D1.1 INTEGRATED INDUSTRY RELEVANT FASHION-TECH CURRICULUM MODEL

FTalliance

FTalliance

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WP 1.1 Integrated Industry Fashion-Tech Curriculum Model

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FULL PARTNERS

POLITECNICO MILANO 1863 · TU Delft · DECATHLON · PAULINE VAN DONGEN

ESTIA · ual: london college of fashion · gradd'zero innovation · PESPOW

THE SWEDISH SCHOOL OF TEXTILES · CENTEXBEL · STENTLE · WY

ASSOCIATE PARTNERS

PVH

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Editor(s):	Professor Jose Teunissen, Michele Danjoux
Contributor(s):	Daniel Caulfield-Sriklad (UAL), Gabrielle Miller (UAL), Michele Danjoux (UAL), Jose Teunissen (UAL), Olga Chkanikova (HB), Rudrajeet Pal (HB), Dimitri Masson (ESTIA), Daria Casciani (POLIMI), Susanna Testa (POLIMI)
Reviewer(s):	Daria Casciani (POLIMI), Olga Chkanikova (HB), Rudrajeet Pal (HB), AB MEMBERS: Lucie Huiskens, Giusy Cannone, Matthijs Crietee, Owen Geronimo
Approved by:	All

Abstract:	This report shares research findings on the Fashion-Tech curriculum model, outlining an integrated and embedded approach for interactions with industry, and guidelines on new pedagogical approaches. WP1 builds on, tests and validates the Edu4FashionTech curriculum model, by integrating industry activities and sector specific approaches to the three focus groups described below. The design aim for the focus groups involves revisiting and interrogating the Fashion-Tech subject-specific and general skills in order to review and fine-tune their current relevance and applicability to industry. The insights from the focus groups will inform future job roles (WP1), and the task of designing and piloting educational learning experiences for HEI university courses (WP2).
Keyword List:	Fashion-Tech, Generic skills, Subject skills, Design education

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EXECUTIVE SUMMARY

FTalliance is a follow up and further exploration of the project "Education4Fashion-Tech: Interdisciplinary Curriculum for Fashion in the Digital Era" (E4FT) (2017-2020). Financed by the European Union through the Erasmus+ action KA203 – Strategic Partnerships for Higher Education, the project aimed to bridge the creative side of the fashion sector with the innovative area of technology in the didactical offer of both higher education institutes, research centres and companies. The University of Borås – Swedish School of Textiles, Politecnico di Milano – Dipartimento di Design (Polimi) and University of the Arts London – London College of Fashion formed a strategic partnership within the field of fashion-tech design. They delivered a 'Fashion-Tech MA Curriculum'(E4FT.eu, 2018) conceived as a guide for establishing an education and research programme in this continuous transforming field, aimed to increase interdisciplinary skills through both design, business and technology-driven innovation learning modules.

This report shares the research findings of WP1.1. This work package builds on, tests and validates the Edu4FashionTech curriculum model, by integrating industry activities and sector specific approaches using focus groups as described in the report.

The focus group planning, and delivery took place during the global pandemic, and it was acknowledged that Fashion-Tech is operating in the context of a rapidly changing landscape for both the world, and fashion business and jobs.

Due to travel restrictions as a result of the Coronavirus outbreak in Europe in March 2020, it was decided amongst all consortium partners that the focus group activities would be redesigned to take place digitally. This would ensure the continued progress of the (T1.1), while parts of the 'staff learning mobility: study visits to companies' (T1.2) were postponed.

Grappling with the concerns around COVID-19 and the global impact on the health, safety and vulnerability of employees and job stability, HEI partners worked in collaboration with industry partners to co-design the focus groups. Careful consideration in planning sensitively reconsidered the new reality of a changing and uncertain world, whilst exploring future job roles.

The design for the focus groups involved revisiting and interrogating the Fashion-Tech subject-specific and general skills in order to review and fine-tune their current relevance and applicability to industry. The insights from the focus groups are informing future job roles (WP1), and the task of designing and piloting educational learning experiences for HEI university courses (WP2). The overall aim and intention of the study was to provide new insights to inform the production of an integrated Fashion-Tech curriculum model blending industry and academic knowledge.

This report explains first the methods been used for the research process to generate feedback and qualitative data in order to be able to fine tune and validate the E4FT Fashion-Tech curriculum model. The consortium industry partners represented different aspects of the Fashion-Tech sector – large global corporation (PVH); disruptive business models (We Love You) and sustainability (Decathlon). In addition, the research explored current and future job roles in the Fashion-Tech sector, subject-specific and generic skills, knowledge and competences aligned to these for WP1.2.

The research conclusions yielded two distinct scenarios with regards to what constitutes the Fashion-Tech practitioner in a dynamic field that is truly interdisciplinary in nature. First, that they are multifaceted individuals who possess multiple skill sets and knowledge that span disciplines and are capable of working independently to develop tangible solutions to complex issues through single-handedly traversing borders. Secondly, that they are team workers equipped with the generic skills and a general awareness that enables them to work routinely in collaborative and interdisciplinary contexts and engage in activities that involve methods of co-creativity to develop solutions and solve

complex issues. These two versions of the Fashion-Tech practitioner are not mutually exclusive however but rather represent two extremes on a scale from an individual possessing multiple subject specific capabilities to one who possesses all necessary generic competencies and insights to enable them to operate highly effectively in dynamic partnerships and team contexts. As this report reveals, both versions have been useful in helping evaluate and offer proposed additions and adaptations to the E4FT Fashion-Tech curriculum and to make recommendations for what learning opportunities should be offered in the three WP2 courses for learners who derive from diverse Fashion-Tech backgrounds and with varying skills, knowledge and competences.

In terms of the EF4T curriculum and its validation, whilst the model was appraised as supportive in the development of the Fashion-Tech practitioner – an individual who is well equipped in terms of both subject and generic specific, research findings from all three focus groups (as discussed above [section 5]), yielded deficits and proposed additions and areas for improvement. These insights constitute the recommendations in this report to be considered in the design of the three WP2 courses.

Finally, it is important to stress that since, as our investigations show, the field of Fashion-Tech is not a static one, but rather in a constant state of flux, further agitated by the ongoing Covid-19 pandemic, the curriculum and learning experience must follow suite. As such, a final recommendation of this report would be that we must seek to maintain an ongoing dialogue and process of knowledge exchange between industry and academia in the design of the Fashion-Tech curriculum and learning experience. This will enable relevance and currency to be maintained whilst ensuring the development of appropriately equipped graduates who possess the necessary practical, creative, intellectual and transferrable skills to enable them to thrive in this interdisciplinary field.

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LIST OF ABBREVIATIONS

E4FT	Edu4FashionTech
ESTIA	École Supérieure des Technologies Industrielles Avancées
FG	Focus Group
FTall	FTalliance
HB	Högskolan i Borås, University of Borås
HEI	Higher Education Institution
POLIMI	Politecnico Di Milano
PVH	PVH Europe
SME	Small/Medium Size Enterprise
UAL	University of the Arts London
WLY	We Love You Communication

1. INTRODUCTION

"The industry is quite old fashioned so to say, and with every step in the value chain there is an opportunity to leverage technology and digital to improve processes so that's something we understand as fashion tech, that we can use technology and digital in every step of our value chain from design to selling, B2B and end consumer, and make that more efficient and better. This offers an opportunity to gather data in these steps and use the data to inform ourselves and make better decisions." (PVH, 29 June 2020)

The integration between fashion and tech sectors has enabled a systemic shift in the fashion industry towards new business models, revenue streams, and improved sustainability and circularity. Fashion-Tech when integrated across the full breadth of the supply chain leverages data is creating smarter and more sustainable products and services. In larger companies, fashion-tech incubators and start-ups are leading digital processes and upskilling, influencing and infiltrating within the business. The fashion designer having 3D design skills has become essential for current and future fashion-tech jobs. The focus on technical innovations for textiles and product development is linked to sustainable production and consumption.

FTalliance is an Erasmus + 3-year academia-industries partnership (2020-2022) aimed to facilitate the exchange, flow of knowledge and co-creation within the Fashion-Tech sector to boost students' employability and innovation potential. The purpose of FTalliance is to ensure ongoing innovation in the European Fashion-Tech sector by providing emerging talents with relevant skills and know-how to enter the jobs market. The project consortium comprises twelve partners from six countries: 5 fashion, design and engineering Higher Education institutions, 1 large fashion and apparel enterprise, 5 SMEs representing the Fashion-Tech ecosystem and the different supply chain segment and 1 Research Technology Organisation. See more at FTalliance website.

FTalliance is a further exploration of the project "Education4Fashion-Tech: Interdisciplinary Curriculum for Fashion in the Digital Era" (E4FT) (2017-2020). Financed by the European Union through the Erasmus+ action KA203 – Strategic Partnerships for Higher Education, the project aimed to bridge the creative side of the fashion sector with the innovative area of technology in the didactical offer of both higher education institutes, research centres and companies. The University of Borås – Swedish School of Textiles, Politecnico di Milano – Dipartimento di Design (Polimi) and University of the Arts London – London College of Fashion formed a strategic partnership within the field of fashion-tech design. They delivered a 'Fashion-Tech MA Curriculum'(E4FT.eu, 2018) conceived as a guide for establishing an education and research programme in this continuous transforming field, aimed to increase interdisciplinary skills through both design, business and technology-driven innovation learning modules.

The aim of WP1.1, addressed in this report, is to facilitate the exchange, flow of knowledge and co-creation within the Fashion-Tech sector through evaluating the E4FT. Outcomes from this research will feed into WP2 and WP3.

2. FINE TUNE AND VALIDATE THE FASHION-TECH CURRICULUM MODEL AND EXPLORE FUTURE JOB ROLES WP 1.1

2.1 INTRODUCTION WP 1.1

These report shares research findings on the Fashion-Tech curriculum model produced in the E4FT project, outlining an integrated and embedded approach for interactions with industry, and guidelines on new pedagogical approaches.

WP1 builds on, tests and validates the Edu4FashionTech curriculum model, by integrating industry activities and sector specific approaches to the three focus groups described below. The design aim for the focus groups involves revisiting and interrogating the Fashion-Tech subject-specific and general skills in order to review and fine-tune their current relevance and applicability to industry. The insights from the focus groups will inform future job roles (WP1), and the task of designing and piloting educational learning experiences for HEI university courses (WP2).

