PILOTING FASHION-TECH EDUCATIONAL STRATEGIES

PROOF OF CONCEPT FOR INNOVATIVE FASHION-TECH PRODUCTS AND SERVICES

edited by
Daria Casciani, Chiara Colombi

FTalliance

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Proof of Concept for Innovative Fashion-Tech products and Services

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FTALLIANCE
Weaving Universities and Companies
to Co-create Fashion-Tech Future Talents

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

This publication is the result of a didactic research process involving students, teaching staff and industry experts from across Europe in three (3) learning experiences implemented over a period of almost one year (2021-2022). It aims to identify and describe the major lessons learned from the testing and piloting of three innovative Fashion-Tech learning experiences in order to discuss opportunities for Fashion-Tech (i) Strategic Innovation, (ii) applied Research for the future Education Agenda and (ii) cooperation, networking and partnership opportunities.

The work has been organised and synthesized by Politecnico di Milano as leader of the activities related to designing and piloting Fashion-Tech learning experiences (WP2), and project coordinator of the Fashion-Tech Alliance, a 3-years European academia-industries partnership project aimed to facilitate the exchange, flow of knowledge, and co-creation within the Fashion-Tech sector to boost students' employability and fashion-tech innovation potential. This project specifically involves five renowned Higher Educational Institutions Academic partners (Politecnico di Milano, Dipartimento di Design, ESTIA École Supérieure Des Technologies Industrielles Avancées, Högskolan i Borås, University of the Arts London - London College of Fashion, Technische Universiteit Delft), one Fashion-Tech research Centres (Centexbel) and seven industrial partners (Decathlon International, Pangaia Grado Zero, Pauline van Dongen, Pespow, Stentle / M-Cube Group, We Love You Communication, and PVH Europe). The aim of this project is to provide an evidence-based perspective on the Fashion-Tech education reporting on the relationship between advanced teaching/learning approaches about design, business management, and engineering that can be applied to the future generation of fashion-tech professionals.

This publication consists of five chapters presenting the learning experiences' workflow starting from the research premises, the implementation, and evaluation, followed by a reflection on the results with concluding remarks and future perspectives on Fashion-Tech education. Chapter 1 sets the premises of the Fashion-Tech educational research, meanwhile, the following chapters (2,3,4) present the case studies of the three piloted learning experiences describing the contents, objectives, and outcomes, reporting the methodology and lesson learned in terms of Fashion-Tech emerging topics, and reflections on the phases of the didactic experiences. Each of these chapters is followed by visual charts that present the results showcasing the portfolio of innovative Fashion-Tech concepts of products/services developed during the learning experiences. Finally, chapter 5 sets out the findings and future trajectories for Fashion-Tech education and collaboration. It discusses how the research findings led to setting the premises for prospective scenarios of the Fashion-Tech education, which serve as an invitation to open a collaborative discussion on the future of Fashion-Tech educational models, collaborative engagement between different stakeholders of the sector, and all concerned about the skills of future Fashion-Tech professionals.

This publication contains the deliverable D2.2 Proofs of Concept for innovative FT products/services, in fulfillment of the European Project FTalliance Weaving Universities and Companies to Co-create Fashion-Tech Future Talents (612662-EPP-1-2019-1-IT-EPPKA2-KA - FTall).

3. CASE STUDY SCALABILITY OF MULTIDISCIPLINARY FASHION-TECH SOLUTIONS

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3.1 ADDRESSING FUTURE SUSTAINABILITY CHALLENGES

Currently we live in a world that is often described by narratives, such as ecosystems in decline, species loss, water scarcity, climate chaos, spread of diseases coupled with the resultant social and economic turmoil *(Aneja & Pal, 2015).* This situation is largely contributed by accelerated trends, such as growing volumes of world trade (volume index has grown by nearly 45 times since 1950) and proliferation of world population (set to increase from 1.8 billion in 2012 to 4.8 billion by 2030). Tracking the exponential growth of the effects of human activity upon the Earth, in terms of 12 socio-economic and 12 earth system parameters, since 1950, these trends mark the period of "great acceleration". Macy and Johnstone (2012) terms this as the "The Great Unraveling" while Rockström and Klum *(2012)* term this as the quadruple squeeze on humanity's ability to secure long-term sustainable development on planet. Overall, the consequences are marked by economic decline, resource depletion, climate change, social division, war, and mass extinctions; thus, rapidly eroding resilience of the earth, where we have so far undermined 60% of the key ecosystem services in support of human well-being *(Aneja and Pal, 2015).* At the current rate of growth, this will rise to 2 Earths by 2030 and 2.5 Earths by 2050—a clear impracticality *(Global Footprint Network 2014)*. To combat the situation, sustainability has become an important catchphrase and a movement meaning "meeting the needs of the present without compromising the ability of future generations to meet their own needs" *(Brundtland Report 1987)*.

The aim of this section is to situate the learning experience 'Scalability of Multidisciplinary Fashion-Tech Solutions' in relation to existing literature on fashion industry impact on sustainability from a holistic multifaceted perspective, tto give an understanding about the importance of educating students toward this thematic area through innovative teaching methods and digital educational tools.

The textile and clothing industry with a global trade worth US$807 billion in 2019 and employing more than 70 million people worldwide is considered to be one of the most polluting industries *(United Nations, 2019)*, with 10% of global greenhouse gas (GHG) emission *(Saha et al., 2020)*. It is the fifth-largest contributor to GHG emission accounting for around 4% of the secondary carbon footprint of an individual in the developed world *(Dev 2009).*

Water pollution is also rampant due to effluents such as fertilizers and pesticides from cotton farming and dyeing units *(Haque, 2017)* and the industry discharges are estimated to be nearly 20% of the global industrial water pollution. Water consumption due to extensive cotton cultivation has led to major environmental degradation and habitat loss (as was observed in the Aral Sea region). Apart from that, the industry has been a major source of fossil fuel-based pollutions for energy generation purposes.

Besides, in a fashion system where only around 20% of clothing is recycled or reused, huge amounts of clothes and textiles ends as waste in landfills or is incinerated *(Global Footprint Network, 2017),* estimated to be worth US$3 billion. The scale of the problem is increasing in-line with increasing demand for clothing, and McKinsey and Company *(2016)* estimates that the global production which reached 1 billion items annually in 2014, will further rise owing to the dominance of the fast fashion as the overall consumption is predicted to increase by 63% from 62 million tons today to 102 million by 2030 *(Pulse of Fashion Industry, 2017).* Fashion logistics, forecast-driven overproduction, irresponsible consumption and uninformed consumers are responsible for the sustainability gap in the textile, clothing and fashion industry *(Strähle & Müller, 2017; Pal 2014).* Thus, climate impacts of textile production, consumption and use present huge challenges, causing climate change and resource depletion. Such environmental challenges stemming out from textile, clothing and fashion industries is topped by social challenges facing the textile industry, and the potential for interventions linked to achieving social sustainability targets *(Huq, Chowdhury, & Klassen, 2016)*. The social hotspots of these industries have been found to relate to significant social risks such as low wage levels, child labour and exposure to carcinogens in the workplace. Therefore the future of textiles, clothing and fashion, much like other industries, is facing problems of limits to natural resources, global warming, sustainability issues, and social and political upheaval. To become sustainable, the industry needs a dramatic change at all levels starting with design, production, marketing, sales, and promotion *(Pal 2014).* With growing awareness, sustainability has gained traction in the textile, clothing and fashion industries and today is becoming even more important. There are several sustainability issues — along the three pillars of the triple bottom line approach—that specifically relate to the components of the supply chain for meeting the challenges of fashion logistics, overproduction, unsustainable consumption behaviour, and social irresponsibility, hence cannot be ignored *(Pal 2014).*

The global textile, clothing and fashion industry is transforming rapidly owing to the impact of the current COVID-19 outbreak with a massive contraction in global revenues. However, this has simultaneously opened up new opportunities for driving a paradigm shift of the industry powered by digital technologies and virtual connections with the promise of enhancing innovation and sustainability along the entire value chain *(Brydges et al. 2020, Gonzalo et al. 2020);* believed to be resulting in faster, more intelligent and more efficient processes, products, services, and

business models. Furthermore, the digital shift in the industry promises not only to drive profitability but also significantly improve sustainability across all value chain stages. Digital technologies are found to have significant impact in driving dematerialization of resource-intensive processes in traditional supply chains. For instance, clothing companies that have started using digital technologies such as 3D design, virtual sampling and prototyping can optimize material consumption for physical sampling which can ultimately reduce carbon footprints *(Cobb et al. 2017; Xiong 2020).* In the production stage, digitally enabled on-demand production allows elimination of unsold clothes, and when combined with digital tools such as 3D virtual fitting can be used to manufacture made-to-measure garments, thus eliminating both pre- and post- consumer wastes. Other technologies, for example adding digital tags or RFID in garment-making stage can reduce the level of safety stocks needed, enable supply chain traceability, thus increasing the lifecycle of clothing by reducing pre-consumer waste *(Denuwara et al. 2019, Östlund et al. 2020).* However, the application of digital technologies in the textile, apparel and fashion industry is in its exploratory phase; and existing technological advancements require widespread adoption and scale to attain. Even though digitalization is a 'silver lining' that offers opportunity to re-imagine the textile, apparel and fashion industry, create operational and financial stability, and underpin focus on sustainability and circularity. The learning experience proposed in the following section attempts to address the identified needs in current Fashion-Tech pedagogy research and aims to investigate design and business innovation possibilities of technology applied to fashion to address societal challenges and deliver sustainability-related improvements.

3.2 FOCUSING ON THE LEARNING EXPERIENCE

Learning experience contents description

The learning experience, 'Scalability of Multidisciplinary Fashion-Tech Solutions' focused on the field of Fashion-Tech and its value chains. The aim was to advance students' knowledge on identifying future sustainable development challenges and to focus on how these can be solved by developing interdisciplinary and scalable Fashion-Tech solutions (covering design, technology, and management aspects). In this context, scalability was discussed from a social innovation perspective in terms of scaling-out, scaling-deep and scaling-up dimensions *(Moore et al., 2015; Sandberg and Hultberg, 2021)*. The course further discussed the link between management, design, innovation, technology and customer to enhance Fashion-Tech industry competitive advantages across the triple bottom line: economic, environmental, social and cultural sustainability. Content, structure and specific information about the learning experience has been included in the 'Scalability of Multidisciplinary Fashion-Tech Solutions' Syllabus *(2022).*

Brief indicative contents

The digital course was delivered with a preliminary theoretical part assigned in an asynchronous way (Discover) aimed to level the knowledge of the students as a prerequisite for the subsequent practical challenge-based part of the course (Define, Design and Deliver) that was delivered synchronously. The contents of the theoretical part were delivered through lectures, preparatory exercises and applicative sessions to level the knowledge of students in the three different disciplinary domains of the project: sustainable design, Fashion-Tech interventions and Fashion-Tech business & impacts. The challenge part started with a kick-off through a brief launch and interactive brainstorming (Define). Students were then asked to develop a comprehensive scalable Fashion-Tech solution to a critical sustainability/societal challenge, by creating a sustainable business model blueprint of a fictitious project company (Design). In the challenge-based part students were formed into interdisciplinary and international groups to experience the process and the methodological approach of a project development activity that includes design, engineering, business management, research & development. The value proposition, and means to create, deliver and capture such sustainable solutions were addressed from a systemic perspective, by developing (where necessary) mock-ups of product design, technical specifications, engineering solutions and value chain. Different strands of the project among a series of thematic options, were:

- Circular Fashion-Tech solutions for resource effectiveness and climate positive impacts;
- Traceability solutions for improved provenance, circularity and due diligence;
- Smart textiles solutions for eco/sustainable materials;
- Innovative manufacturing and/or assembling processes for climate-smart solutions;
- 3D experience for simulation and personalization.

