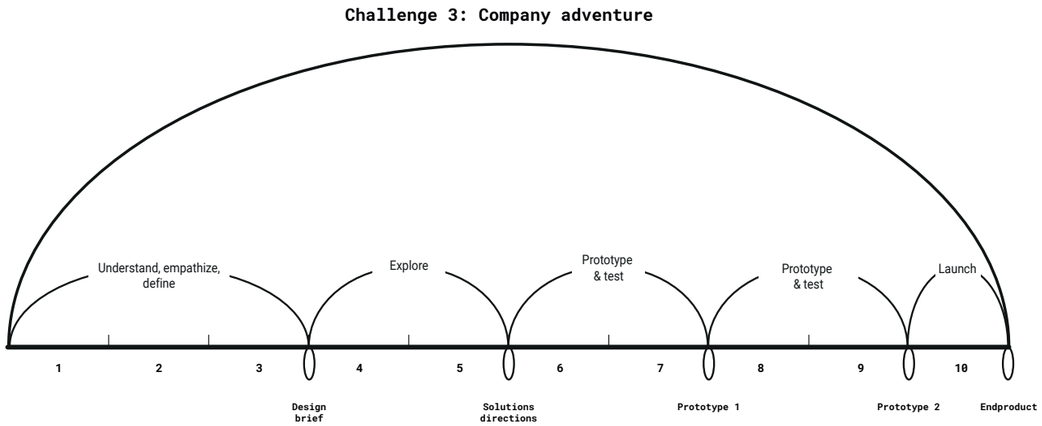
process

You must take a holistic approach to a student population, for example 1st or 4th year students, international students, technical or non-technical students at Fontys, and develop a solution for that group. You will use data collected by you or your fellow students in challenge 1.

requirements

1. General: Show you analyzed the wicked problem, set the conditions for governance and explain why the result is a small win.
2. Digital Technology: Use neural network algorithms to implement a model that applies to you and your fellow students and evaluate the model through performance metrics.
3. Digital Technologies: Show that the impact of technology on human values and the properties of neural networks are included in the solution (using the tict.io tool).
4. Systems Engineering: Create a value proposition for the prototype you design and develop a modular system for which you can demonstrate how parts of your system could be reused in future applications.
5. Practice-Based Research: Delve into your target audience and discover its needs using qualitative and quantitative user research methods.
6. Design-Based Working: Use a Design Thinking approach, create at least 2 lo-fi prototypes and make at least 1 iteration in your design process.

challenge 3: company adventure



Number of students per group: 2-3
Complexity from 1-5 (5 highest): 3 > design for a company

context

The organization you are going to work with may have a very clear idea of what it wants you to develop. The innovation you are going to develop is a solution for a problem the organization is currently facing or for an opportunity it sees in the market. The most important question is to what extent the company has a clear picture internally of the real problem and the opportunities in the market. How realistic is the opportunity they are describing? Are there any competitors or similar solutions on the market already?

In addition, what are the most plausible paths for the innovation you will work on for the company? The intention is that you don't blindly stare at that one 'best' idea. You really have to make an effort to identify multiple solution directions. Force yourself to think differently, listen carefully to the experts involved and think outside the box.

challenge

You will develop your solution from idea to prototype to a minimum viable product (MVP).
An MVP is the first working version of a product, with just enough features to satisfy potential clients and collect & analyze their feedback for the next product version, with minimum effort and resources required. An MVP should deliver the very essence of the product idea in its simplest form. Based on the context, this form can be different, meaning that your minimum viable product example can differ depending on the project and range from a demo video to a working software prototype.