In light of COVID-19, devastating impacts to the fashion industry have forced businesses to accelerate, change and evaluate options to transform and respond to many challenges and difficulties. The focus group planning, and delivery took place during the global pandemic, and it was acknowledged that Fashion-Tech is operating in the context of a rapidly changing landscape for both the world, and fashion business and jobs. Grappling with the concerns and global impact on the health, safety and vulnerability of employees and job stability, HEI partners worked in collaboration with industry partners to co-design the focus groups. Careful consideration in planning sensitively reconsidered the new reality of a changing and uncertain world, whilst exploring future job roles.

2.1.2. Focus Group Rationale

Three parallel focus groups have been organised and co-developed in collaboration with consortium partners to harvest feedback from industries aligned with current and future industry practices and needs.

From the onset, partners decided that each focus group involved industry representatives from the consortium (across design, HR and management departments). The focus groups have assessed the relevance of the proposed E4FT curriculum with industry aligning learning to relevant job profiles and ensuring that that they complement and informed by their processes, activities and delivery.

The result is an integrated curriculum model blending industry and academic knowledge and industry related competences of the Fashion-Tech sector.

2.1.3. Focus Group Aims

The aim of the focus groups was to link and integrate the Edu4FashionTech curriculum model with industry activities and sector and subject specific approaches, to gather feedback on **the curriculum** to develop future job roles and define skills of the future. The outcomes provided an understanding of the role of Fashion-Tech in employability; and to have an understanding of the future opportunities this presents for graduates by exploring current and emergent future job roles.

2.1.4. Focus Group Process and Methodology

Three parallel focus groups were organised by UAL, HB, and ESTIA (2 and 3 days') workshop each) and co-developed with industry partners.

Each HEI partner worked collaboratively with an industry partner(s) to develop a bespoke focus group – each exploring a different subject specific theme aligned with E4FT Curriculum and focus of industry partner. It was decided to explore different territories and directions in fashion-tech in order to compliment the findings of the work package objective.

- **UAL + PVH** – theme: **Fashion- Tech across the value chain for core business**
  Organiser: *UAL- PVH*
  Participants: *PVH, HB, ESTIA, POLIMI, ALL + AB*
  Dates: 27 May 2020 and 29 June 2020
  Two digital focus groups with fashion and lifestyle company PVH to explore emergent and future fashion-tech skills and roles. Participants from across design, management and HR at PVH came together to determine how fashion-tech is currently and will be integrated across the value chain for core business at PVH.

- **HB + We Love You (plus multiple industry guests)** – theme: **Fashion-Tech for disruptive business models**
  Organisers: *HB and WLY*
  Participants: ALL + AB + Fashion brands, tech companies, telecom operators.
  Dates: 2nd, 4th, 16th of June 2020
  Exploring Fashion-Tech industry developments in light of disruptive business model innovations. To identify Fashion-Tech skills and roles required to support business model transformation for unleashing untapped revenue streams enabled by integration of 'analog' and 'digital' fashion.

- **ESTIA + Decathlon** – theme: **Fashion-Tech for core business and sustainability**
  Organisers: *ESTIA - UAL*
  Participants: DECATHLON, POLIMI, GZI, ALL + AB.
  Dates: 22nd and 23rd of June, 2pm - 5:30pm
  The two workshops aimed to surface emergent roles for the fashion-tech industry. The focus group was led by the Chair Bali and Estia ecosystem (and in particular Decathlon) around sportswear and sustainability. More than 20 roles emerged from each workshop for future exploration and elaboration in forthcoming WPs and research.

Limitations and re-design of focus group in a digital environment

Due to travel restrictions as a result of the Coronavirus outbreak in Europe in March 2020, it was decided amongst all consortium partners that the focus group activities would be redesigned to take place digitally. This would ensure the continued progress of the (T1.1), while parts of the 'staff learning mobility: study visits to companies' (T1.2) were postponed.

COVID-19 Fashion Industry Impact

The COVID-19 pandemic disrupted original plans for the design of the focus groups. Grappling with the anxieties, concerns and global impact on the health and safety of human lives, HEI partners worked in collaboration with industry partners to sensitively reconsider the new reality of a changing and uncertain world. Among all businesses, the fashion industry faced many challenges and difficulties, responding to economic impacts such as financial layoffs, temporary and permanent closure or physical stores and work environments, as well as vulnerable

employees and suppliers due to lockdown on the fashion value supply chain.

According to The Business of Fashion and McKinsey & Company's The State of Fashion 2020: Coronavirus Update. "80 percent of fashion businesses based in Europe and the US face financial distress".

Devastating impacts have forced businesses to accelerate change, and evaluate options to transform, innovate and shift in the digital space.

"Covid-19 will completely re-shape and re-focus the Fashion and as consequence the Fashion-Tech market, curricula and employability profiles" – Eng.D. Enrico Cozzoni (PhD), Grado Zero June 2020.

Context and Process

The HEI partners worked together to re-design the first tasks of WP 1 into digital focus groups. As such, the hosts adapted the framework into an episodic staged approach, fitting for an online environment, which meant shorter workshops over two or three days to break up screen time from an acknowledgement and assumption that online environment is harder for participants to engage. For this specific online context:

- Online interactive and data capture tools were researched and selected
- An evaluation framework was designed
- Performance evaluation was designed
- GDPR/ Consent Form/ FGs' data storage updates were developed
- Recommendations/guidelines for digital focus group facilitation were provided
- A clear agenda was created and shared beforehand
- Observers, facilitators were selected for each focus group
- A staggered timeline was developed in order to enable to take the learning from each session into the following on
- A collaborative approach helped to support each other's focus group development.

Focus Group Participants

Each focus group involved industry representatives from the consortium – each partner was in charge of inviting at least one of the three professional figures among design, HR, management departments.

Re-design

Thoughtful considerations around the focus groups changing took place in a digital environment resulted in the re-design of a one day workshop into a staggered and episodic approach. It was agreed between the three HEIs (HB, UAL and ESTIA) that the focus groups would be split into two or three digital episodes, which would facilitate the four-step framework narrative to be delivered across consecutive weeks. The episodic approach permitted data to be analysed between episodes, therefore it enabled time to reflect, inform and personalise focus group content based on learnings and emergent findings. One benefit of moving the focus groups to a digital environment meant that it allowed easy access for all Fashion-Tech Alliance consortium members to join the focus groups as observers, moderators and presenters. Members joined in a discreet manner so as to not disrupt the organisation or content of the focus group.

2.1.5. Evaluation Framework and 4-Step Approach

From the outset, the framework agreed between the three HEIs responsible for organising the industry focus groups was to take a four-step ontological approach to capture data on: 1) current state of Fashion-Tech 2) future directions of Fashion-Tech 3) transitions required to achieve future directions in Fashion-Tech and 4) supporting Fashion-Tech roles and skills to assist transitions.

Since each focus group addressed complementary perspectives on Fashion-Tech (e.g. fashion-tech for core business, sustainability and for disruptive business), the rationale behind application of the 4-step ontological approach was to allow for flexibility of individual focus group design, while at the same time ensuring consistency in data collection and enabling better interpretation of results across all three focus groups. A 4-step ontological approach was used in different ways to structure different focus group episodes, depending on what deemed relevant for each particular focus group aim and design (Figure 1).

	FG1: UAL & PVH		FG 2: HB&NEUE		FG 3: ESTIA&DECATHLON		
4-STEPS APPROACH	**EP1**	**EP2**	**EP1**	**EP2**	**EP3**	**EP1**	**EP2**
Step 1. Current state of F-Tech	X		X				
Step 2. Future state of F-Tech	**X**	X	X			X	
Step 3. Transformations required		X		X			X
Step 4. Supporting roles and skills	X	X			X	X	X

Figure 1. Application of a four-step ontological approach across the board of three focus groups.

Besides assisting in structuring focus group episodes and data collection, a 4-step approach was used to structure data evaluation and feedback from participants. The three HEIs (HB, UAL and ESTIA) agreed to identify emerging themes and insights (the so-called 'thematic' framework) in each of the addressed steps (including the explanation of the logic of analysis for each step).

The organisers perceived the application of a 4-step approach meaningful for establishing a relevant and engaging context for discussion of Future Fashion-Tech roles and skills with participating industry partners. It helped to surface corporate objectives behind current and future engagement with Fashion-Tech and their alignment with the development and investments into digital talents to support the fashion-tech business transformation journey.

Overarching focus group evaluation framework consisted of:

- *Generic framework for data collection and analysis* to ensure systematic approach to data collection and analysis, and enhance validity of results
- *Performance evaluation questionnaire* to assess the delivery of the focus group

Generic focus group framework for data collection and analysis include the following steps:

1. Data collection
2. Identification of thematic framework (using a 4-step ontological approach)
3. Interpretation of results for each focus group
4. Interpretation of results across all focus groups

Politecnico di Milano (Polimi) provided for each step generic guidelines and suggestions, whilst it was up to individual HEI to adapt the methodology for the specific focus group in collaboration with the participating industry consortium partners. The only mandatory requirement was the use of 'skills radar' and 'Fashion-Tech personas' tools to help to identify 'supporting roles and skills' in step 4 of a 4-step ontological approach. All tools were developed by Polimi based on the "Education for Fashion-Tech" (E4FT) project. (See: chapter 3 and Appendix).

HB prepared a focus group performance evaluation questionnaire to be distributed to participants to assess the delivery of each focus group episode. The specific areas of evaluation included:

- General reflections (i.e. overall level of satisfaction, including clarity of objectives and sufficiency of communication before and in-between the digital episodes);
- Content, activities, duration;
- Digital format and tools;
- Moderation;
- Appropriateness of participants composition;
- Final reflections (i.e. gaining additional insights on what participants likes most/least during the digital episodes and what changes can be suggested to improve the delivery of the focus group).

Most of the questions were closed-ended questions, using the Likert scale to evaluate participant's experience. A number of open-ended questions were included in the questionnaire to open up for additional insights from participants.

3. METHODOLOGIES AND SCOPE OF RESEARCH TO VALIDATE THE FASHION TECH CURRICULUM MODEL E4FT.

3.1 INTRODUCTION

As stated above, FTalliance is a further exploration of the project "Education4Fashion-Tech: Interdisciplinary Curriculum for Fashion in the Digital Era" (E4FT) (2017-2020). The project delivered a 'Fashion-Tech MA Curriculum'(E4FT.eu, 2018) providing guidelines for establishing an education and research programme in Fashion-Tech, aimed at increasing interdisciplinary skills through both design, business and technology-driven innovation learning modules.