Finally in the Deliver module, students were asked to produce the results of the project in different formats. Students were also introduced to innovative ways of teaching that are based on digital tools used both to deliver the course and to develop project work and group collaboration between teammates. Therefore, the course was delivered totally digitally in a Virtual Learning Environment (VLE) using tools, such as Pingpong,

Zoom and Miro.

Course materials
For the Discover part (asynchronous theoretical part), the learning experience developed:

- An in-depth series of video lectures and multi-media presentations with high-quality graphics & detailed descriptions (13 video lectures)
- A list of required course textbooks, texts and other readings indicated at the end of every lecture in the videos, pdf files of the presentations and also as extra material. These are intended as optional materials to be read and studied to complete the learning objectives.
- High-detail examinations of the topics produced through digital documents, readings)
- A comprehensive set of quizzes and assessment tests

For the Define and Design parts (Brief Launch and Challenge based part), the learning experience delivered:

- 6 industry talks from experts from Centexbel (CTB) and WeLoveYou (WLY)
- A set of specific templates and connected reading materials related to the 3 phases of the challenge-based group project, that includes business plan, sustainable business model canvas, value mapping tools, scaling models, and template for final deliverables (group report and presentation).

Learning Experience Objectives
The general purpose of the course was to train professionals who are able to employ the potentials of digital technologies in the domain of fashion, to drive development of Fashion-Tech solutions covering technology, management and design aspects, to address sustainable development or societal challenges.
The course, through an innovative way of teaching, aimed at providing students with useful tools and skills to critically interpret the project dimension within the broader context of sustainable and societal developments contemplating diverse social, cultural, and technological contemporary shifts (new lifestyles and needs, new typological configurations and innovative technological scenarios). The digital theoretical lessons, preparatory exercises and applicative sessions were aimed to transfer students' knowledge of how fashion and digital technologies are interconnected, and their potential as well as limitations towards addressing sustainability related challenges in the entire value chain. From product/service ideation, design and engineering stages, to business model strategy development, students were asked to explore and exploit the potential of Fashion-Tech tools, as well as the implications of digitalization and virtualization of the value chain processes in relation to scaling opportunities for sustainability innovation.
The course also contained a challenge-based phase that was designed to nurture adaptive professionals with the ability to collaborate in delivering a project in the field of Fashion-Tech, as well as pitch their product and business ideas in a professional manner.

Learning Experience Outcomes
Upon successful completion of the course students were expected to gain the following learning outcomes:

- Knowledge and understanding
- Describe and explain scaling and scalability in fashion-tech value chains;
- Understand the role of fashion-tech solutions (covering design, technology, management aspects) in the context of future sustainable development risks and challenges;
- Identify the implications of developing inter-disciplinary and scalable fashion-tech solutions in addressing societal trends and sustainability demands.

Skills and abilities
- Apply innovative research and methodological approaches in the multidisciplinary Fashion-Tech context;
- Develop insights into fashion-tech tools and how to scale them in order to solve specific sustainable development challenges related to circularity, personal safety and health, climate change, social cohesion, etc.;
- Develop innovative business model scalability approaches to accommodate the fashion-tech solutions related to products, processes and value chain;
- Engage in dialogue and co-produce knowledge and innovation with various stakeholders across multiple disciplinary international contexts.

Evaluation ability and approach
- Critically reflect from the SDG perspective on the economic, environmental, and societal impacts of implementing scalable fashion-tech solutions;
- Critically reflect on complexities associated with scaling fashion-tech value chains, and demonstrate awareness of the negative impacts of it.

3.3 METHODOLOGY

Learning Experience Structure and Outline

The learning experience was delivered over 12 weeks, from September to November 2021. It contained both theoretical and practical activities that stretched over 50 hours of frontal teaching/tutoring (synchronous and asynchronous) and about 80 hours of student work, i.e. asynchronous self-learning and teamwork interaction. The number of quantified hours are approximate and an average from the different HEIs involved in the course. The activities included lectures, instructions, assessments, peer interactions and the delivery of a final project. The course was broadly divided into 5 modules as shown in Figure 12.

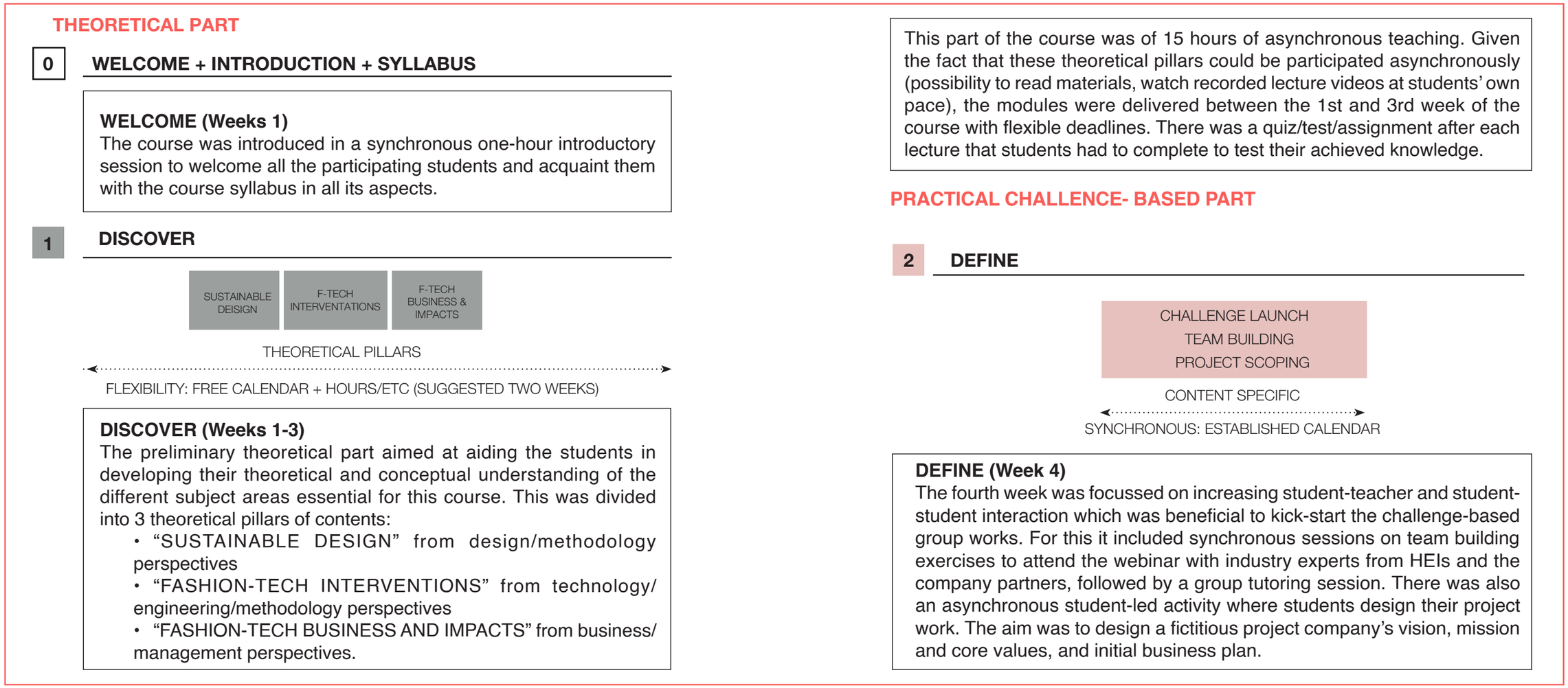
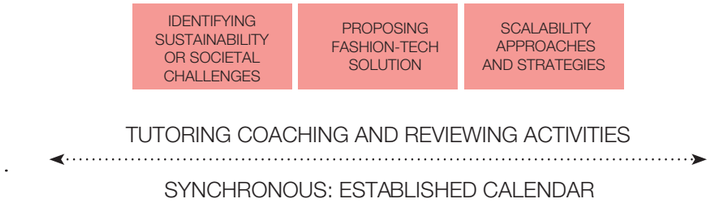


FIGURE 12 LEARNING EXPERIENCE STRUCTURE AND OUTLINE

3 DESIGN



DESIGN (Weeks 5-10)
The next part of the course was practice and challenge-based and was divided in three chronological phases of two weeks each. The challenge-based part of the course had students from the different HEIs working in their student groups to develop a comprehensive scalable Fashion-Tech solution to a critical sustainability/societal challenge. The goal was to create a sustainable business model blueprint of a fictitious project company. The value proposition, and means to create, deliver and capture such sustainable solutions was also addressed from a systemic perspective, by developing mock-ups of product design, technical specifications, engineering solutions and value chain. The three phases were as follows:

Weeks 5-6: Identifying sustainability or societal challenges.
In this context, student groups had to:

- Identify a critical societal/sustainability challenge that their company pivots on,
- Prepare initial elevator pitch on how this company is guided by the SDGs and what challenges it critically targets to solve through its business.

In this phase, there were three synchronous sessions; first dedicated to industry talks on "Sustainability/Societal challenge-driven Innovation in Fashion-Tech arena", the second organised as a group-wise preliminary concept pitching, and the final one as feedback and interaction session on the work-in-progress status of the group projects.

Weeks 7-8: Proposing Fashion-Tech solution.
In this context, student groups should:

- Locate the Fashion-Tech solution rendered by the project company,
- Map the value profile (proposition, means to create, deliver and capture these) for the project company,
- Make sustainable business model blueprint with detailing technology, design, process and value chain dimensions.

In this phase, there were two synchronous sessions; first dedicated to industry talks on "Fashion-Tech solution space amidst sustainability/societal challenges", while the second was a feedback and interaction session on the work-in-progress status of the group projects.

