

Mod.No.

Title: Digital Innovation Lab

Instructors

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Course Pre-Registration

Due to limited course capacity available, you will need to contact the instructors in advance if you are interested in enrolling to the course. Please send your inquiries to Imke Grashoff (imke.grashoff@uni-hamburg.de).

Overview

This course takes the form of a **project-based digital innovation lab**. The objective is to develop a functioning novel *digital innovation prototype* (containing both hardware and software component) that addresses a chosen *sustainable development challenge*. With this objective, we have two specific foci.

1. Address a Sustainable Development Challenge

We define a sustainable development challenge as a problem of either environmental or social but not primarily commercial value. As inspiration, consider the *Sustainable Development Goals of the United Nations* that provide a set of goals and agenda for peace and prosperity. Another source of inspiration for sustainable development challenges is the *Fridays for Future* movement that emerged from school strikes demanding action to prevent further global warming. As a concrete project example consider the [Fairphone](#) – a highly modular smartphone that accounts for conflict-free production resources, worker welfare and e-waste programs – or [WakaWaka](#) – a solar-powered lamp providing 16 hours of reading light on less than a day of sunlight. What we do not consider as sustainable development are, for example, lean manufacturing approaches that are directed to primarily increase efficiency in production processes and which may include reduction of waste only as a side effect. Another negative example are greenwashed products and practices that make unsubstantiated or even misleading claims about their environmental benefits (e.g., reducing the carbon footprint).

Our goal in this course is to help students understand both grand sustainable development challenges that concern current and future generations, and to advance students' understanding of the solution potential of digital technologies to address these global challenges.

2. Develop a Digital Artifact as a Solution to the Sustainable Development Challenge

Students must work together in cross-disciplinary teams to develop a concrete, tangible, digital innovation solution that contains hardware and software components and which addresses the chosen sustainable development challenge. For the hardware components, we will provide a selected hardware technology stack within the Coworking Space of the [Management Transfer Lab](#) (MTL), which students can choose to work with. The students' task is then to configure the hardware technology stack and develop a corresponding software solution such that a digital innovation can be realized.

For illustration purposes, consider these examples:

- Vertical Hydroponic Farm Arduino Project (Langdon 2015)
- Self-powered water meter for direct feedback to safe water consumption (Tasic et al. 2012)
- Meter devices for smart and energy-efficient school buildings (Pocero et al. 2017)
- Open source low-cost power monitoring system (Oberloier and Pearce 2018)
- Wireless sensor network system for environmental monitoring applications (Ferdoush and Li 2014)
- A datalogger for irrigation water use monitoring to enable crop management (Spinelli and Gottesman 2019)

The following two examples are solutions developed by students in previous instances of this course held at the University of Cologne:

- [Proteus: A Platform for Monitoring and Predicting Water Quality and Availability](#)
- [Speak4Me: A wearable "eye-to-speech" solution to help people who are unable to communicate verbally and cannot use sign language](#)

Learning outcomes

Students learn to...

- ... understand what digital innovation means and learn about important related concepts.
- ... acquaint themselves with the potential of emergent digital technologies.
- ... understand challenges related to developing digital innovations.
- ... understand challenges of sustainable development
- ... develop a socio-technical artifact incorporating latest digital technologies.
- ... organize themselves and work in independent teams.

Contents

The contents of the unit roughly unfold in the following way:

- Introduction to digital innovation
- Grand challenges and wicked problems of a sustainable society
- Selected emergent digital technology stacks
- Digital innovation and systems development practices
- Project and team management
- Design and implementation of digital innovations
- Prototyping and Testing

Procedures

Students will form teams to complete this unit. In teams, they are free to choose their own sustainable development challenge as a problem setting to be addressed within their digital innovation project. Team formation is scheduled for the kick-off session.

A selection of hardware technologies will be made available in the [Management Transfer Lab](#) at the beginning of the course to start experimentation right away. In advance, students are encouraged to familiarize themselves with some preparation material and fill out a brief survey that can be used for team formation.

During the semester, student teams will be provided with a budget of 500€ that they can use to buy additional hardware components such as sensors, extensions, motors, tools etc. for their projects on an as-needs basis. Orders have to be issued through the course instructors.

Over the course of the semester, student teams will continuously work on developing their digital innovation solution. The course will include a range of accompanying help and assistance formats including lectures, tutorials, and interactive workshops. For the workshops, students are provided with resources and materials in advance to prepare for the workshop in a flipped-classroom style.

The final report and solution should be submitted under a free and open-source design solution that meets the requirements of a professional outlet such as [HardwareX](#) – an open-access journal established to promote free and open-source designing, building and customizing of scientific infrastructure (hardware). Therefore, reports must provide potential end-users with sufficient information to replicate and validate the advances presented. More information on documentation requirements and examples can be found on the journal's website. As compatible open-source license model, we recommend the *General Public License (GNU)*.

Technology Stack

In our MTL Coworking Space we already have a selected stack of hardware technologies available for students, which they can use to start experimentation and trial straight from the beginning. The following list is illustrative for some of the technologies available; it is not a comprehensive list of technologies that can be used.