E4FT defined Fashion-Tech as 'technology that enables a fashion experience for the user wearing it or interacting with it'. (Fashion Tech Education and research Benchmarking Report, 2018). Due to its interdisciplinary nature, Fashion-Tech is difficult to define as a sector and/or a new discipline, since it is intersecting and hybridizing like a hypertext of knowledge. Fashion, design, natural sciences, business and management, engineering and technology are all converging in the field of fashionable technology, known as Fashion-Tech. Within the current fashion industry, Fashion-Tech (McKinsey report State of Fashion 2020, 2020) is rapidly

growing and due to the continuous transformation, expanding toward different domains and technological upgrade. (Teunissen & Bertola, 2018).

The Fashion-Tech Curriculum, as developed in E4FT, is a two-year MA Fashion-Tech Design program with a modular and flexible structure. Divided into 3 Educational Sections of Focus and consisting of 18 units in total, the MA program offered the option of levelled education for learners with a different background in education and experience. This structure enabled the integration of learning mobility experience in the programme, thus promoting internationalisation (Edu4Fashion Tech Design Tuning Document, 2018). The programme aimed to educate interdisciplinary professionals with specific subject-specific skills in the intersection of fashion and technology in the areas of wearables, smart textiles and digital manufacturing for fashion. In addition, the curriculum focused on Problem Based Learning (PBL) as well on generic competences (or soft skills): collaborative, entrepreneurial / intrapreneurial and transferable skills to deliver agile and proactive professionals with a focus on social, cultural and environmental aspects of innovation and sustainability. These generic competences enable students to reflect autonomously and to make complex judgement in a collaborative work environment.

In terms of academic contents, the curriculum contains the following Educational Section of Focus. The purpose of these key sections is to provide learners with knowledge, skills and approaches in these three key areas:

1) DESIGN and MULTIMEDIA COMMUNICATION aiming at providing the knowledge, skills and approach to develop innovative ideas and transform them into Fashion-Tech concepts, products and services. It includes theoretical foundation to fashion design, design-driven methodology and utilisation of 3D virtual design and prototyping.
2) TECHNOLOGY and ENGINEERING relating to the areas of wearable technologies, smart textiles and digital manufacturing, digital manufacturing knowledge 3D virtual design and prototyping, AR, VR.
3) HUMAN, SOCIAL, PSYCHOLOGICAL and ECONOMIC CONTEXTS focusing on entrepreneurship, exploring changes in consumer behaviours and emerging business models, whilst critically evaluating ethical and sustainability issues related to Fashion-Tech products.

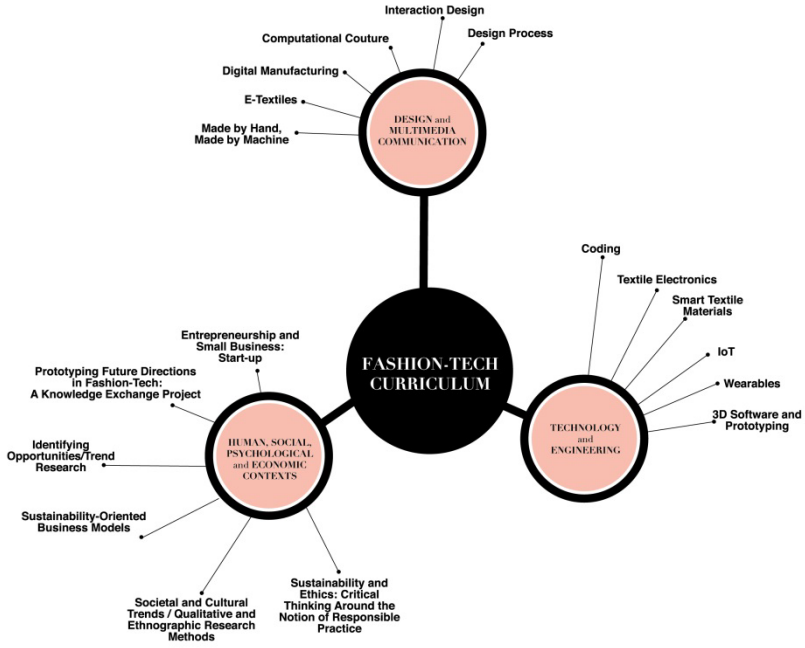

Figure 2 – Edu4FashionTech Curriculum Map with learning units and corresponding courses

3.2 METHODOLOGY AND SCOPE OF RESEARCH

The first research question of the FTalliance project (WP1.1) focused on exploring if and how the Fashion-Tech curriculum designed in the E4FT project was adequate to the market and industry demands for future professionals and job-roles in the Fashion-Tech sector. The scope of the investigation was to:

- Identify and measure skills gap between current job-roles and future ones;
- Assess outputs and outcomes of the fashion-tech curriculum designed in E4FT;
- Identify job roles in the fashion-tech sector in the short/medium term.

The different focus groups explored the future competences and skills required for future Fashion-Tech roles. The different fashion companies involved, varied from traditional big companies to small fashion tech start-ups. The FGs explored the competences gaps facing the current and future transitions in technological and digital transformation. How are they facing the technological challenges in the fashion sector? What kind of new roles and what kind of new skills are required. Polimi designed three toolkits to support the investigation.

3.2.1 Proposed Toolkit

The following toolkit was designed to facilitate all three focus groups for the delivery of FTalliance's T 1.1. The toolkit described all the tasks and activities for the participants to execute with the help of the moderator of the FGs. The toolkit contained three main steps:

1) Tool 1: Assessing, validating and implementing the E4FT fashion- tech curriculum;
2) Tool 2: Reflecting, assessing and validating the E4FT generic and the subject specific competences;
3) Tool 3: Ideating, measuring and synthesizing the skills of future fashion-tech profiles.

These analytical tools enabled a unified approach in data collection and in evaluation the future Fashion-Tech skills, generating consistent and comparative results across all three focus

groups.

Tool 1: E4FT Curriculum: Educational Units and Courses

The first tool enabled participants to understand the overall framework of the Fashion-Tech curriculum designed by E4FT and to assess, validate and review its main structure of learning units and corresponding courses for the development of the new professionals in the fashion-tech field (Annex 1). The tool was divided in three main parts in order to enable to describe synthetically how the curriculum was structured and composed:

- a glossary section with explanation of the educational units,
- a visual/graphic diagram representing the structure of educational units and courses,
- a qualitative questionnaire to enable to generate insights about the significance and importance of the map synthesizing the educational areas, units and courses defined to train professionals in the Fashion-Tech field (Figure1).

Tool 1 Inclusion in the Focus Groups

In setting up the digital Focus Group, the organising partners decided to focus on Tool 1 and 3 to assess the future creative profiles and their skills as well as to gather feedback on the E4FT Curriculum.

The first episode focusing on Tool 1, should start with a presentation of the E4FT Curriculum followed by gathering feedback by FGs' participants. Participants could use the glossary here as a reminder and the visual/graphic diagram as a synthetic visual scheme of educational units and/or courses that could be adapted by changing (in terms of position, importance and naming), deleting or adding both educational units and/or courses.

For the qualitative insights, the partners developed a questionnaire about the understanding of the Curriculum and the modifications operated on the visual diagram. Participants were asked to give information about positive, negative and missing aspects around the following question "In which way do you think the map (Annex 1) synthesizes the areas and disciplines involved to train professionals in the Fashion-Tech field?"

Participants were asked to explain and reflect on the usefulness of each educational unit in the Curriculum. They were also asked to list the educational units in order of importance (considering also the eventually new ones that were added) and to rank the three most relevant units for each educational area.

Min	Topic	Tool	Type of Activity
Total: 10'	Presentation of EDU4FT CURRICULUM: EDUCATIONAL UNITS & COURSES focus on terminology - Glossary	Presentation (screen sharing)	Presentation
Total: 16' 8'	Work on map: • adding educational units and/or courses • deleting educational units and/or courses • modifying educational units and/or courses	Relationship Map (visual)	Guided individual work

8’	• List the educational units in order of importance (considering also the added ones). • List the 3 most relevant courses for each educational unit.	Text	
Total: 15’	Reflection on the way the map synthesizes the areas and disciplines involved to train professionals in the Fashion-Tech field? POSITIVE ASPECTS NEGATIVE ASPECTS MISSING ASPECTS ASPECTS TO BE CHANGED Voting the answers of others (agreement and disagreement)	Feedback Map (visual) Dot Voting	Group work
Total: 10’	Qualitative information about other educational units and courses If you added any other educational unit, please describe the reason why you think they are useful for the Curriculum. If you added any other course, please describe the reason why you think they are useful for the Curriculum.	Guided open discussion	Group work

Tool 2: E4FT Curriculum: Areas, Disciplines and Competences

The second tool was developed in order to reflect on the generic and subject specific competences (Table below) enabled by the different courses of the three educational units of the curriculum (Annex 2).

Generic competences and soft skills	Subject specific skills
• Problem formulation and solving • Creativity and innovation • Planning and management • Communication skills • Communication of information • Teamwork • Independent work • Critical thinking • Research ability • Interpersonal abilities • Information literacy	• Capacity to acquire knowledge of fashion design in relation to natural science, engineering, economics and management with regard to professional and/or experimental work; • Capacity to acquire knowledge of design methodology and design theory with respect to both experimental and professional work; • Capacity to use methods of composition, form principles and design expression as the basis for human-centred design; • Capacity to develop original ideas and apply them in a systematic way, transforming concepts into design solutions, to develop them into products/services; • Capacity to function as a catalyst that enables designers to plan, manage and lead design led interdisciplinary research and development process • Capacity to acquire knowledge of textile and

	smart materials and their applications; • Capacity to acquire knowledge of wearable technologies, smart textiles and digital manufacturing and their processes; • Capacity to acquire knowledge of collaborative design and innovation methods to deliver more effective ways of developing user driven innovations, disruptive products and services; • Ability to research and transfer innovation with particular reference to materials, meanings and processes in various fields; • Ability to integrate capabilities in the engineering area and the design area to develop innovative products and applications; • Capacity to evaluate diverse and disruptive forms of innovation that contribute value to a fashion enterprise; • Capacity to creatively and critically envision future possibilities of emerging technologies and propose both new and well explored concepts for opportunities and/or solutions in socio-cultural and economic context; • Capacity to transfer knowledge from disciplinary fields to new sectors and applications, favouring the creative solutions of problems; • Capacity to acquire and develop knowledge and understanding of the social and economic context; • Capacity to acquire knowledge of socio-cultural and technological trends and practices to evaluate market scenarios and opportunities; • Capacity to acquire knowledge of new and emerging business models of the fashion industry; • Ability to demonstrate entrepreneurial thinking that optimises opportunities, products and markets; • Ability to develop communication and distribution strategies.