Weeks 9-10: Scalability approaches and strategies.
In this context, student groups had to:

- Locate the current scalability challenges and scaling opportunities in the solution provided by their project company,
- Identify approaches/strategies for scaling impacts based on systemic innovation perspective,
- Reflect on scaling outcomes on SDGs.

In this phase, there were two synchronous sessions; the first dedicated to industry talks on "Fashion- Tech scalability and its impact", while the second one as a feedback and interaction session on the work-in-progress status of the group projects.

Based on the specific disciplinary background, each component of the interdisciplinary groups took care of the following activities and tasks in order to complete the project and the final assignment:

- Concept Pitching, and presenting project company's vision, mission and core values, and initial business plan
- Societal/sustainability challenge-driven innovation
- Sustainable Development Goal alignment
- Sustainable business modelling and value mapping with detailing on technology, design, process and value chain dimensions.
- Approaches/strategies for scaling impacts and systemic innovation.

Teamwork was tutored and supported by a team composed of teaching staff and tutors from each HEIs to review the work of the students from different disciplines and perspectives.

FIGURE 12 LEARNING EXPERIENCE STRUCTURE AND OUTLINE

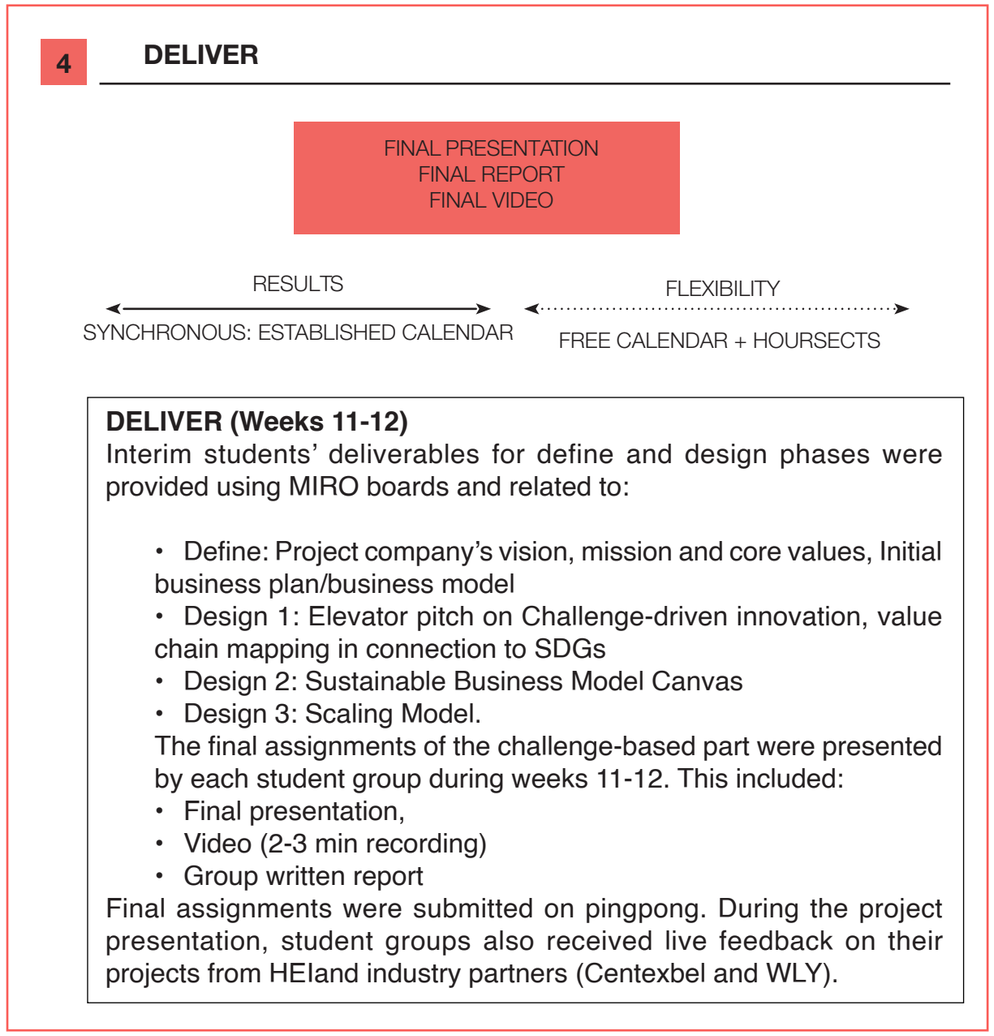


FIGURE 12 LEARNING EXPERIENCE STRUCTURE AND OUTLINE

Participants

The classroom was composed of 21 interdisciplinary and international students, 11 teaching staff, and 2 professionals from Fashion-Tech companies from the FTalliance consortium (Fig. 13).

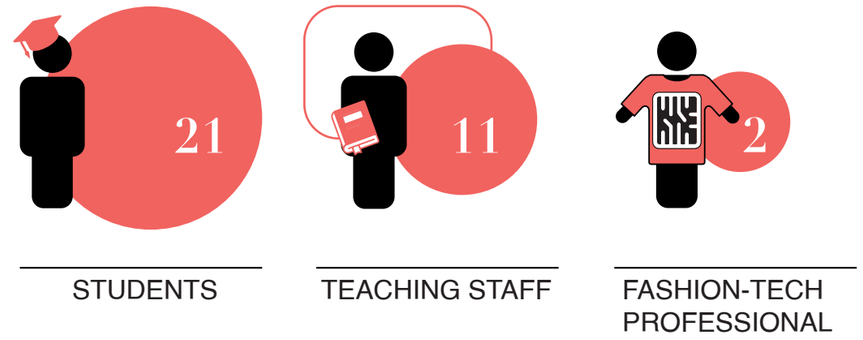


FIGURE 13 LEARNING EXPERIENCE PARTICIPANTS

Teaching Staff

Teaching staff members were involved in delivering the learning experience as follows (Fig.14):

- 5 professors from Politecnico di Milano, School of Design (Italy) focusing on Fashion and Fashion-Tech Design, Sustainability, Circular Design and Materials.
- 3 professors from Hogskolan i Boras - The Faculty of Textiles, Engineering and Business The Swedish School of Textiles (Sweden) focusing on Circular economy, value chain innovation, Fashion-Tech value chains and business models;
- 1 professor from TU/Delft - Industrial Design Engineering Faculty (The Netherlands) focusing on Smart materials and textiles.
- 2 professor from Ecole supérieure des Technologies industrielles avancées (France) focusing on Robotics.

81% of teaching staf (9 professors) were involved in delivering theoretical lectures during the theoretical part and the 55% (5 professors) were involved in delivering the challenge-based part of the learning experience. They were available during the project design through a series of mentoring and tutoring activities covering different topics such as Fashion and Fashion-Tech Design, and Fashion-tech value chains and business models, Societal Challenges, Scalability, Circularity,

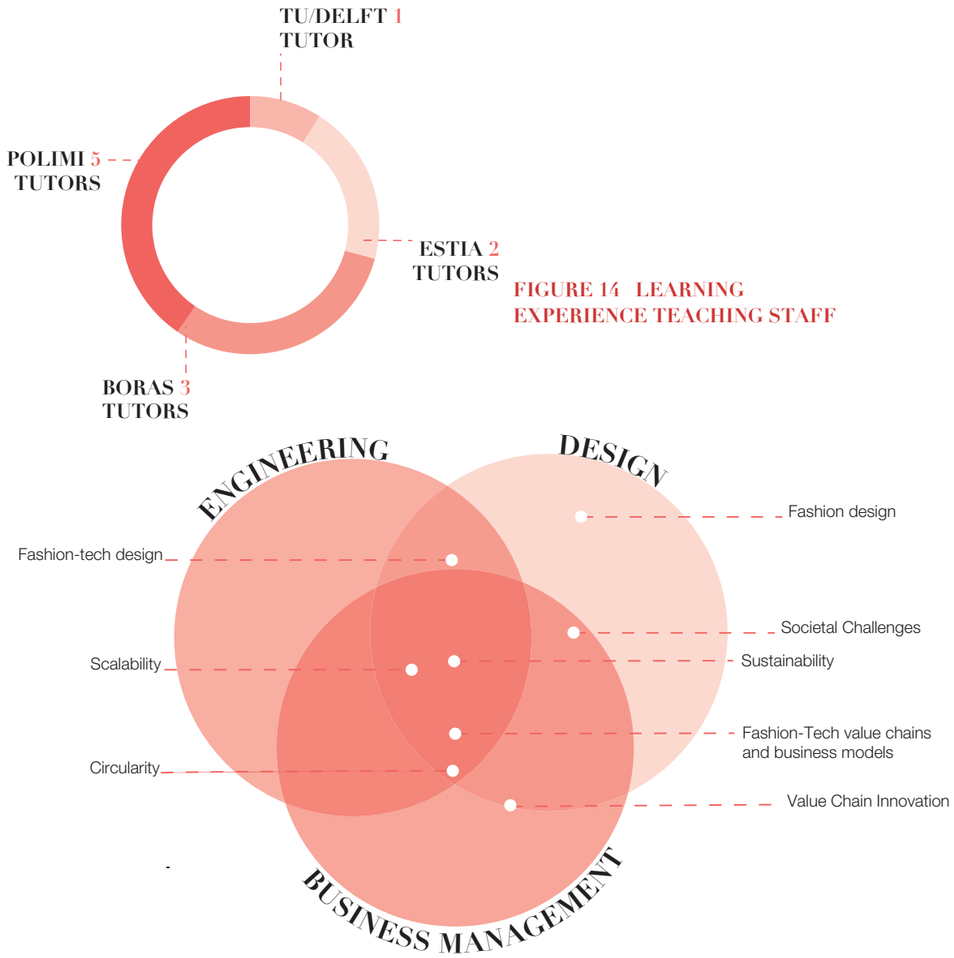


FIGURE 14 LEARNING EXPERIENCE TEACHING STAFF

Sustainability.