- Arduino Hardware Platform / Arduino Education Starter Kits – central part is an open-source microcontroller board, including integrated development environment
 - o Official Website: <https://www.arduino.cc/>
 - o Arduino Project Hub: <https://create.arduino.cc/projecthub>
- Circuit.io – prototyping tool for instant circuit schematics and code for electronic circuit
 - o Official Website: <https://www.circuito.io>
 - o Blog: <https://www.circuito.io/blog>
- Ultimaker 3D printer – create and innovate with the easy and powerful 3D printing solution
 - o Official Website: <https://ultimaker.com/>
 - o Blog: <https://ultimaker.com/de/learn/blog>
- Tobii Eyetracker – wearable and static eyetracker for behavioral research in a wide range of settings
 - o Official Website: <https://www.tobii.com/product-listing/tobii-pro-lab/>
 - o Blog: <https://blog.tobii.com/>
- Acer Predator computer – high-performance computer for demanding tasks with processors of the 12th generation
 - o Official Website: <https://www.acer.com/ac/de/DE/content/predator-series/predatororion3000>
- Sony 4K-HDR Camcorder – a compact handheld camcorder for shots in broadcast quality
 - o Official Website: https://pro.sony/de_DE/products/handheld-camcorders/pxw-z90
- Furthermore, our technology stack comprises Raspberry Pi 4 microcontrollers, a printer and camera equipment that can be used for the project
- For further inspiration of technologies and tools to use, students can take a look at web sites such as [Stackshare.io](https://stackshare.io).

Room

Coworking Space of the MTL (room 3096/3097 in VMP 5)

Assessment

Overview of Assessments

Assessment	Due Date	Assessment Weighting	Type of Assessment	Deliverables
1. Problem definition	30.04.2022	10%	Group	Presentation
2. Solution concept and prototype	04.06.2022	20%	Group	Presentation and prototype
3. Project report and working solution presentation	24.06.2022	70%	Group	Finished prototype, report and presentation

Assessment 1: Problem definition

Students formulate their problem description including motivation and relevance. Problem definitions should already address the type of innovation and stakeholders, possibly the realm of technologies involved. Students present their deliverable in an adequate format (e.g., an oral group presentation).

Assessment 2: Solution concept and prototype

Students formulate their solution concept. Reports address the planned digital technology solution to serve as a blueprint. An integral part is the description of the group's development method and project plan. Feasibility tests and prototypes, schematic diagrams, mock-ups, and other useful forms of early design should be included. Students present their deliverable in an adequate format.

Assessment 3: Project report and working solution presentation

Students formulate a detailed report of their project. The working solution is described and adequately presented. The assessment comprises two parts: (1) the project report and (2) the presentation of the working solution.

Introductory Reading Resources

- Fairphone (website): <https://www.fairphone.com/en/>
- Fridays for Future (website): <https://www.fridaysforfuture.org/>
- General Public License (GNU) – free, copyleft license for software and other kinds of works: <https://www.gnu.org/licenses/gpl-3.0.en.html>
- HardwareX Journal (website): <https://www.journals.elsevier.com/hardwarex>
- Stackshare.io (website): <https://stackshare.io/>
- United Nations, Sustainable Development Goals Agenda (website): <https://sustainabledevelopment.un.org/?menu=1300>
- Wakawaka (website): <https://waka-waka.com/en/>

Schedule

Week	Date	Topic
1	Sa, 09.04., 09:00-15:00	Kick-Off: Organization and procedures, team formation, introduction to the course topics, guest lecture on sustainability, introduction to hardware technologies
1	So, 10.04., 09:00-12:30	Workshop I (continuation from day I): Problem scoping and design techniques
3	Mi, 20.04., 18:00-20:00	Check-In I: Dealing with hardware problems
4	Sa, 30.04., 09:00-16:00	Interim Presentation I + Workshop II: Introduction to digital innovation and wicked grand challenges
7	Mi, 18.05., 18:00-20:00	Check-In II: Dealing with software problems
9	Sa, 04.06., 09:00-14:00	Interim Presentation II + Workshop III: Presenting and selling your ideas/solutions
11	Mi, 15.06., 18:00-20:00	Check-In III: Removing roadblocks
12	Fr, 24.06., 16:00-20:00	Final Presentation

Your lecturers

Jan Recker is Alexander-von-Humboldt Fellow, Nucleus Professor for Information Systems and Digital Innovation at the University of Hamburg, and Adjunct Professor at the QUT Business School, Australia. In his research he explores the intersection of technology, people and work. He works with particularly large organizations, such as Woolworths, SAP, Hilti, Commonwealth Bank, Lufthansa, Ubisoft, Esri, federal and state governments, and with particularly small organizations ("start-ups") in the consumer goods, hardware, and financial sectors. He teaches on topics such as digital innovation, technology management, qualitative methods, and scientific research.

Imke Grashoff completed her master's degree in the field of Social Economics and is now working as a research assistant at the Chair for Information Systems and Digital Innovation. With a strong interest in topics involving the influence of digital technologies on organizations, collaboration and (the future of) work in general, she is currently pursuing her doctoral studies dealing with the question of how Artificial Intelligence is designed for professional decision-making.

Johanna Lorenz obtained a master's degree in business administration at the University of Hamburg and is now working as a research assistant and PhD student at the Professorship for Information Systems and Digital Innovation. She is also involved in the Management Transfer Lab of the Faculty of Business Administration – a BMWi-funded initiative that fosters multidisciplinary transfer activities of university actors. In her research, she deals with the digitalization of the experience economy.