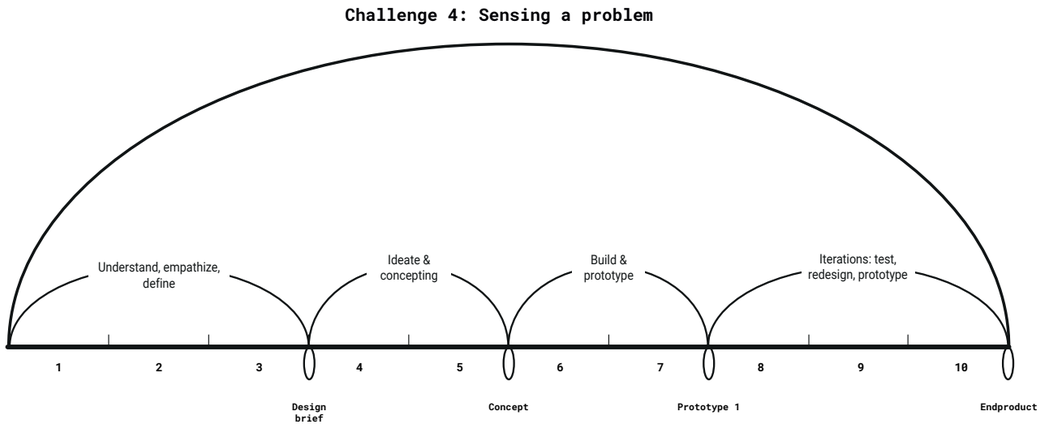
process

After each stage of the design process, you align with the client's management what options there are regarding the next step in the process, and which step you think should be taken. You do this on the basis of a thorough and solid foundation based on research results and the design-based working approach.

requirements

1. General: Show you analyzed the wicked problem, set the conditions for governance and explain why the result is a small win.
2. Digital Technology: Evaluate the use of different state-of-the-art digital technologies through literature studies. Integrate the technology in your solution and substantiate your choices with validation and verification tests.
3. Systems Engineering: Make use of a fitting systems development process and explain how this process fits with the company's approach on systems design. Demonstrate how your solution fits with the organizational context and create a minimum viable business case of your solution.
4. Design-Based Working: Conduct at least 2 multi-disciplinary sessions. Create at least one lo-fi and one hi-fi prototype and make at least 2 iterations in your design process.
5. Practice-Based Research: Formulate several research questions, which you will answer through user research with prototypes and evaluate with your target audience.

challenge 4: sensing a local problem



Number of students per group: 2-3
Complexity from 1-5 (5 highest): 4 > design for society

context

There is a tendency to pay more and more attention to regional and local cooperation. Why should you be interested in what is happening nationally or in the U.S., when local living conditions have much more impact on your daily happiness?

Small improvements in the local community often have a greater impact on residents than large developments that happen further away.

But what are the problems locally? What can be fixed? And how? Can smart devices measure things that can then be translated into smart solutions? Or improvements? And what is smart?

challenge

The challenge is to use the combination of a physical machine that senses or acts on data and an artificial neural network to create a solution for a local problem or a local improvement.

process

The product you are going to create must be firmly rooted in the local community. This means that you need to find local partners (a housing association, a residents' organization, an elementary school, a sports club, the municipality, a local business association, etc.) with whom you will be collaborating.

requirements

1. General: Show you analyzed the wicked problem, set the conditions for governance and explain why the result is a small win.
2. Digital Technology: Use your knowledge about available sensing technologies and smart devices to implement a solution based on devices interaction and advanced data processing.
3. Digital Technologies: Technology impact is demonstrably critically viewed by the peers. NOTE: check Technology Impact Cycle Toolkit www.tict.io.
4. Systems Engineering: Transform the value proposition of your solution into a physical prototype, plan for implementation and scale-up, and demonstrate how solid the choices are that you have made.
5. Practice-Based Research: Select an appropriate framework and use it to answer your research questions.
6. Design-Based Working: Create two visualizations of your design process; One at the start of challenge 4 that you can use to convince others of your design approach and one at the end to communicate your design process.

06. learning lines of the master

There are four learning lines, each learning line consists of four courses with tutoring. In the first year of your master's you take three courses per learning line, in the second year you take one course per learning line.
By following the courses of a learning line, you become familiar with the relevant theoretical knowledge, skills, tools and methods of that particular field. In this way, the courses support you in achieving the learning outcomes.

digital technologies

nr.	course	duration
1	Data retrieval, basic processing and data visualization	10 weeks (during challenge 1, year 1)
2	AI: Hands-on machine learning and neural networks	10 weeks (during challenge 2, year 1)
3	Deep dive into data analysis: mastering the state-of-the-art	12 weeks (during challenge 3, year 1)
4	Smart devices - sensors & embedded software	10 weeks (during challenge 4, year 2)

short introduction

This learning line will focus on gathering hands-on experience with technologies that are vital in the field of digital technology engineering. Building an understanding of the complexity of technologies from the perspective of Engineers, giving you a solid foundation on how these technologies work in daily practice and how they can be deployed and developed. You will come in contact with experts, visit inspiring organizations showing a future proof and sustainable use of digital technologies. The field of digital technologies stretches into every facet of business and life. As Digital Technology Engineer you will need a clear vision on how technologies can improve processes and understand that technology pushes the limits of our imagination. Within this learning line we will address technologies that are commonly used in modern organizations, giving you the opportunity to develop a toolkit of knowledge and skills. It will focus on mainly three topics: Data, AI and Smart devices.

systems engineering

nr.	course	duration
1	Understanding perspectives in systems engineering	10 weeks (during challenge 1, year 1)
2	Designing a value proposition	10 weeks (during challenge 2, year 1)
3	Optimizing and improving product design in an organizational context	12 weeks (during challenge 3, year 1)
4	Developing solutions: how to make a product successful	10 weeks (during challenge 4, year 2)

short introduction

The challenge for any engineer is to think not only as an engineer, but also as a customer or user of the product. The user is not only looking for functionality. Image, service, enjoyment, convenience, the price and quality also play a role in the decision.