Participants were tasked to mark the competences that they thought to be the most relevant (by placing a cross) in a specific educational unit and courses with a maximum of 10 competences per course.

Alternatively, participants were asked to review the same table with competences of the E4FT curriculum filled in, by adding / deleting / modifying the competences that they thought to be required for the courses. Once agreed on the competences, participants should make a selection of the three priority competences delivered in every specific course.

Tool 3: Fashion-Tech Personas: Skills Radar

The third tool aimed to support the phase of ideation of future fashion-tech professional profiles, job-roles or personas through definition, assessment, and synthesis of their soft and subject specific skills (Annex 3). To describe synthetically how the Skill Radar is structured and composed, the tool consisted of three main parts:

- a glossary section with explanation of both soft and subject specific the skills,
- a radar chart for assessing the soft and subject specific skills,
- a guided brainstorming to describe the future Fashion Tech Creative Profile.

Suggested agenda for using Tool 3 in the Focus Groups

Participants were asked to describe the features of a future Fashion Tech Creative Profile needed in their companies in the next future (1 to 3 years). The future profile should be described through the Job title of the Fashion-Tech personas, the department into the organization, competences and other skills different from the ones in the radar along with a short description of the profile (example: seniority, activities...)

In addition, they were asked to complete the SKILLS RADAR through the evaluation of each skill of the future Fashion-Tech Creative job profile imagined, according to the scale provided (Indispensable, Necessary, Important, Desirable, Non-essential).

Min	Topic	Tool	Type of Activity
Total: 10’	Presentation of the E4FT SKILLS – focus on terminology - glossary	Presentation (screen sharing)	
Total: 10’	Description of the features of a future Fashion- Tech Creative Profile needed in the next 1 to 3 years Job title of the Fashion-Tech personas Department into the organization Short description of the profile (example: seniority, activities...) (150 characters) Competences (Keywords)	Chart (Visual + text)	Guided individual work
Total: 15’	Fill the SKILLS RADAR to evaluate each skill of the future (1 to 3 years range) Fashion-Tech job profile imagined. Mark them by crossing the dots according to the scale provided (Indispensable, Necessary, Important, Desirable, Non-essential).	Skill radar (visual)	Guided individual work
Total: 5’	Think about other Skills you think could be important for that profile (add to the radar and score it) Vote the 3 more important areas related to the skills	Text Visual Dot	Guided individual work
Total: 15’	Presentation of the profile and more important areas related to the skills	Guided open discussion	Group work

3.2.2 EDU4FT Curriculum Presentation

The curriculum presentation summarized the crucial results of two-year MA Fashion-Tech Design program developed within EDU4Fashion-Tech Interdisciplinary Curriculum for Fashion in the Digital Era European Project. The scope of the Education4Fashion-Tech project was to develop developing a framework of higher education in the novel field of fashion-tech among different Universities: the University of Boras - Swedish School of Textiles, Politecnico di Milano

– Dipartimento di Design and University of the Arts - London College of Fashion. The curriculum aimed to improve the level of key competencies and interdisciplinary skills of students and trainers in the areas of wearables, smart textiles and digital manufacturing for fashion as well as to break down barriers between technologists and creative communities in order to build meaningful collaboration.

As stated above, the curriculum of MA fashion-tech design aimed to enhance generic and subject-specific competences, embedded in 18 educational units, evenly divided in the areas of Design and Multimedia Communication, Technology and Engineering and Human, Social Psychological and Economic Contexts.

Especially the generic competences have become increasingly important due to their transferability across different degree programme. Therefore, these skills should be acquired (and build upon previously obtained competences) right at the start of the studies to prepare students for lifelong learning. In addition, the transferable generic competences aimed to prepare students to navigate their environment, work well with others, and achieve their goals with complementing subject-specific skills. The subject-specific competences were aligned to the three educational areas of focus of fashion-tech design Design and Multimedia Communication, Technology and Engineering and Human, Social Psychological and Economic Contexts) and are mapped in Figure 2.

The subject-specific competences are as follows.

Digital modelling is referred to the design process that use the computing-aided design (CAD) for the geometric three-dimensional modelling and digital representation of objects, with particular attention to aesthetics and the realistic representation of fashion garments and accessories. The skills require the ability to use hardware and software systems for 3D graphics and rendering, through the use and knowledge of algorithms and Computational Design.

Making and Prototyping is about being able to physically craft design ideas and make conscious decisions about material selection and the fabrication processes employed, from the more traditional ones (Pattern Making and Sartorial Techniques) to the more innovative ones (Additive and Subtractive Digital Manufacturing, circuit design, coding and programming).

Experimenting and Experiencing: focuses on the ability to experiment and explore an issue through user experience and prototype testing.

Meta-design: refers to the design methodology that leads to the concept definition of a Fashion-Tech product or service, through a research process that synthesizes design goals, technological and productive constraints through scenario, mood board, Lifestyle Boards and Concept Development.

Communication: regards the ability to tell a story using the most appropriate medium to drive a specific message. It includes Digital Storytelling and Digital Drawing and Sketching skills.

Research deals with stressing the ability to understand the market context (Market Research), consumption trends for a consumers' group of reference (Trend Research and Consumer Profiling), the users' needs and the interaction between people and technology (User and Ethnographic Research).

Management focuses on the abilities related to business innovation strategies and new way of organizing a company. The area includes those skills, which define or support the plan of the company in term of core business and strategic decisions, including Sustainability-oriented business Models Development and Strategy definitions.

Analysis refers to the capability of being able to test a product/service through qualitative and quantitative data analysis.

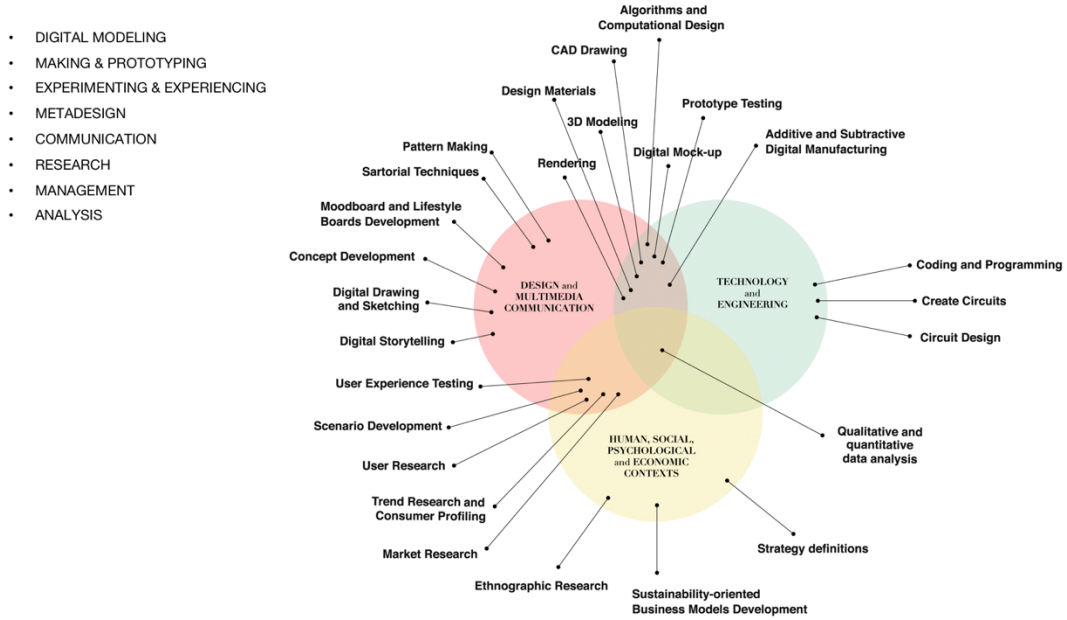

Figure 3 - Edu4FashionTech Curriculum Map with subject-specific competences

Future Fashion-Tech Scenarios Presentation

The methodology scenario thinking was chosen to enable a proper conversation and debate around the fashion-tech conception in the companies, scenario thinking. Scenario thinking as a tool supports challenging the status quo, by asking “What if?” in a disciplined and organised way (Manzini & Jegou, 2000) through using narratives and stories about how the future might unfold for the organizations. Scenario thinking enabled to tests the mind, to challenge belief and to settle a possible future strategy. Therefore, the hosting partners considered the tool useful for the FGs for exploring collaboratively the topic of Fashion-Tech within the companies as well as to gather information on the known as well as the unknown. Scenarios are hypotheses, provocative and plausible stories about diverse ways in which relevant issues might evolve, about the opportunities and threats that the future might hold. A scenario is based on a vision, which answers the question "What would the world be like if…?" and proposes a story or a synthetic image of what would be the state of the things if a given sequence of events takes place.

The scenario thinking process started with identifying opposite driving forces of change (or macro trends), such as technological, societal, economical drivers. Combined in different ways they created a set of Fashion-Tech alternatives to envision and discuss the future directions of companies. The challenge for the companies was to imagine what it would be like to live and react to the most plausible and desirable of these futures. For example, Hyper body refers to protection and body enhancement through an artificial second skin or to human enhancement through technology, smart materials, digital manufacturing technologies, augmented reality and

artificial intelligence.

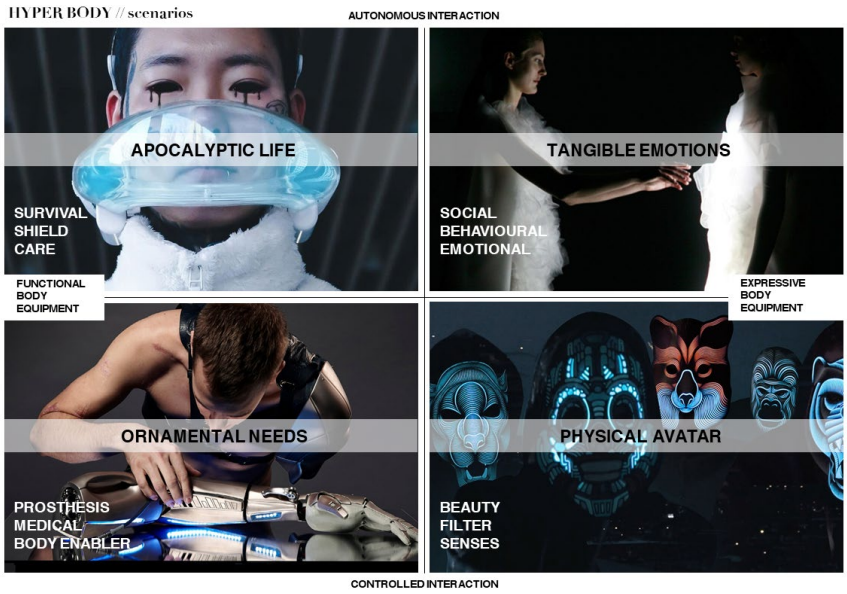

Figure 4 – 4 Scenarios

The four developed scenarios offered holistic visions based on opposite macro trend of equipping the body from the hyper-functionality to a more decorative/expressive ways. The other opposite force explored the interaction, between autonomy and objects, systems, and processes taking control. The upper part referred to the agency of the objects, systems and processes, which enabled to react to humans, to take control over their behaviour and activities. The lower part referred to a passive interaction with objects, systems and processes where the user controls. The paragraphs provided explanations and 'what if' questions for each of the scenarios.