Students

Students have been selected and participated to the learning experiences, as follows (Fig.15):

- 9 students from Politecnico di Milano, School of Design (Italy) (second year MA in Design for the Fashion System and Integrated Product Design),
- 9 students from Hogskolan i Boras - The Faculty of Textiles, Engineering and Business. The Swedish School of Textiles (Sweden) (First and second year MSc in Textile Value Chain Management, Fashion Marketing and Management, Fashion and Textile Design,

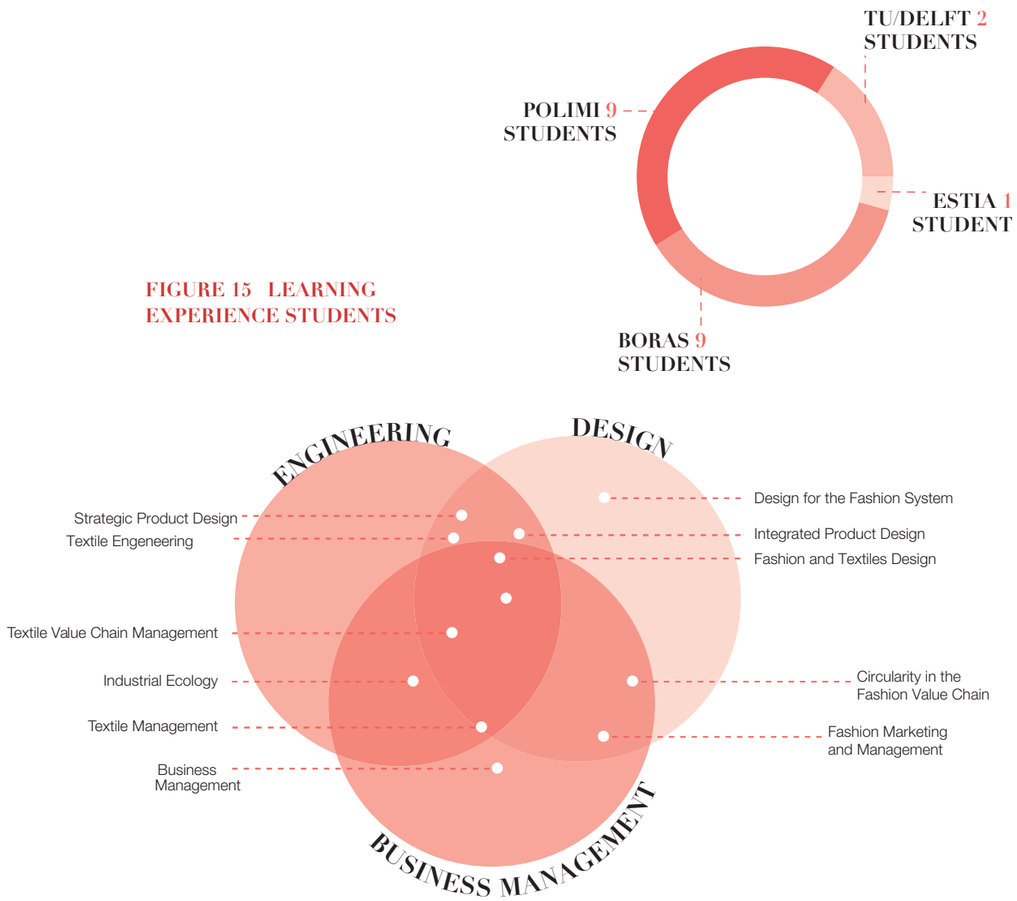


FIGURE 15 LEARNING EXPERIENCE STUDENTS

Textile Engineering, Business Management)
- 2 students from TU/Delft - Industrial Design Engineering Faculty (The Netherlands) (MA in Strategic Product Design),
- 1 student from Ecole supérieure des Technologies industrielles avancées (France) (PhD student in Circularity in the Fashion Value Chain).

Students worked in 7 teams of about 3 members each, with interdisciplinary backgrounds and varied abilities. Group selection has been defined from the teaching staff, in order to create a balanced mixture of disciplines in each group. The learning experience has been partnered with two European companies leading the sector of Fashion-Tech: Centexbel (CTX) and We Love You (WLY).

3.4 RESULTS

The learning experience has been able to implement a series of the Subject-specific Skills as resulting from the three focus group and integrated into the E4FT project (see Chapter 1). Subject specific skills related to Fashion-Tech Design process and methodology and Fashion-Tech project management were implemented in order to allow students to collaborate from different disciplinary domains and to produce Insights into multi-disciplinary area of Fashion-Tech and its industrial applications. In particular, this learning experience focused on design, and business management related to new technologies applied in the fashion sector with a clear aim to advance sustainable development. The course has also focused on skills related to scalability from a social innovation perspective in terms of scaling-out, scaling-deep and scaling-up dimensions (Fig.16).

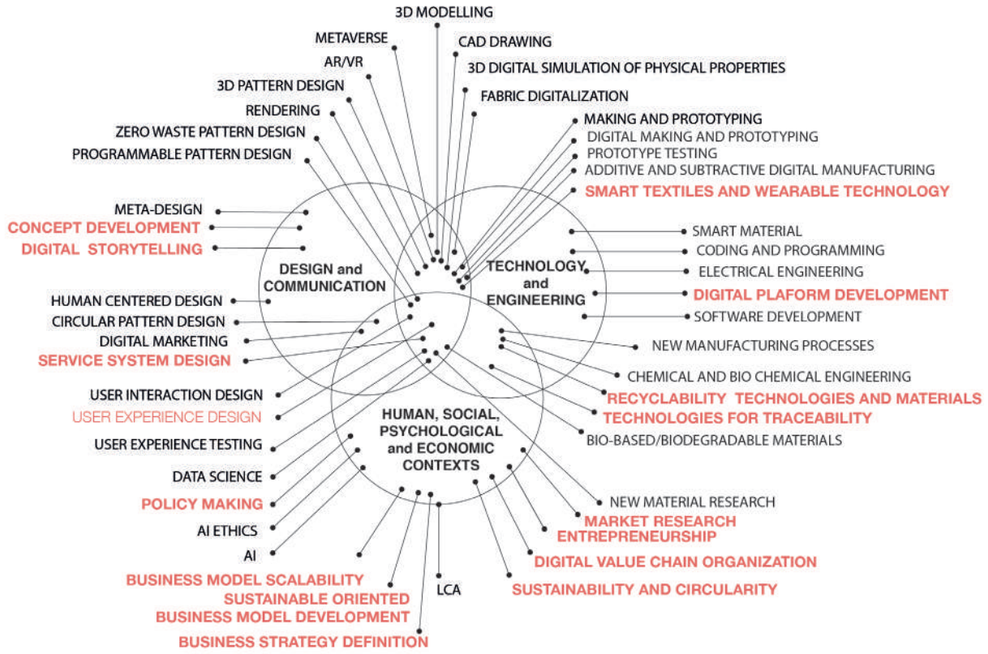


FIGURE 16 SUBJECT SPECIFIC SKILLS IMPLEMENTED IN THE LEARNING EXPERIENCE

Lesson learned from integrating design and business management education

The examination of the didactic experience identifies opportunities and challenges when integrating learning activities between two main different disciplinary domain such as design and business management, in the field of Fashion-Tech focusing on sustainable and societal challenges. The results of this study come from a thematic analysis of the project documentation delivered by students during and after the didactic experience, as well as from a comparison of these projects with the Intended Learning Outcomes initially presented. The findings have been clustered according to the projects' topics/contents (sustainability-oriented challenges, multi-dimensional value creation and SDGs, architecture of delivered solutions, technology, revenue streams and scaling opportunities) and to elements influencing the process development/ implementation (tools and phases of the didactic experience). The intention is to highlight lesson learned and recommendations for future implementations of similar learning experiences in the Fashion-Tech field within interdisciplinary and international students and teaching staff.

Reflections on the project topics/contents

Sustainability-oriented challenges

The developed portfolio of 7 projects in total addresses the topic of the diversity of sustainability challenges, offering product and service-oriented solutions for both business and customers. These include:

- B2B services that directly target reduction of pre-consumer and post-consumer textile wastes by enabling upcycling (UP:CO) and recycling (KleerTech);
- B2B2C product service systems tackling fashion overconsumption and deadstock/excess inventory by offering on-demand personalized locally produced fashion from sustainable (Clod3) or biomass/living materials (Enokitake);
- B2B and C2C services driven by social mission of preserving local craftmanship traditions (Coordinates, B2B) and re-investing income from re-commerce of second-hand/vintage clothing into local communities by funding education and social initiatives that promote standards of conscious consumption (R-Indumento, C2C);
- B2B services that help bring supplies of innovative sustainable materials (e.g. orange fibers) to market by matching scientific knowledge of materials innovation with the needs of textile industry actors for eco-friendly fabrics. These services also provide financial resources in the form of venture capital investments (I Turn Around).

Multi-dimensional value creation and SDGs

The solutions developed aim for systemic changes in the textile industry

and target multidimensional value creation for different stakeholders (e.g., economic, environmental, social, information etc.) as reflected in a range of addressed SDGs:

- SDG 12 (Responsible production and consumption) by all 7 projects;
- SDG 17 (Partnering for goals) by 5 projects (e.g., KleerTech, Clod3, UP:CO, R-Indumento, Enokitake);
- SDG 8 (Decent work and economic growth) by 4 projects (e.g., KleerTech, Clod3, I Turn Around, Coordinates);
- SDG 13 (Climate action) by 4 projects (e.g., UP:CO, I Turn Around, R-Indumento, Enokitake);
- SDG 9 (Industry, innovation and infrastructure) by 2 projects (e.g., Clod3, UP:CO);
- SDG 4 (Quality Education) by 2 projects (e.g., R-Indumento and Coordinates);
- SDG 6 (Clean water and sanitation) by 1 project (e.g., I Turn Around);
- SDG 14 (Life below water) by 1 project (e.g., I Turn Around).

Collaborative and platform-based architecture of Fashion-Tech solutions

Reflecting on the architecture of the delivered solutions in the student projects, it is evident that establishing a business ecosystem/network is essential for their existence: this means that intended multidimensional values are created in collaboration with different stakeholders. This collaboration is characterized by not mere exchange of tangible resources (e.g., products and financial capital). Instead, the focus of collaboration is on exchange of intangible assets, such as information, knowledge, competences and/or traditions, indicating the strong presence of service-dominant logic in all proposed solutions. The pursuit of multidimensional value creation via exchange of intangible assets among different stakeholders explains why all projects suggest an idea of establishing digital platform as fashion-tech solution for tackling sustainability challenges.

Technologies

The technologies suggested in students projects (as part of proposed platform solution) are big data analytics (KleerTech, I Turn Around) for facilitating design of sustainable/circular products and materials, 3D virtual digital technologies (Clod3, Enokitake) and Artificial Intelligence (Clod3, R-Indumento) for avatar creation, personalization, digital pattern generation in design phase and efficient inventory management,

convolutional neural networks (CNN) and modelling software (UP:CO) for creating upcycled fabrics and garments, NFC tags (R-Indumento) to unlock the personal story behind the garment shared by previous owner, circular product id/tag for collecting and sharing of traceable product information (KleerTech), and biomass materials (Enokitake, I Turn Around) merged with 3D scanning and printing technologies (Enokitake) to create sustainable garments with enhanced technical qualities.