Therefore, the successful design of a product must look at all aspects to make a product attractive to a customer. It's not just about functionality, but a whole system, where everything is related to everything else. Only when all relationships are optimal can your system be successful. In this learning line you will learn all aspects of the design process, and learn to think like a critical customer of your own developed product.

Questions you can ask yourself during this learning line:
- Is the developed product being reviewed by a critical user?
- Is the developed product being evaluated by a professional organization and its production?
- Have all relevant influences been considered, and weighed, from the right angle?

practice-based research - graduation level

nr.	course	duration
1	Practice-based research - basic skills	10 weeks (during challenge 1, year 1)
2	Collecting & analyzing data	10 weeks (during challenge 2, year 1)
3	Communicating research results	12 weeks (during challenge 3, year 1)
4	The bigger picture	10 weeks (during challenge 4, year 2)

short introduction

The Practice-based research (PBR) learning line is based on the principle of innovative, practice and evidence based work and offers you a toolkit based on academic research methodology. This toolkit will help you to secure the quality of your design, to add meaningful solutions to your target group's needs and to develop an attitude of a critical thinking professional. This results in understanding the problem, determining exactly what the problem is, which aspect of the problem needs to be solved, which research design fits the research question and how to report it satisfactorily.

The learning line PBR is closely linked to the learning line Design-based working (DBW). In the PBR courses you will learn to use research methods and tools, allowing you to make the right design choices in the design-based working approach based on research results. By the end of this learning line you understand and apply the important foundations of practice-based research, you will be able to set-up and conduct small-scale research and subsequently use the outcomes of your research to strengthen the digital technology integration.

design-based working

nr.	course	duration
1	Create and make choices	10 weeks (during challenge 1, year 1)
2	Design thinking	10 weeks (during challenge 2, year 1)
3	Human centered approaches	12 weeks (during challenge 3, year 1)
4	Visualizing your process	10 weeks (during challenge 4, year 2)

short introduction

Design Thinking is a proven and repeatable design methodology that provides a solution-based approach for solving problems. In the Design-based working (DBW) learning line you will learn how to apply the Design Thinking stages. By using this approach, you will be stimulated to create and test solutions for complex problems and to make iterations and improvements based on the input and feedback of stakeholders. The learning line Practice-based research (PBR) supports this DBW approach. By the end of this learning line you will be able play a leading role in the digital technology integration process using a design-based working approach.

07. coaching line of the master

coaching topics	
Year 1	Year 2
Talent and learning	Dimensions of culture
Norms and values	Talents in teams
Communication and learning strategies	Professional performance
Diversity and inclusivity	Professional performance and impact environment

short introduction

Society is constantly changing. Future-oriented professionals must keep up with these societal changes. To shape the future, we need impactful professionals.

Before you start the Master's in Digital Technology Engineering, you already possess a number of unique characteristics. You have a cultural background, and you can profile yourself with unique talents. During the coaching line you will discover more about your identity as a Digital Technology Engineer.
The coaching line pays focus on the development of your unique identity and the integration of the knowledge, skills and attitude of the different learning lines.
In this program you will also work on your mission; discovering what you want to achieve as a Digital Technology Engineer.
You will learn how to apply your identity and mission to your challenges and determine your learning strategy to achieve these goals. You will also develop monitoring skills and receive individual and group coaching to support you. During all challenges you will collect evidence, which will be used to reflect on your identity and learning progress in relation to the learning outcomes of the master's program.

08. assessments of the master

During both years of the master, a number of formal assessments will take place. With each assessment, we assess whether you have achieved one or more (parts of) learning outcomes. We use various types of assessments, each suiting the content of the learning outcome and the phase of the master. Next to the formal (summative) assessments in the master, there are also various opportunities to get feedback, feed-up and feed-forward on your progress on each of the learning outcomes. These opportunities are organized as part of the courses of each learning line.

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