See more details in Annex 4.

Suggested Agenda for Scenario Thinking Methodology use in the Focus Group

The following table summarized the proposed agenda including the scenario thinking methodology to be used in one of the episodes of the focus group. For the participants to envision future products, services and systems in the Fashion-Tech evolution in their companies and to imagine new roles and job-profile with generic/soft and subject-specific skills.

Min	Section	Topic	Tool	Type of Activity
10'	Scenario Presentation	Presentation of Scenarios as a tool to envision future products and roles at the participant Companies	Presentation (screen sharing)	Presentation of Scenarios
15'	Scenario Presentation	Group reflection on the way the presented scenarios depict the areas the Fashion-Tech futures at participant Companies • What is the most probable fashion-tech scenario? • What is the most possible fashion-tech scenario? • What is the most	Google Slide	Guided group discussion to share scenarios and select the most discussed ones in terms of probability, possibility, preferability and

		desirable/preferable fashion-tech scenario? • Why is this scenario significant for you?		meaning.
15’	Future products/systems or services	1 – Individual brainstorming What would the design & production of the participant Companies be like if scenario x (selected one) took place? How and what products/processes/ services would be offered by them if scenario x (selected one) took place? 2 - Aloud elicitation of envisioned product/processes/systems 3 - Selection and voting (seek for agreement)	Google Slide (participant will have their own slide to edit) Dot voting	Guided individual work
15’	Future Fashion-tech Roles	By selecting the most voted products/systems of services, work on generating new roles: 1 – Individual brainstorming If this product/process/service were to be realized, what new figures would you need in your Company? 2 - Aloud elicitation of envisioned new roles	Google Slide (each participant will have their own slide to edit)	Guided individual work
15’	Future Fashion-tech Skills	1 – Individual brainstorming If this role will be configured, what new skills/competences/features they would have? 2 - Aloud elicitation of envisioned skills/competences/features	Google Slide	Group Work
15’	SKILLS RADAR	Fill the SKILLS RADAR to evaluate each skill of the future (1 to 3 years range) Fashion-Tech job profile imagined. Mark them by crossing the dots according to the scale provided (Indispensable, Necessary, Important, Desirable and Non-essential).	Skill radar (visual)	Guided individual work
15’	SKILLS RADAR	Think about other Skills you think could be important for that profile (add to the radar and score it) Vote the 3 more important areas related to the skills	Skill radar (visual)	Guided individual work
15’	Discussion	Presentation of the profile and more important areas related to the skills	Guided open discussion	Group work

Integration of the three Tools into the Agenda of Each Focus Group

When setting up the Focus Groups the hosting partners reflected on objectives and outcomes. Taking into account the participants were primarily from industry, the hosting partners agreed that Tool 1 and Tool 2 needed tweaking, due to high level of details participants had to take in. Since participants were from industry and not academic experts, a detailed understanding of the academic curriculum seemed not relevant. Alternatively, they were an important resource in terms of envisioning the future trends of Fashion-Tech in their industry, revealing new skills and roles needed. Therefore, the partners agreed to define the skill gaps and the validation of outputs and outcomes from E4FT Curriculum by reflecting on the results through using Tool 3.

These outcomes were useful, although in a more indirect way, to review the structure of the curriculum and to implement improvements if necessary.

The organising partners (UAL, HB, ESTIA) were allowed to adapt the proposed tools, agenda and supportive materials in an appropriate way to maximum support each focus group in order to scope and investigate future fashion tech rules and persona, to identify required skills to better engage with certain areas and topic of the fashion-tech sector. Tool 3 was considered a prerequisite to achieve analytical results that could be compared among the three FGs. In the following paragraphs, the adaptations and integration of the tools into each FG are described in more detail.

UAL Focus Group

UAL performed the FGs in two episodes with participants from different brands of the PVH group. Episode 1 aimed to engage with the E4FT Curriculum and mapped skills of current Fashion-Tech roles. Episode 2 aimed to envision the future Fashion-Tech roles foreseen at PVH and personas identifying skills. Tool 1 and Tool 2 were not formally integrated into the design of the focus group, but POLIMI presented the curriculum during Episode 1, providing a framework to gain initial feedback on the curriculum and the skills and competences taught within the curriculum. Tool 3 was integrated into Focus Group Episode 1 as well as into Episode 2.

The UAL FG episode 1 started with an introduction of the E4FT curriculum to contextualise the MA as well as to give participants an overview of the generic competences and subject-specific skills taught in the curriculum. The aim was to provide an overview of the taught curriculum to illustrate where the generic competences and subject-specific skills were sitting in the curriculum. The presentation functioned as a terminology glossary for participants to use and engage with. The introductory information was repeated in the form of a Skills Radar (Tool 3) in a later activity. The EDU4FT curriculum presentation was shared during the focus group as a PDF to be used for further reference. Following the 15-minutes presentation, participants were invited to reflect on the curriculum to provide the moderators with any initial feedback. PVH participants were given the opportunity to provide final reflections on the curriculum and any skills that were not captured or addressed within the curriculum.

Tool 3 “Fashion-Tech Personas: “Skills Radar” was integrated in both the episodes by UAL. Due to the digital design of the FG, it was readapted within a Google Slide template (link: here) to best suit the digital environment of the focus group.

PVH Fashion-tech Skills and Roles

Group uses the EDU4FT skills below to define fashion-tech roles at PVH

Soft Skills	Subject-specific Skills			
• Problem Solving • Critical Thinking • Creativity • Communication Skills • Teamwork • Independent Work • Interpersonal Abilities	**Digital Modeling** • CAD Drawing • Circuit Design • 3D Modelling • Rendering • Algorithms and Computational Design	**Making & Prototyping** • Design Materials • Pattern Making • Sartorial Techniques • Additive and Subtractive Digital Manufacturing • Digital Mock-up • Create Circuits • Coding and Programming	**Experimenting & Experiencing** • User Experience Testing • Prototype Testing	**Metadesign** • Scenario Development • Moodboard and Lifestyle Board Development • Concept Development
	Communication • Digital Storytelling • Digital Drawing and Sketching	**Research** • User research • Trend research and consumer profiling • Ethnographic research • Market research	**Management** • Sustainability-oriented business models development • Strategy definitions	**Analysis** • Qualitative and quantitative data analysis

Figure 5- Adaptation of the Skill Radar into the google slides template by UAL

During the FG Episode 1, in the first workshop activity, participants explored the soft skills and subject-specific skills from the Skill Radar in order to map to existing job roles within PVH. Then, participants discussed their interpretation of the soft skills and subject specific skills from the PVH perspective.

During FG Episode 2, participants were tasked to explore fashion-tech job roles at PVH the current ones (0-1 years), the future ones (5 years plus) and how these roles supported the transformations and the future directions of PVH. Episode 2 accommodated more discussion in favour of more qualitative insights, so Google Slide template and activity were simplified. Participants were asked to map the skills from the identified skills profiles of the E4FT skills radar into these future job roles.

HB Focus Group

For structuring and facilitating discussion on future Fashion-Tech roles and skills, the FG organized by HB included Tool 3 ("Skills Radar" and "Fashion-Tech persona") in Episode 3. In addition, the E4FT curriculum was briefly presented to participants during Episode 3, including an overview of the relevant subject specific and generic skills in the 18 educational modules.

The inclusion and integration of the tools was performed with an individual asynchronous questionnaire, delivered by e-mail and through the presentation of results from Episode 2 and the questionnaire during Episode 3, followed by a group workshop session and discussion. See Annex 5.

The questionnaire used the results from the FG Episode 2 around the identified capabilities for realizing Fashion-Tech business model transformation and the skills reported in the Skill Radar as a starting point. This analytical approach identified 15 skills grouped divided in 11 categories to be relevant for Fashion-Tech business model transformation. The questionnaire was executed between the Episode 2 and 3 with the scope to gain insights on the relative importance of these skills (currently present or lacking/underdeveloped) in their Company. Participants could rank the relative importance of the Fashion-Tech skill; add additional and considered relevant ones. In addition, they were asked to include the key roles within which the skills for supporting fashion-tech business model transformation were allocated.

During Episode 3, participants reflected on the presented skills and roles focusing on ranking and missing ones. The following discussion focused on brainstorming on professional Fashion-Tech profiles required in the near future (1-3 years) using the 'Fashion-Tech Persona' Tool (Tool 3). Participants could refer to ideated and jointly developed Fashion-Tech skills and roles but also to extra-skills and roles. In order to expand on the board of skills that might be relevant for future Fashion-Tech professionals, the subject specific and generic (soft) skills derived from E4FT project were provided as example (Figure 6).

ESTIA Focus Group

ESTIA two episodes of focus groups aimed to explore how the culture of developing technical products would evolve in light of emerging fashion technology. This was executed via workshops where new roles and functions in the Fashion-Tech domain were discussed and developed. Tool 3 provided by POLIMI was integrated in FG Episode 1. The "Future Fashion-Tech Scenarios Presentation" invited the Decathlon participants to share their vision on

Fashion-tech in their company/brand/team in relation the Hyper Body scenarios. The “What if?” scenarios were presented to provoke discussions around integrating technology in future products. It also supported a brainstorm in defining Decathlon core values in detail. None of the other tools were integrated in the two episodes. The FGs did not specifically focus on skills elicitation but were primarily defining new and emerging roles and functions to support Fashion-Tech in the team/brand/organization. The qualitative insights related to rules and jobs-profiles deduced from the two focus groups helped to define the emerging skills.

4. OUTCOMES AND EVALUATION OF THE DATA, FEEDBACK, VALIDATION

4.1 INTRODUCTION

In this chapter, generic and subject specific skills, as being proposed in the E4FT curriculum, are reviewed in light of the outcomes of the FGs. Recommendations are made to inform and improve the E4FTcurriculum to align it better to industry demands.