Revenue streams

Ideating revenue streams for sustainability-oriented fashion-tech solutions allowed students to reflect on possible commercialization opportunities for future innovative products and/or services. These extend beyond the traditional approach of selling physical garments (Clod3, R-Indumento, Enokitake) and include membership/subscription, consultancy or royalty fees (KleerTech, UP:CO, Coordinates), as well as selling/licensing patented technologies I Turn Around, Enokitake). Capital flows are also foreseen from local/national governmental funds and investors in the form of venture capital (KleerTech, I Turn Around, Coordinates).

Scaling opportunities

As part of commercialization, scaling opportunities for Fashion-Tech solutions were devised by students. Majority of these opportunities arise from collaborations/partnerships that form the foundation of proposed digital platforms, and are viewed as imperative for scaling targeted sustainability improvements. All student projects suggest a complementary set of scaling policies, including scaling up (e.g., impacting institutions at the policy level), scaling out (e.g., replicating and disseminating business practices) and scaling deep (e.g., impacting cultural values and beliefs), that highlights a systemic approach to scaling innovation.

In particular, scaling up strategies in all projects include alliance building and advocacy to promote changes in the policy framework that supports the circular economy, e.g. adoption of regulation on data collection and management, and Extended Producer Responsibility (EPR) policy. Few projects, e.g. KleerTech, I Turn Around, UP:CO, argued for the need of establishing partnerships with governments (in the form of governmental support and/or funding) to promote industry-wide collaboration for the adoption of these regulations and policies. Scaling out strategies are pursued via diversifying the product portfolio (e.g., I Turn Around), by licensing/selling the developed solutions to other firms (e.g., Clod3), by replicating business units in other regions/countries (e.g. R-Indumento). Among the often suggested scaling deep strategies are practices of

offering online events, workshops and courses to educate customers about sustainable and circular fashion, support technological upskilling and highlight advantages of developed solution both from individual and environmental/social perspectives. Few projects, e.g. R-Indumento and Clod3, suggest re-investing parts of revenues in research and local communities development by funding sustainable education and social innovation projects.

Results on tools and phases of the didactic experience

Discover Phase

The discover phase consisted of three theoretical modules (sustainable design, Fashion-Tech interventions and Fashion-Tech business and impacts) delivered via HB's educational digital platform Pingpong. To demonstrate the completion of the theoretical part and to be admitted to the project-based activities, students were required to pass the quizzes following the lectures. Although the participants found the theoretical part of the course (discover phase) to be comprehensive and aligned with activities in the challenge based part of the course (define and design phases), there are a number of improvements can be recommended:

- Inclusion of more 'real life' cases of companies and specific sectors of the industry so that students can discover, analyse (using presented theory in lectures) and critically reflect on before engaging in the consequent project tasks (in define and design phases). This can be done using peer review methods that will also stimulate more collaboration and interdisciplinary skills exchange in the early stage of the learning experience;
- More lectures covering different topics on the engineering perspective (expanding theoretical module on 'Fashion-Tech interventions') to create better understanding among learners on the application opportunities and role of technology;
- Better explanation of theories, tools and templates (including practicing its application, e.g., in analysis of aforementioned 'real life' cases) to be used in the design phase.

Define Phase

The define stage as mentioned earlier was designed to facilitate interaction between students' peers and students-tutors. It included the following activities:

- Presentation of tutors, team building and intro of challenge brief;
- Group tutoring in smaller groups (30 minutes per group) with no formal deliverable and provided as opportunity to ask questions to clarify the tasks of the design phase;
- Asynchronous student-led activity (drafting project company vision, mission, core values and initial business plan using MIRO boards with provided templates) to support problem formulation in the consequent design phase. The review of this activity was included in design 1 phase of the learning experience.

Reflecting on activities of the define phase, it can be suggested to provide more precise categories of sustainability and societal challenges to better guide students in the early process of developing their initial business ideas. This in turn would contribute to a more focused problem formulation and concrete solution developments in the consequent design phase.

Design Phase

Design phase consisted of three design sub-phases.

Design 1 phase focused on the following tasks:

- Identifying a critical societal/sustainability challenge that your company pivots on;
- Elaborating on how your company is guided by this challenge and associated SDGs in its vision, mission and business plan.

The following activities were carried out to complete the tasks of design 1 phase:

- Industry expert talks from WLY & Centexbel followed by Q&A;
- Asynchronous student-led activity to deliver the above mentioned tasks (using MIRO boards with provided templates/tools);
- Group tutoring in smaller groups to help ideation process (10 minutes per group)
- Plenary review session with tutors where each group delivered 10-15 min elevator pitch on critical challenge, related SDGs targeted by their company and how it is reflected in company's vision, mission and business plan (using MIRO board as presentation space)

The problem/challenge in design 1 phase was primarily informed by students desktop research of the scientific and 'grey' literature. By engaging in dialogue with potential users of the solution (e.g. companies and consumers) during the early design phase of the project, allowed a more specific/in-depth problem identification by students. It will also enable development of more specific and applied fashion-tech solutions/ offers. For instance, corporate tutors can engage in presenting and discussing cases, needs and challenges from their experience of working in the industry.

Design 2 phase focused on the following tasks:

- Locating the Fashion-Tech solution rendered by your company;
- Mapping the value profile (proposition, means to create, deliver and capture these);
- Detailing sustainable business model blueprint;
- Preparing additional material, e.g. Images, sketches, to explain how your solutions works (detail technology, design, processes, materials etc. based on what is relevant and possible based on your group expertise).

Design 3 phase focused on the following tasks:

- Identifying the current scalability challenges and opportunities in the solution provided by project company;
- Identifying approaches/strategies for scaling impacts based on systemic innovation perspective;
- Reflect on scaling outcomes on SDGs and providing recommendations for the adjustment of scaling strategy/approaches (if relevant).

The following activities in design 2 and design 2 phases to complete the associated tasks:

- Industry expert talks from WLY & Centexbel followed by Q&A;
- Asynchronous student-led activity to deliver the above-mentioned tasks (using MIRO boards with provided templates/tools);
- Plenary review session with tutors (15-20 minutes per group) where developed ideas were presented and discussed (using MIRO board as presentation space).

The dominance of the platform-based solutions and broadness of delivered students' concepts often lack in-depth elaboration of product/service/experience design aspects, pointing towards the need to provide more focused project brief and more concrete design-driven tasks, guidelines and methodologies, so that students better understand the selected problems, develop and present more specific solution related ideas in the design phases. There is also a need for providing a room for more elaborated discussion on interaction between design, technology and business perspectives in the design phases so as to facilitate understanding of how complementarities and tensions of multifaceted considerations affect the final solution, and its real-life application and commercialization potential. This discussion should be implemented more proactively within and between student groups (for instance via using peer review approach), as well as between students and tutors from companies and academia. Whereas more time and commitment would be required on behalf of tutors from different organizations, such discussion will help establishing a shared understanding of what is a sustainable design from a plurality of perspectives, as well as enabling more tangible/concrete concepts design in interim and final project deliverables.

Deliver phase

As mentioned above, final deliverable included project presentations in the format of the pitch (15 min), video communicating the project outputs (2-3 minutes) and group written report (max 6000 words excluding references). For all deliverables accompanied templates were provided both on pingpong and on MIRO boards. Although the overall quality of student's presentation, reports and video making skills was generally perceived as good, it was obvious that substantial differences existed between the different group presentations. Reflecting on final project outputs, more in-depth presentation of developed solutions was expected to enhance its quality and relevance, especially in terms of referring to customers and competitors research, detailing design and technology choices. In addition, more critical reflection with regards to sustainability implications of developed solutions was expected.

Digital learning environment and tools

The digital environment and tools facilitated the learning experience and knowledge sharing well. MIRO, PINGPONG and ZOOM were of rather high usability and functionality, although several challenges related to the use of the MIRO collaborative boards were encountered, e.g., contents moving or disappearing, slow performing interface. Also, pre-structured boards based on use of templates were found by some students as constraining.

Opportunities and limitations of the case study

Business-driven and design-driven Fashion-Tech innovation

The developed portfolios of student's projects and experiences shared at the end of the course reflect the multidisciplinary nature of proposed Fashion-Tech innovative solutions, combining business, design and technology perspectives. Within the frames of the course run by HB and dominated by presence of HB enrolled students, the stress nevertheless was on business-driven (vs. design- driven) Fashion-Tech innovation. We envisioned business opportunities driven by multidimensional value creation (aligned with triple bottom line approach and SDGs) and by new revenue streams. This was the major pathway for ideating innovative Fashion-Tech products and services. This pathway was then enriched with design and technology-oriented perspectives when possible, in line

with envisioned sustainability-oriented business innovations. However, based on received project results and lessons learned, it should be acknowledged that design and technology perspectives should become more prominent/integrated in students delivered portfolios (e.g., in terms of more detailed explanation of product/service design and technology use/application), so as to deliver more concrete Fashion-Tech solutions and improve its innovation/exploitation potential for the industry. In particular, there is a need: 1) to provide more room for design activities in order to perform in-depth research and mock-up some concepts, 2) to include more contents covering technology perspective, 3) to formulate more focused industry brief to guide more concrete project definition and implementation, and finally 4) to facilitate better discussion on interaction between plurality of perspectives (design, engineering and business) on sustainable design of innovative Fashion-Tech solution.

Sustainability skills development/critical reflections on sustainability implications of developed solutions

Sustainability considerations were at the forefront of the student's projects, guiding the development of the Fashion-Tech solutions throughout the define and design phases. The delivered projects were specific in terms of targeted societal challenges, SDG goals and associated targets (2-3 goals were selected per project). Moreover, it was complemented by a mapping of the multidimensional sustainable value creation opportunities for different stakeholders when ideating business model architecture and scaling. At the final stage of the challenge-based part, students also reflected on how the ideated Fashion-Tech solution might affect directly and indirectly other SDGs not inherent to the initial project ideas, so as to be aware of the possible negative sustainability impacts of the developed concepts. Nevertheless, this was accomplished at a superficial level, as the implications of developed Fashion-Tech solutions for the use phase and possible rebound effects that can lead to more unsustainable consumption patterns and levels that were not highlighted in the final students' reports and presentations. By default, digitalization and digital platforms were perceived by majority of students as advantageous for sustainability, dismissing debate on the 'dark side' of digitalisation and platform economy. Therefore, in the future courses it is recommended to include learning contents and activities that help students in developing more critical perspective on sustainability implications of technologies, e,g., how it affects use phase behaviour and users motivations, equality issues etc.

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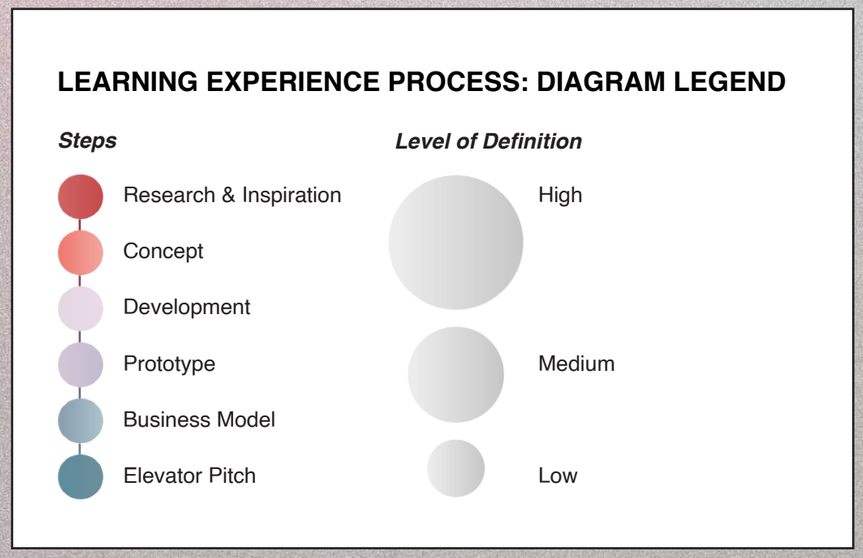
FIELD EXPERIENCES
The portfolio of innovative fashion-tech concepts of product and services

KLEERTECH
CLOD3
UP:CO
I TURN AROUND
R-INDUMENTO
ENOKITAKE
COORDINATES



KLEERTECH

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#RECYCLING NETWORK **#CONNECTEDNESS** **#CIRCULARITY**

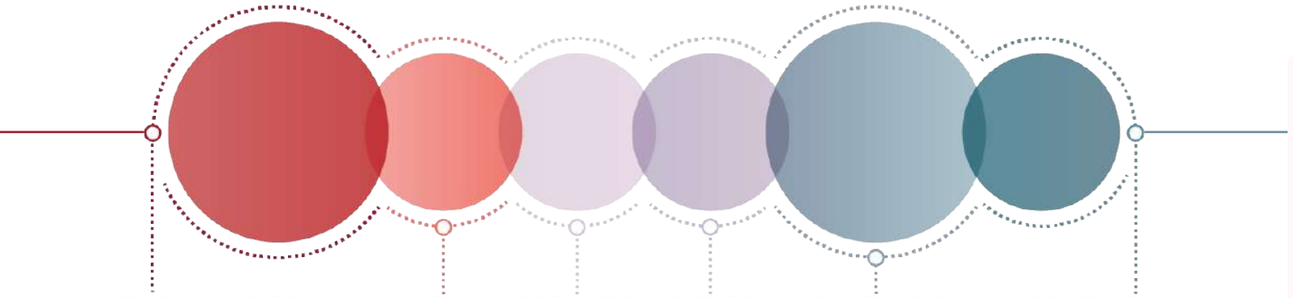
ABSTRACT
KleerTech is an online platform that aims to create efficient collaboration among brands and recycling companies, establishing a dialogue on the materials choices for the next generation of garments. Brands can in fact browse a wide digital material library constantly updated by recycling companies. Moreover, as all new fashion and textile collections become digitized, brands are given the opportunity to create a digital passport for their products embedded in the labels to communicate production data about the brand, price, care of the product, and production processes.

LEARNING OUTCOMES

Soft Skills
Multidisciplinary collaboration
Team development
Communication skills

Subject Specific Skills
Sustainable business management
F-tech research and state of art
Corporate strategy development

LEARNING EXPERIENCE PROCESS



RESEARCH & INSPIRATION
Corporate strategic statement & sustainability challenge: lack of transparency

CONCEPT
Collaboration network among brands and recycling companies

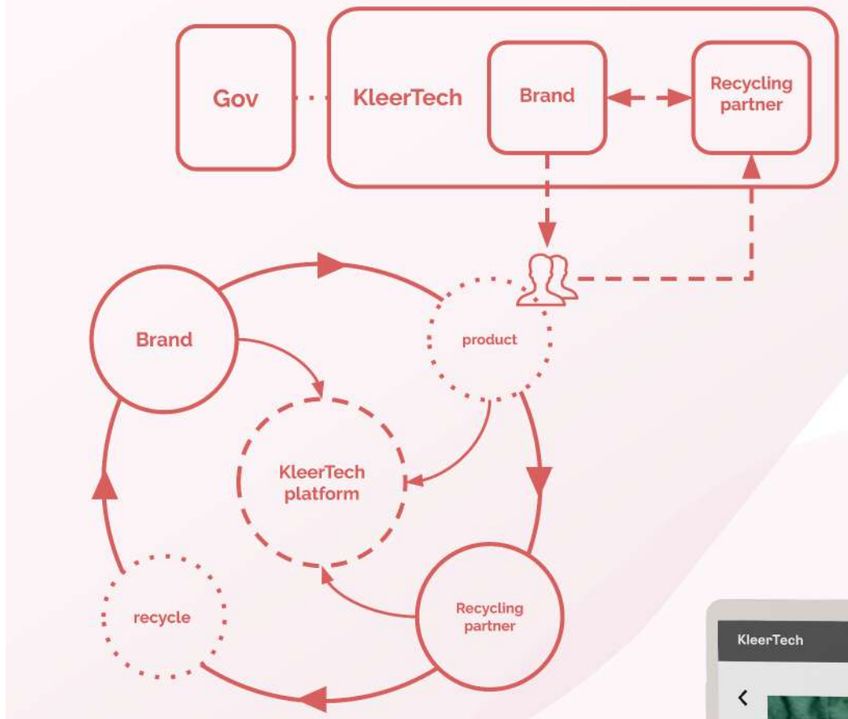
DEVELOPMENT
Digital passport for products & materials, platform design

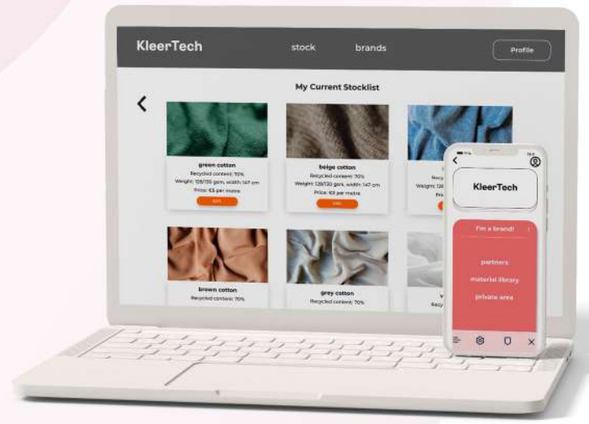
PROTOTYPE
Website prototype

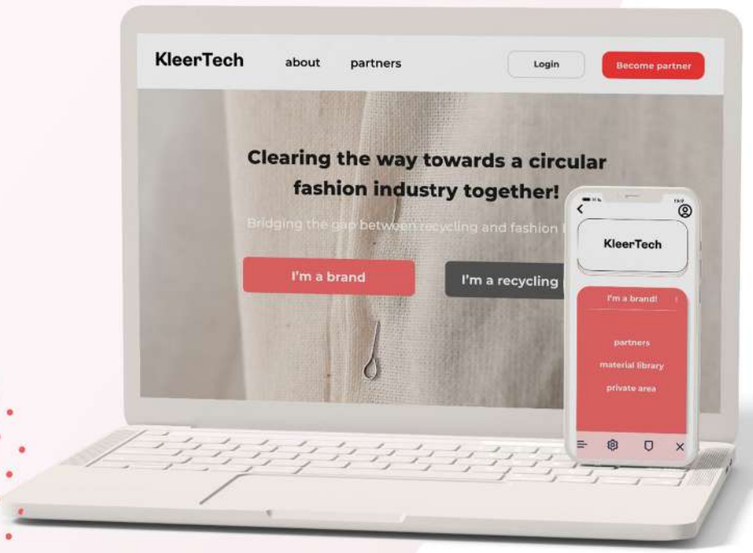
BUSINESS MODEL
BM canvas, scaling strategies & sustainability considerations

ELEVATOR PITCH
Presentation & video of the fashion-tech solution

IDENTIFIED SUSTAINABILITY IMPLICATIONS







CLOD3

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#DIGITAL FASHION #PERSONALIZATION #AI FORECASTING

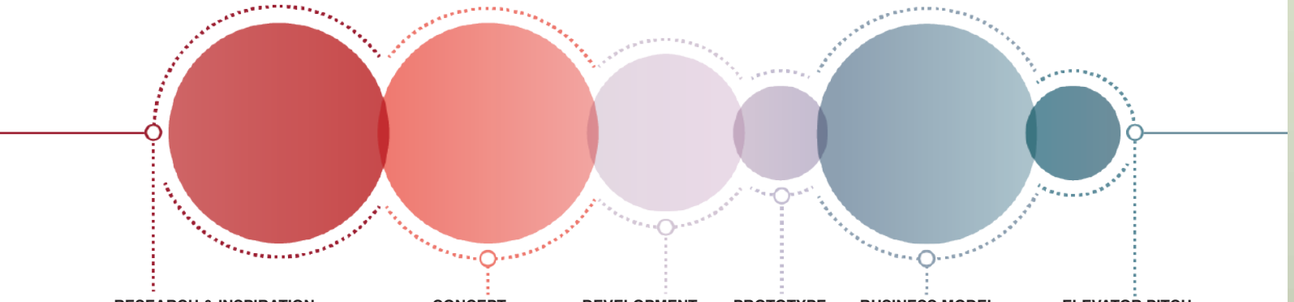
ABSTRACT
CLOD3 addresses overconsumption by using Artificial Intelligence and 3D-based solutions to create fashion collections. It is conceived as a worldwide digital business that combines AI-generated avatars based on customers' measurements and on-demand produced garments. CLOD3 also tackles inclusivity and a niche market, including consumers that have trouble finding the right size clothes due to their body types, and cannot relate to standardized body shapes and measurements.