4.1.1 UAL FG Results

Evaluation of the Fashion-tech Generic Skills

Feedback from the first FG with PVH learnt that the Generic competences included in E4FT curriculum (problem solving, critical thinking, creativity, communication, teamwork, independent work, interpersonal abilities) are applicable to Fashion-Tech roles. Depending on the role (junior or lead) different percentages of each soft skill are required. Soft-skills such as communication, teamwork and interpersonal abilities are useful in interdisciplinary processes where different departments of the same company have opinionated, diplomatic discussions to emerge and thrive new ideas. An interdisciplinary exchange between designers and programmers, for instance, could support a more connected and efficient process.

Evaluation of Subject specific Skills

At the first FG PVH highlighted Digital Modelling skills in the area of Fashion Design as crucial in current job roles as well as for emergent transitionary and future roles in different junior or lead position. The enhancement of 3D design and visualization expertise: 3D pattern design, CAD drawing, 3D modelling via the use of 3D platforms and software (e.g. Clo3D and Browzwear) is opening up roles that are more technical for designers. These skills are applicable to product development and prototyping, to buying space (digital platform) and buying experiences design, and visual merchandising. PVH prefers to recruit people who have basic 3D-related skills across design, product and merchandising so they easily can be upskilled, inside the company. Digitalization of fabrics through the realization of a Digital Library. PVH flagged up the need for rendering skills in the production next, the digital showrooms, the creation of avatars, holographic experiences and AR, that might arise in the near future.

PVH highlighted the necessity of skills that enable the design of fashion digital experiences delivered to wholesale customers more than solely physical/digital products: an UX (User Experience) and UI (User Interaction) designer with skills to experiment, design the customer journey experience in Omni channel, ecommerce platforms, and retail innovation areas, through online and digital apps and showrooms. In order to enable forecast customer

expectations and analyse trends, PVH suggested the need of data science skills to empower the design process in relation to programme management.

In the far future of the company, the digitalization of the design processes might lead to a focus on 3D printing related skills that enable local, micro, on-demand and rapid manufacturing. In the Making and Prototyping competences of the future, a 3D printing specialist should handle 3D modelling hardware and software for additive and subtractive manufacturing. This is also connected to the skills of making and prototyping that could be required in the far future designers at PVH.

PVH highlighted an interest in future fashion designer roles with a knowledge on bio-based/biodegradable materials and chemical processes, with specific expertise in chemical and biochemical engineering and an understanding about the science behind the fabrics. These skills are also related to sustainability that needs to be enhanced in the education, by focusing on design knowledge about circular pattern design and processes, LCA (Life Cycle Assessment), recyclability technologies and materials, technologies for traceability in the supply chain (NFC, RFID, DNA) along new with circular business models related to rental and re-commerce.

In addition, skills related to design of smart textiles and digital/connected wearable technology were envisioned as emerging in the far future at PVH.

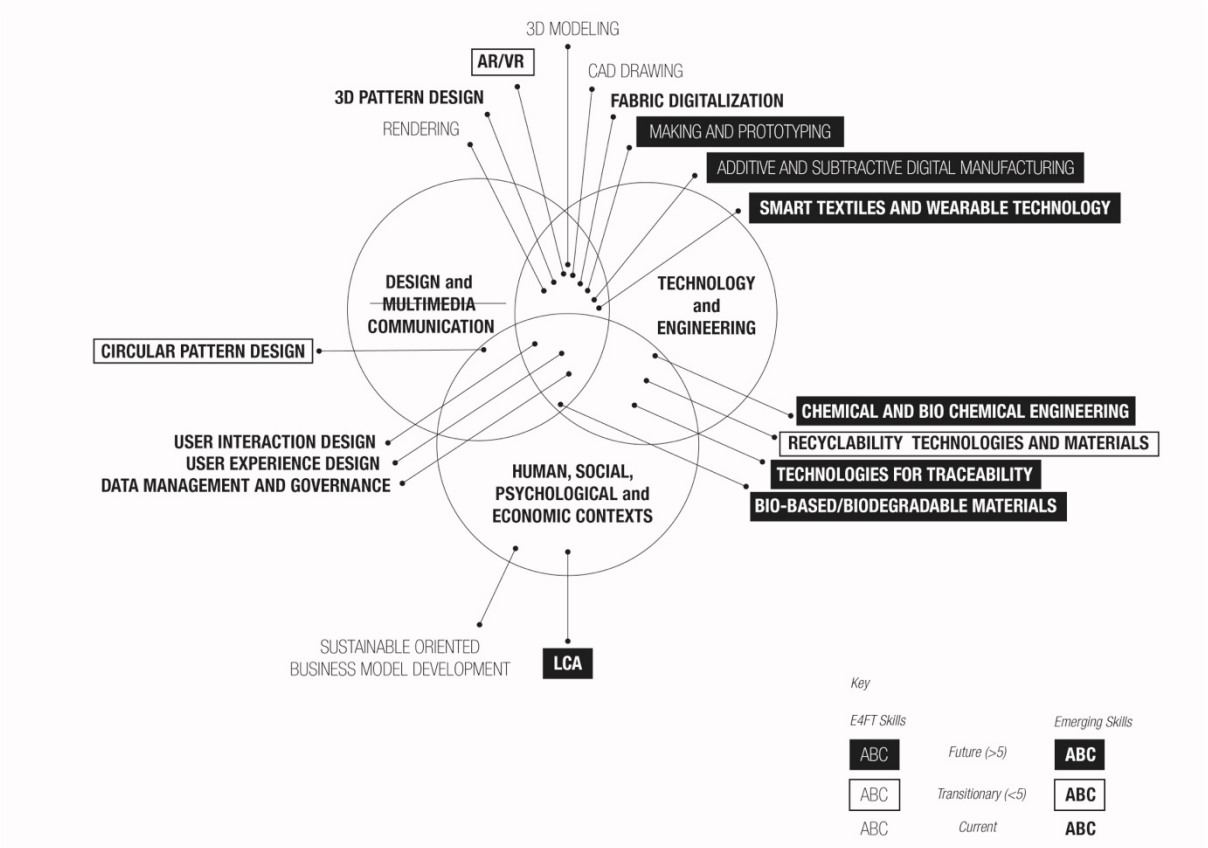

Figure 6 - Subject-specific Skills resulting from the FG1: UAL x PVH

General Insights

- Participants questioned the level of depth of knowledge that students learn in the

various disciplines and units of the E4FT curriculum. Given the interdisciplinary nature of the E4FT curriculum, students would reach different levels of learning achievements depending on their background and previous formation.

- The need for interdisciplinary interaction across teams underlined as an important aspect of the interdisciplinary nature of the E4FT curriculum. It enables students to be more interdisciplinary rather than interdisciplinary or specialist skilled in one field, to better support collaboration and communication across different disciplines.
- The use of the word 'multimedia' in the curriculum was highlighted as a dated term that needed updating.
- Senior-experienced professionals with 3D skills and expertise in the fashion area are new and hardly available in the job-market.

Validation and Lessons Learned for the E4FT curriculum

The UAL FG highlighted and validated the importance of merging the three educational areas/units within the three main disciplines (Design and Communication, Technology and Engineering, and Business Management) by designing and delivering courses and units that provide interdisciplinary content in the area of design, technological and business-oriented directions.

As stated by Oxman (2016), "knowledge can no longer be ascribed to, or produced within, disciplinary boundaries, but is entirely entangled". Instead of providing specific courses related to specific disciplinary educational units, the necessity of creating overlapping educational units of merged disciplines is clear. This entangled new discipline consists of many different units/courses that cover the topic from different disciplinary points of view. In order to provide the students a complete and holistic view of the addressed topic an interdisciplinary approach is required, especially for students trained in one specific discipline: it will enable them to understand and handle other disciplines' glossary and methodologies.

Recommendation 1: To widen the overview of the complexity of managing a Fashion-Tech project as well as to disrupt the boundaries between different disciplines. The PVH participants stated this entanglement and interdisciplinary already has proven to have positive results within the company, enriching the process and the intellectual outcomes.

Secondly: the need to add learning outcomes that enforce communication abilities and team working skills, to enable future fashion designers to understand the tech and business disciplinary domains, by combining horizontal and vertical competences.

Recommendation 2: applications of Fashion-Tech are permanently evolving inside the companies. This is requiring interconnected skills. Therefore, there is a need to create a consequential didactic experience that build upon the previous skills, toward multiple, more complex applications and implications. 3D Modelling for example has a wide range of applications in the overall phenomena of the Digital Twin. Its current applications cover the digital visualization of garments, but in the near future it will applied in the AR/VR/holograms applications, connecting prototyping, product development, new selling strategies, retail experiences and business revenues streams. This digital twin of the fashion value-chain has also implication in terms of new skills related to user experience design on the digital/virtual on-line platforms and consequently data management for trend analysis and forecasting.

Recommendation 3: Additions to course content. 1) Sustainable practices related to design seemed beneficial (e.g. circular pattern design). 2) Technologies (e.g. material recyclability,

micro-scale/on-demand/local manufacturing). 3) Business models (e.g. circularity, re-commerce, etc.) inside the Fashion-Tech domain. 4) Emerging scientific disciplines such as chemistry and biochemistry and the application of bio-based/biodegradable/growing materials in the fashion-tech sectors to add to the E4FT curriculum.

4.1.2 HB FG Results

Evaluation of the Fashion-Tech Generic Skills

The following generic skills are required to support Fashion-Tech Business Management innovation: renewal/upskilling competence to bridge the understanding of fashion and tech, through collaboration, serendipity and an open and innovative mind-set. Generic skills such as creativity and cooperation are required for professionals to enable co-design, especially the role of an "interdisciplinary facilitator" can help to bridge gaps among different disciplines.

Since SMEs are operating in a more agile/fluid way in fashion-tech projects, they tend to form temporary cross-disciplinary teams to address specific challenges. Therefore, a bridging role, which is pairing and enhancing different competences (industrial/material design + digital + fashion skills) are recommended. Bringing specialists from various domains together to co-create new hybrid skills. The collaboration with supply chain actors, service providers and new industries was also recommended as important.

Evaluation of subject specific skills

Fifteen subject specific skills were identified in the context of the transformation of the Fashion-Tech business model in order to adequately capture the new ecosystem/platform revenues.