LEARNING OUTCOMES

Soft Skills
Multidisciplinary collaboration
Overcoming technical difficulties
Lateral thinking

Subject Specific Skills
Concept development
Fashion business management
Iterative design process

LEARNING EXPERIENCE PROCESS



RESEARCH & INSPIRATION
Corporate strategic statement & sustainability challenge: overconsumption

CONCEPT
Made-on-demand garments on AI and 3D-based platform

DEVELOPMENT
Avatar-based try-on technology definition, social impact of AI

PROTOTYPE
Website architecture

BUSINESS MODEL
BM canvas, scaling strategies & sustainability considerations

ELEVATOR PITCH
Presentation & video of the fashion-tech solution

IDENTIFIED SUSTAINABILITY IMPLICATIONS

UP:CO

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#COLLABORATION #REPURPOSING #CNN

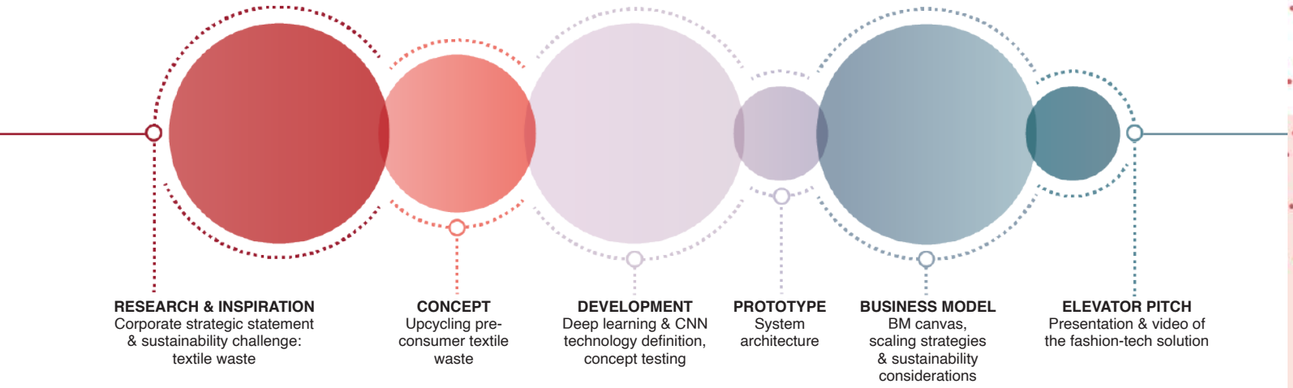
ABSTRACT
UP:CO is an online platform aiming to repurpose pre-consumer textile waste to transform it into high-value fabrics and garments. It connects upcyclers, manufacturers and the general public to help them exchange the unused fabric cut-offs. Using convolutional neural networks (CNN) and modelling softwares, it is able to maximize the use of textile waste in innovative ways, creating upcycled fabrics and garments. It also promotes collaboration with designers and fashion design students through an online shop that sells the upcycled materials.

LEARNING OUTCOMES

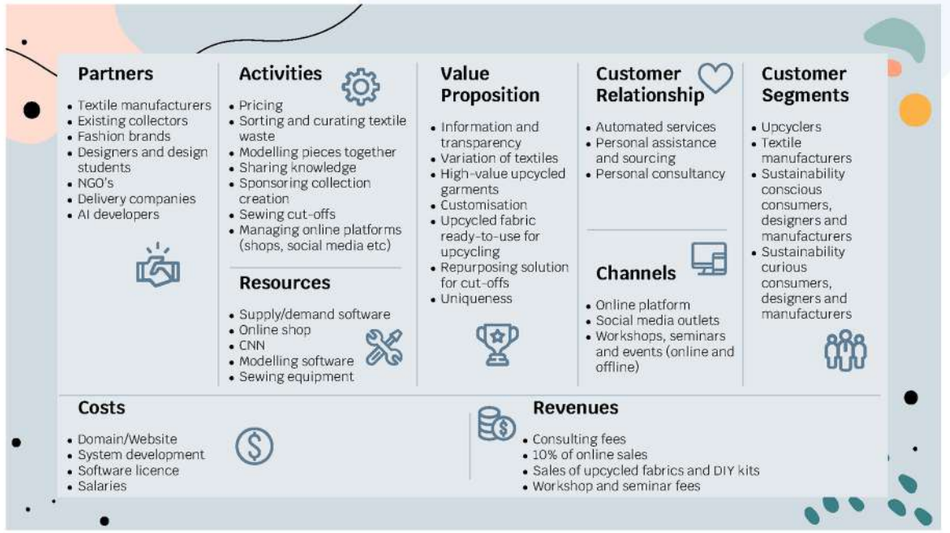
Soft Skills
Multidisciplinary collaboration
Team development

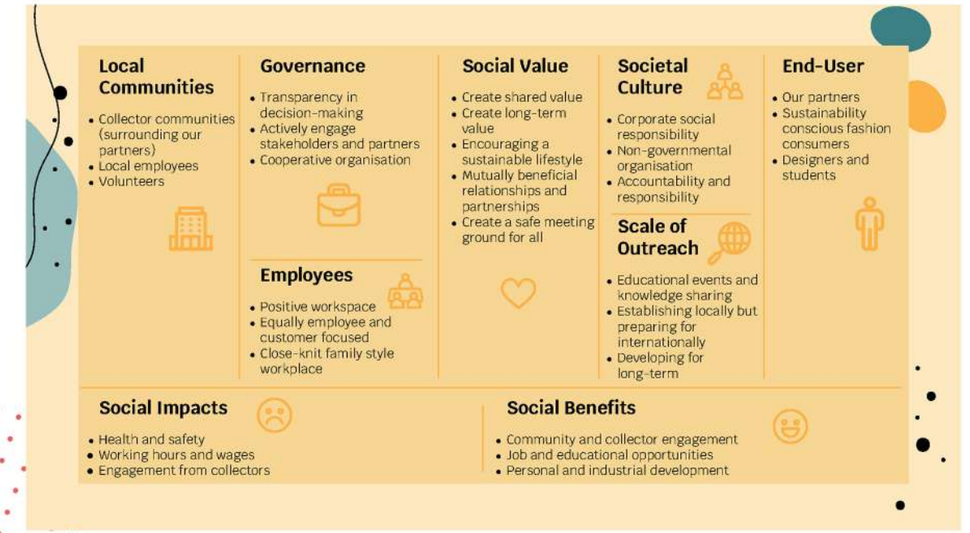
Subject Specific Skills
Sustainable business management
Consumer profiling

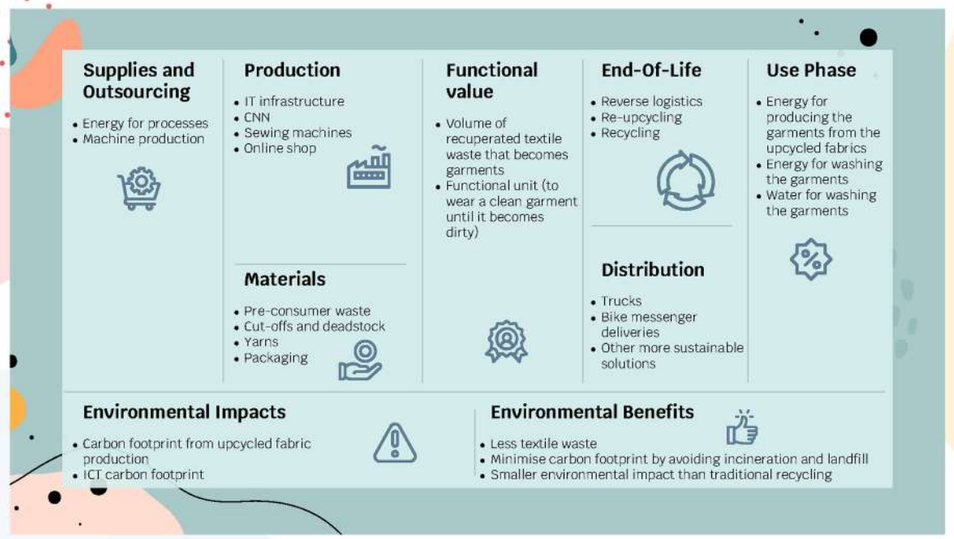
LEARNING EXPERIENCE PROCESS



IDENTIFIED SUSTAINABILITY IMPLICATIONS







I TURN AROUND

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#ALTERNATIVE FIBERS **#SUPPLY CHAIN MANAGEMENT**

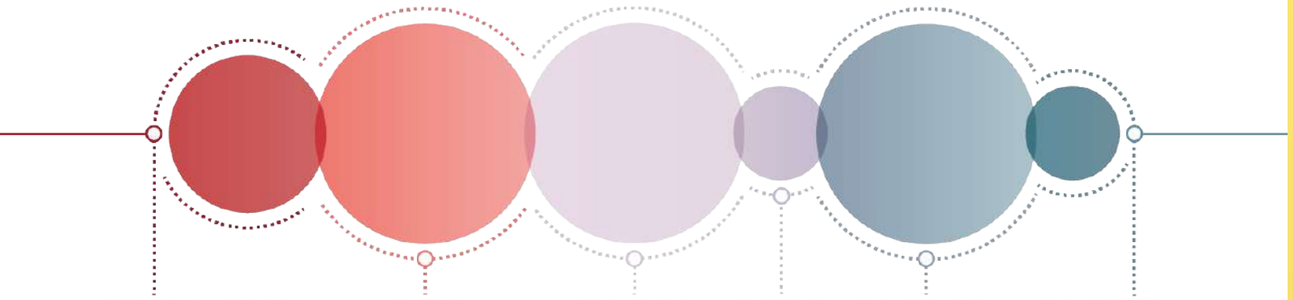
ABSTRACT
I Turn Around is a venture investment fund focused in buying rights and producing alternative textile fibers. It creates a network between brands and developers targeting the B2B market. The final aim is to create a sustainable hi-tech value chain and stimulate the scientific society to innovate. To ensure transparency, the intellectual property of the inventor is protected, and the entire production and supply chain, along with calculation of materials cost and value chain processes are monitored through online tracking and blockchain technologies.

LEARNING OUTCOMES

Soft Skills
Real life challenge
Communication skills

Subject Specific Skills
Business model development
Sustainable textiles management

LEARNING EXPERIENCE PROCESS



RESEARCH & INSPIRATION
Corporate strategic statement & sustainability challenge: encouraging textile innovation

CONCEPT
Venture investments in textile technology

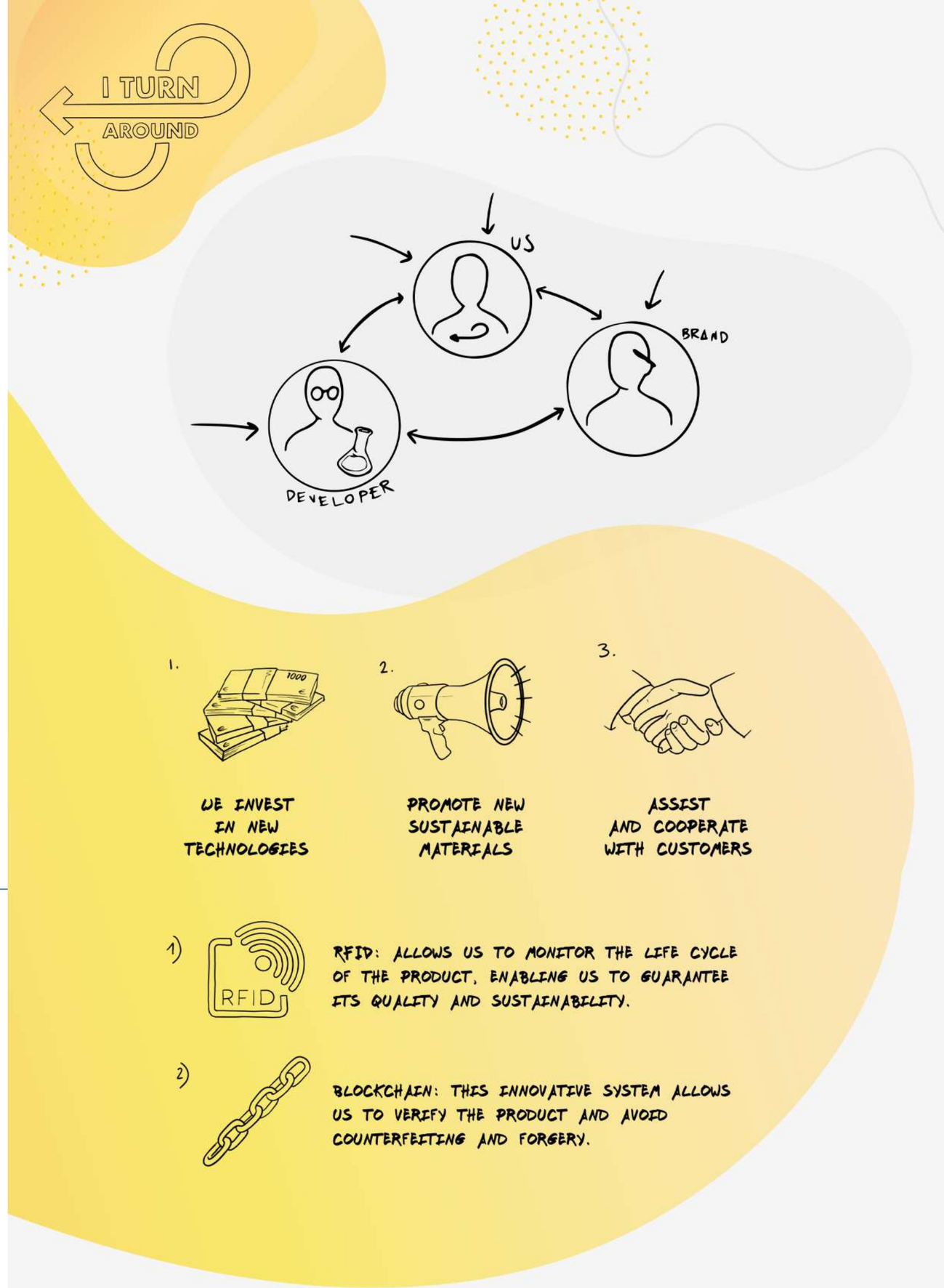
DEVELOPMENT
RFID and blockchain technologies definition

PROTOTYPE
System architecture

BUSINESS MODEL
BM canvas, scaling strategies & sustainability considerations

ELEVATOR PITCH
Presentation & video of the fashion-tech solution

IDENTIFIED SUSTAINABILITY IMPLICATIONS



R-INDUMENTO

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Zhixiang Tao, Integrated Product Design (POLIMI)

#SECOND HAND **#COLLABORATIVE CONSUMPTION**

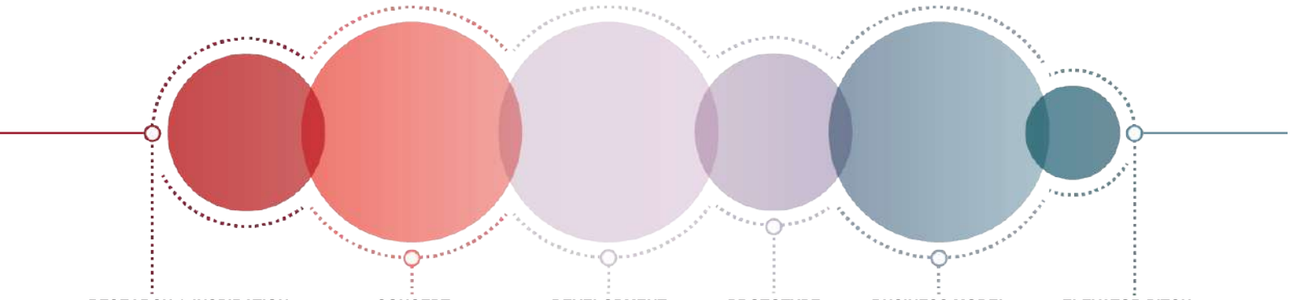
ABSTRACT
R-Indumento is a social enterprise launching B2C re-commerce tech-powered digital platform for vintage and second-hand garments and accessories. The system is composed by the digital platform via website/app is coupled with offline spaces via pop up events, where the consumer can donate, style, reuse and recycle their items. It partners with brands to sell unsold stocks to customers and with a recycling enterprise to tackle waste responsibly. Ozone & UV cleaning technology are used to sanitize the garments, and AI and innovative NFC labels that tell the story behind the re-used garment.

LEARNING OUTCOMES

Soft Skills
Multicultural teamwork
Tasks distribution
Decision-making

Subject Specific Skills
Commercial product roadmap
Corporate strategy development
Sustainable business

LEARNING EXPERIENCE PROCESS



RESEARCH & INSPIRATION
Corporate strategic statement & sustainability challenge: reducing material footprint

CONCEPT
Digital platform to promote second-hand & repurposed clothing

DEVELOPMENT
NFC and AI technologies definition, garment storytelling via digital notes

PROTOTYPE
App prototype

BUSINESS MODEL
BM canvas, scaling strategies & sustainability considerations

ELEVATOR PITCH
Presentation & video of the fashion-tech solution

IDENTIFIED SUSTAINABILITY IMPLICATIONS

ENOKITAKE

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Shan Lu, Design for the Fashion System (POLIMI)
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#BIOMATERIALS #3D PRINTING #3D SCANNING

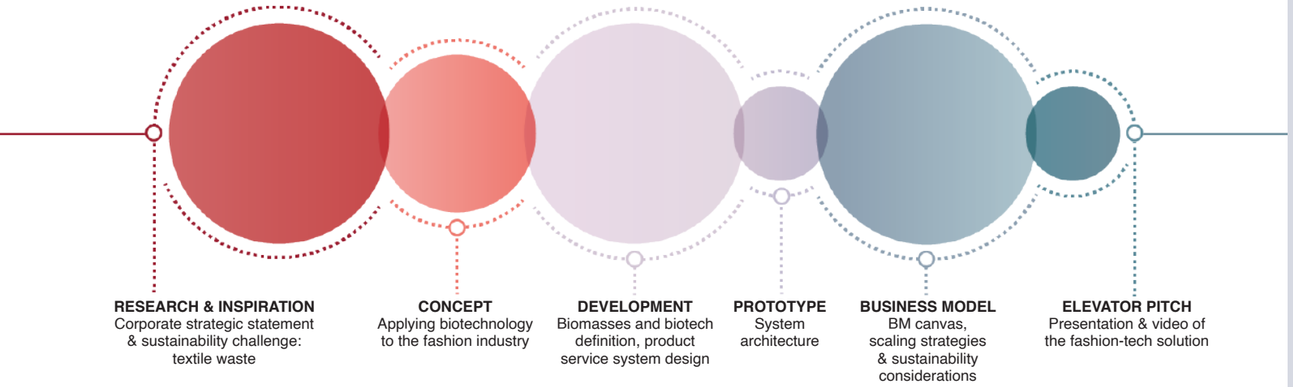
ABSTRACT
Enokitake strives to reduce waste production through the combined use of 3D scanning and printing technologies coupled with the emerging field of biomasses and living materials. The concept is to produce a small collection made out of biomaterials, that the consumer could personalize and fit to themselves through an app. The customer's 3D file would be translated into a pattern and a garment to be 3D printed or sewn as locally as possible, and finally, delivered to their doorstep. Being organic and biodegradable, the final product is easy to recycle.

LEARNING OUTCOMES

Soft Skills
Real life challenges
Tackling specific issues

Subject Specific Skills
Market research
Sustainable business management

LEARNING EXPERIENCE PROCESS



IDENTIFIED SUSTAINABILITY IMPLICATIONS

USE 3D SCANNING TO OBTAIN THE EXACT REPLICA OF YOUR BODY

"We make what we need, no more and no less.
We make sure it looks flawless."

COORDINATES

Riccardo Guiducci, Design for the Fashion System (POLIMI)
Alva Hjelm, Textile Engineering (HB)
Ulrika Hoonk, Business Management (HB)

#CRAFTSMANSHIP #LOCALNESS #SLOW FASHION

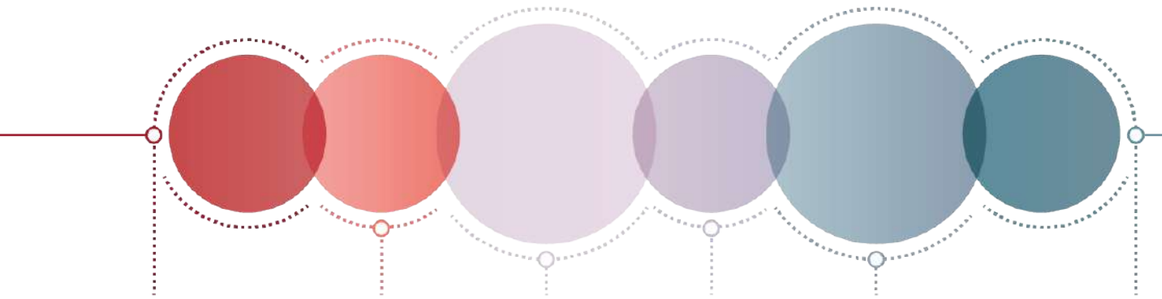
ABSTRACT
Coordinates is a digital display window for designers, producers and the general public, aspiring to educate designers about circularity and to teach the general public how to consume responsibly. They offer a catalog of producers to support customers in finding locally produced materials and use a sustainability index to monitor producers. Coordinates aims towards slow fashion while at the same time promoting small, local and traditional craftsmanship.

LEARNING OUTCOMES

Soft Skills
Tackling specific issues
Multidisciplinary collaboration

Subject Specific Skills
Consumption patterns identification
Sustainable business management

LEARNING EXPERIENCE PROCESS



RESEARCH & INSPIRATION
Corporate strategic statement & sustainability challenge: encouraging slow fashion

CONCEPT
Digital display window for local craftsmanship

DEVELOPMENT
User journey mapping, platform structure and delivery model

PROTOTYPE
Website prototype

BUSINESS MODEL
BM canvas, scaling strategies & sustainability considerations

ELEVATOR PITCH
Presentation & video of the fashion-tech solution

IDENTIFIED SUSTAINABILITY IMPLICATIONS