Data collection, interpretation and analysis category of skills (data science), missing in the E4FT curriculum, was highlighted as essential for collecting fashion related insights. Especially recommended were software (need front and back end) development skills, connected to data security and privacy, providing knowledge about digital laws and digital data protection and all legal aspects involving the use of collected and archive data from users. In addition, policy-making related skills, on a governmental/national as well on corporate level were recommended in order to support Fashion-Tech business model innovations. Both AI (Artificial Intelligence) and Ethics are highlighted as essential competencies to support data analysis, research and meta-design skills as well the sustainability and circularity focus already present in the curriculum.

Next, meta-design skills were highlighted as important Fashion-Tech skills especially to support research and product development as well as to support system design skills, which are complementing the design of innovative business model alongside digital storytelling and digital marketing skills. All these skills are needed alongside data protection and GDPR.

Regarding design and technology, the importance of user experience testing and material tinkering with sensor integrated projects (e.g. wearables, garments made of smart materials) was highlighted, requiring a 'hands on' approach, understanding the context, the user on managing interfaces, coding and programming, materials and some electronic engineering.

These hybrid skills in the area of design, material and technology related to digital making and prototyping are currently underdeveloped in comparison with the user experience in virtual/digital/online/software contents located within the UX designer role. However, these skills

are essential are to help designers' in making decisions. Researching and understanding consumer feedback, the possibility for example, to invite pilot users to test garments, was considered and important competence. Material focused skills with an understanding of how the tech and digital affect and influence the traditional material knowledge were mentioned as important.

Finally, more process related skills: First, emerging new skills such as traceability, for example, an in depth knowledge of the supply chain in traceability and tracking of products, materials and production processes. Secondly, recycling / End-of-life /Circularity related skills to understand recycling processes and fully circular systems. Finally, new manufacturing processes and assembling methods competences and knowledge to enable to implement new innovative transformative systems.

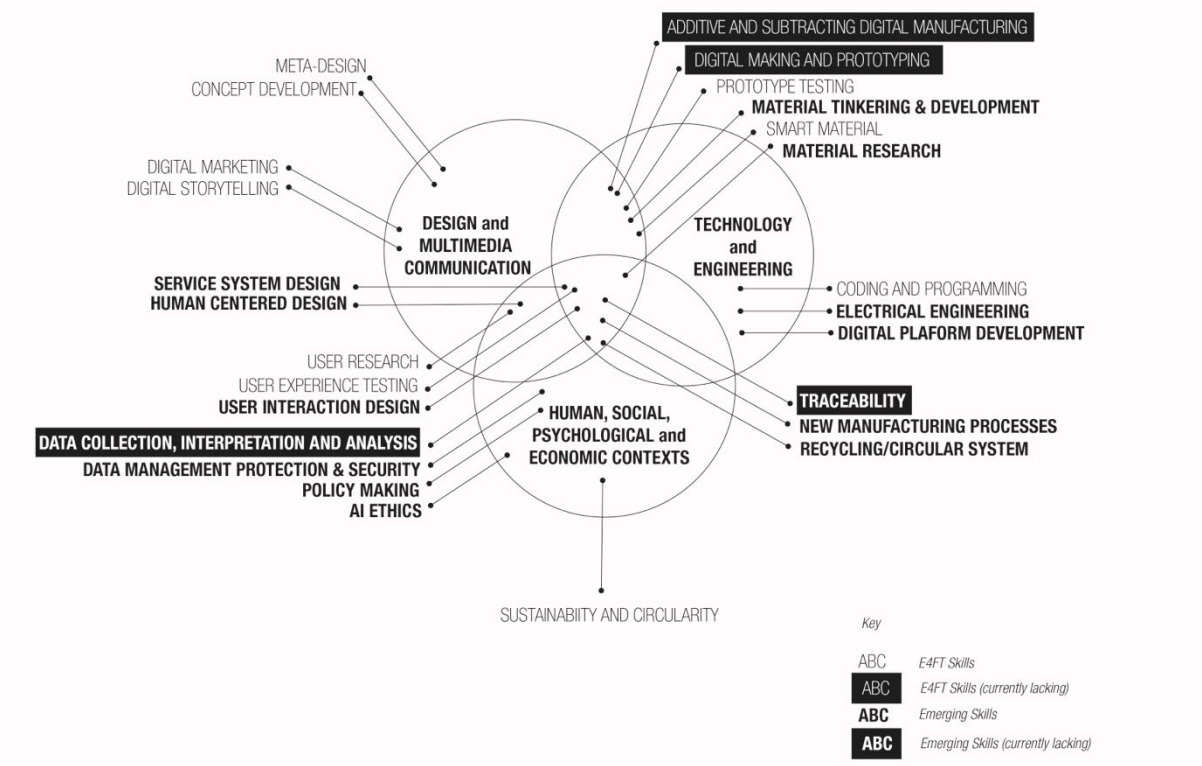

Figure 7 – Subject-specific Skills resulting from the FG2: HB x WLY

Validation and Lessons Learned for the E4FT Curriculum

Recommendation 1:

The importance of a further merge of competences and discipline in the E4FT curriculum. A more interdisciplinary, more comprehensive and holistic Fashion-Tech curriculum will enable the future professionals and practitioners to tackle more complex and different Fashion-Tech projects. It is crucial that students with different specializations (e.g. fashion, business, engineering, coding, re-/upcycling, e-commerce, sustainability) learn to collaborate from scratch in an educational process addressing the current challenges and problems in Fashion-Tech products, services and cultural concerns. In Fashion-Tech SMEs, these hybrid competences are already standing practice: they enable to understand the complex Fashion-Tech domain from different perspectives and to leverage emerging opportunities to realise future Fashion-Tech business models.

Recommendation 2:
Generic or soft skills in creativity such as collaboration and creating/developing your own roles (ability to develop/adapt/transition your knowledge and skills to meet the future needs of the company) are important to create interdisciplinary facilitation skills to effect full cooperate and co-design with professionals from different disciplines. Thus, specialization and generalization as well as developing 'hybrid' competences across various subject disciplines are hugely relevant for the future of Fashion-Tech education. Finally, it is important for designers to learn more on the latest by having an ongoing dialogue with technicians (developers/coders/engineers) who instead do not necessarily need fashion related knowledge.

Recommendation 3:
Finally, a series of additional subject specific skills was recommended. Knowledge in ethics around AI, data and sustainability is essential. Insights in the potential of new business models related to Fashion-Tech not fully explored as a skill in the E4FT curriculum. In particular, AI ethics along with sustainability and circularity were highlighted crucial in the context of data management, protection and security in both online and offline products/systems engaging with users' data. The introduction of interaction research and user tests should be added to the E4FT curriculum. Besides, some education in an overall view on the design and management of the Fashion-Tech projects recommended, enabling students to integrate the latest developments in innovative manufacturing processes, to understand the entire process and to pivot and restructure existing business.

4.1.3 ESTIA FG RESULTS

Evaluation of the Fashion-Tech general skills

Higher specialization in the Fashion-Tech field creates the necessity of interdisciplinary roles to facilitate and support the specialists along the whole process of design, prototyping, production and sales. Activities are getting more specialized and complex (e.g. green sourcing, end of life management, Customization, customer intelligence from big data source) and roles are getting more specialized whilst there is a need to keep a holistic overview. Generic or soft skills will enable the different actors to connect and familiarise with different specialized competences.

Evaluation of the Fashion-Tech subject specific skills

3D Modelling, was highlighted as an important subject specific skill across the value chain. In Decathlon, 3D modelling is already integrated in the PLM software for products but not in garments and textiles products. Integrating the 3D modelling skills in the full process was one the key future directions of Decathlon, integrating the 2D pattern making in the 3D modelling workflow (3D pattern design). The complete integration of this process is considered important to accelerate the design process in order to reduce the number of physical prototypes to be made and to perform digitally some activities that requires new skills. For instance, these are:

- 3D digital simulation/testing of physical properties, functionalities and performances previously checked through physical tests,
- 3D digital model simulation/ testing to validate design choices in terms of styles, colours, material,
- 3D digital model simulation for end user experiences of fitting in virtual environments,
- customized models and patterns programmable through procedural and computational algorithm referring to different biometric features,
- 3D models for additive manufacturing production allowing 3D printing at home or locally

on demand (end users).

Part of the new roles and skills are creating new experiences whilst pivoting the business plans toward the end users. Especially, for the digitalization of the products such as digital fittings new roles with expertise in developing augmented reality apps, holographic rooms, and 3d views are needed. For this growing sector expertise in 3D Digital shop and digital experiences, skills in digital and omni-channel narration and storytelling, user Experience (UX) and customer experience (CX) designer are required.

The additive manufacturing skills refer to being able to plan a local production and sourcing of materials in micro-factories to make environmental savings. The technological implementation of a sustainable perspective that includes environmental and societal impacts embodied in sustainability and circularity skills. The ability to source and select green fabrics that could be reused pre-consumer or post-consumer, locally produced materials: the subject specific skill to source and evaluate sustainable fabric suppliers through eco-design audit. Skills related to circular design, engineer and management of the fashion products to be important, in addition to related-legal aspects knowledge. Circularity skills are important in design (zero waste pattern design, product durability and end of life), engineering (new material and manufacturing processes), business models (renting, coupons for returned products, refreshing), management and supply chain (traceability).

Data analyses and Artificial Intelligence Skills integrated and aligned to fashion, textile process or end-user/customer needs are also increasingly important to achieve sustainability (traceability) and a more integrated workflow (pattern programming, digital visualization). Data science connected to software development knowledge, to implement and prototype functionalities and platform that make use of data.

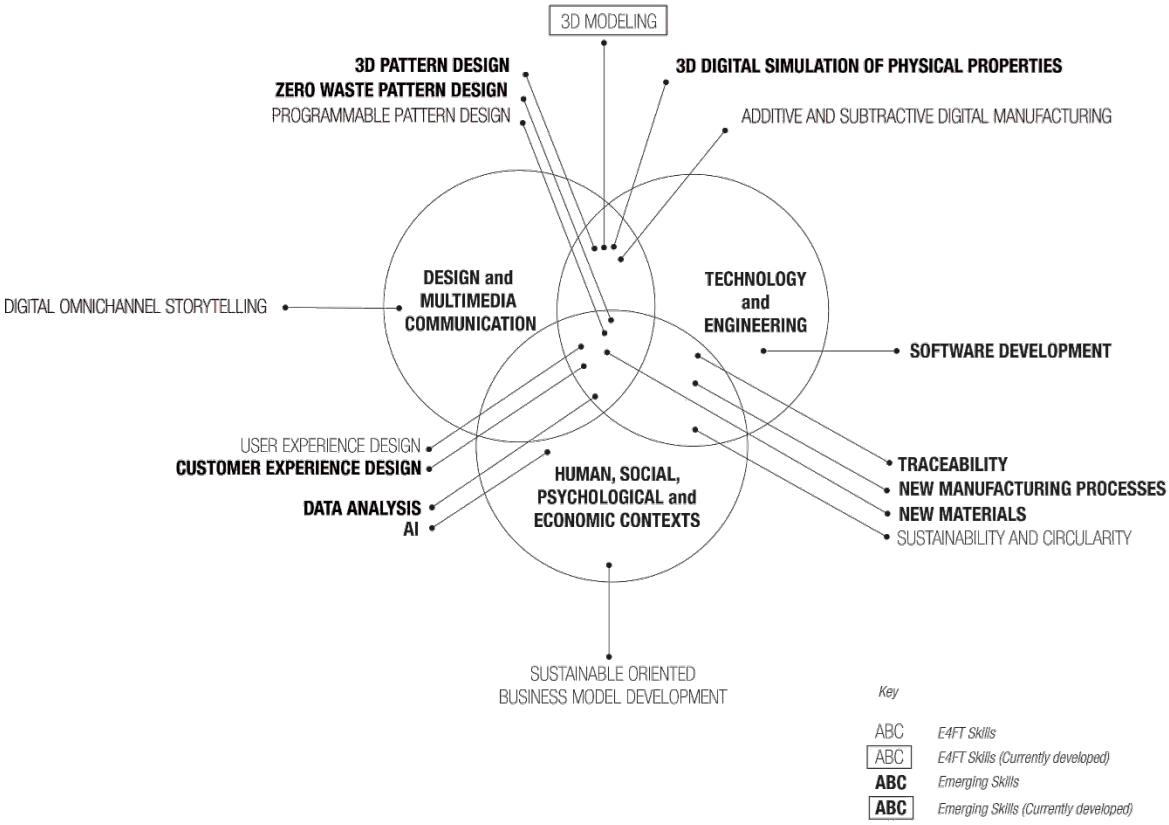

Figure 8 - Subject-specific Skills resulting from the FG3: ESTIA x DECHATLON

Validation and Lessons Learned for the E4FT Curriculum

Recommendation 1:
The need for interdisciplinary with a common understanding. The necessity to ensure that different specialized roles and experts have a common understanding and basic knowledge of two main areas: sustainability (materials, processes, design, business) and digitalization (design, testing, simulating, visualizing, fitting, experiencing.

Recommendation 2:
The interconnections between fashion, technology and business management are creating complex projects requiring an integrated approach through the entire workflow from prototyping to production, sales and distribution processes to achieve a real and holistic innovation.

5. PROPOSAL FOR AN INTEGRATED CURRICULUM MODEL BLENDING INDUSTRY AND ACADEMIC KNOWLEDGE AND INDUSTRY RELATED COMPETENCES OF THE FASHION-TECH SECTOR TO INFORM WP 2.2

5.1 INTRODUCTION

The results of the three focus groups led by HB, UAL and ESTIA are summarising the point of views of industrial and academic knowledge around the skills in the Fashion-Tech industry. They are used as the starting point for guidelines and recommendations to inform WP2, in particular the design of 3 dedicated courses (WP2.1) updated with market demands for university students from partner HEIs.

5.2 Recommendation 1: INTERDISCIPLINARY COURSES AND TEAMS

"*So there is a technical journey that have to happen* (more understanding of the fashion domain, and focus on human centred design – Olga's clarification), *as well as the journey for traditional fashion participants on how to approach the tech, and that should be done together.. And that is why I am interested in this conversation, because if you don't understand the domain, than it is very difficult to see the opportunities and leverage the tech to build partnerships to build these new businesses we are talking about. There is a level of understanding of differences, whether you are a developer, fashion designer, CTO.. and all of these have to be coordinated together .. and especially because this is new, no one is really understanding what they are doing, so there is a way of figuring it out on the way as it goes.. so it is important that everyone on the list have the basic understanding of fashion, and also technology, and what they are trying to do.." (HB- WE LOVE YOU, June 2020)*

Fashion-Tech involves diverse, heterogeneous disciplines, which makes it extremely difficult for a single student or professional to be able to hold all the specific knowledge needed in each sector. Therefore, collaborative work in this context is fundamental: interdisciplinary experience are needed to enrich all team members by creating an exchange of knowledge, facilitates learning and management of different topics that require different specializations.

A interdisciplinary approach is essential to stimulate innovation. Therefore, companies are looking for people with soft skills, especially interpersonal and problem-solving skills. Next to the discipline skills, it is important that students have the ability to work in a team, know how to listen, understand and interact with people of different backgrounds from the start.

In the current Fashion-Tech practice, the use of a dialogue is shifting the perspective from a single and partial vision to a holistic, integrated and inclusive vision. A participatory approach creates the shared vision and integrated solutions needed.

In conclusion: interdisciplinary courses and teamwork experiences are essential both in the academic training as well as in the workplace environment to train transversal skills and generate innovation.

Hence, there is a need to train in-depth, highly specific and sectoral skilled professionals to learn to collaborate across disciplines with experts in other areas and to apply knowledge in areas of expertise other than their own (T-shaped skills).

Practical tips for WP2: courses must be oriented towards teamwork, sharing knowledge and skills between different sectors, disciplines and universities. Each workshop to include students from different universities with different expertise in the Fashion-Tech sector.

5.3 Recommendation 2: KNOWLEDGE AS COMMON GROUND: THEORETICAL PILLARS (PHASE 1)

I think it's really important to invest in young talent… and I think that's where we could really make a difference. Because young talent at the moment they learn things that we could never think about, and they also are very millennial, so they will speak their mind. And that's where ideas happen. And that's how we can potentially change our direction within PVH. So, I think that we shouldn't always bring in people that have the knowledge that we need, but we actually also grow the talent that we have internally as well. Need fresh young ideas… they should be an actual team within themselves, and we use them as an incubator". (PVH, June 2020)

The increasingly team-oriented approach to work requires a common language, a code of shared basic knowledge that allows the various actors to develop a fruitful dialogue. Design and management students require a basic technical knowledge to understand the dynamics of the technological disciplines. At the same time, engineering students need to have a basic understanding of design and business methods. More time for training and learning is needed.

Practical suggestions for WP2: Before the start of the educational unit, there is a need to provide an introduction. Via optional, modular, theoretical lessons, students from heterogeneous backgrounds and different HEIs are able to require a common vocabulary, basic knowledge to improve interaction in the further phases of project development in team.
Students need to complete an initial study plan indicating the basic knowledge on a scale (novice, intermediate, expert). These preparatory units then, will level the basic knowledge in order to make interdisciplinary collaboration work.
A digital literacy catalogue, to update regularly, will contain various in-depth courses on different topics that students can consult asynchronously. The theoretical units offer the basic literature in the sector as well as specific topics to be used in teamwork and project development.

5.4 Recommendation 3: LEARNING BY DOING: CHALLENGE BASED EXPERIENCE (PHASE TWO)

Based on the assumption that only Learning By Doing leads to a true learning and deeper understanding through action and doing. For a more in-depth, long-term retention of material, for developing 'replicable' skills, as well as for improving students' attitudes towards learning challenged based learning is essential. (Strobel and van Barneveld, 2009). The advantages of the learning by doing approach for Fashion-Tech education are:

- Increases the involvement of the participants, because they learn through engaging and dynamic experiences that reduce the distance to cryptic themes and the integration of technologies;
- Helps to bridge the training gap deriving from an exclusively theoretical approach and learning processes are more effective, fast and continuous;
- Helps to contextualize notions, principles and tools learned in real situations;
- Allows applying the learned skills immediately by testing what works - note that a technology must be functional to be used.

The output of the process is not a focus on a products and results, but on a proof of concept. The aim of the process is to involve students in problematizing, reframing and iterating their design-, engineering- or business management domains. (Cross, 2010; Nelson and Stolterman 2003).

This problem or challenge-based learning is standing practice in innovative Fashion-Tech companies. Therefore, the involvement of these companies and professionals in the sector is

fundamental in defining relevant project briefs in educations. A synergy between challenges of companies (such as use and experimentation of specific technologies, cost management, industrial production or sales, very tight deadlines) with the research-oriented challenges of universities are crucial and increasingly fundamental for the future.

Practical suggestions for WP2: A learning by doing project experiences will be implemented in the second stage of the course. Fashion-Tech companies will set up a brief for problem based learning challenges for the interdisciplinary student teams. Students will work in teams reviewed periodically in the work by a team of professionals including both company representatives and university professors.

5.5 Recommendation 4: Employing and adapting the E4FT Curriculum Model

Enabling navigation and selection of units is the most crucial recommendation from industry that needs to be added to the existing E4FT curriculum. A more bespoke approach to an individual Fashion-Tech learning experience and pathway for students with different knowledge and skillsets will ensure the ongoing validity of the curriculum model whilst meeting the requirements of industry.

According to the industry, the current 18 units, spanning across the areas of Design & Ideation, Technology & Engineering and Human, Social, Psychological and Economic Contexts are providing a comprehensive learning experience. However, the industry recommends adding specific knowledge and learnings in business, entrepreneurship, circular design/sustainability and market research and intelligence. These units can be interrelated and connected in different ways to create a flexible learning experience. A holistic approach maximises the potential of the unit content addressing the industry needs at the same time as subject-specificity and generic competences including collaboration, co-creation, creative thinking and team working.

However, there are gaps to address and additions/modifications to make and we will address these in the design of the WP2 courses. For example, ethics and data handling will be incorporated into WP2 course design for courses 2 and 3, some basic elements of commerce/e-commerce and law, UX design will benefit the 'Wearables' course, AR/VR experiences and digitisation can be offered in a business context. Furthermore, we will expand existing units to incorporate amongst others zero waste pattern making, product testing and digital avatar design included in the course design.

To establish an integrated Fashion-Tech curriculum model blending industry and academic knowledge demands, we will ask industry- and academia support to guide and/or coach. This could be adopted in the courses so that students might be empowered to experience a more personally tailored learning experience.

6. CONCLUSION T1.1

As detailed in this report, one of the key objectives of this research was to obtain feedback and qualitative data to assess, fine tune and validate the E4FT Fashion-Tech curriculum model. The consortium industry partners represented different aspects of the Fashion-Tech sector: large global corporation (PVH); disruptive business models (We Love You) and sustainability (Decathlon) ones. In addition, the research explored current and future job roles in the Fashion-

Tech sector, investigating subject-specific and generic skills needed for this roles as well as knowledge and competences aligned to these. The overall aim and intention of the study was to provide new insights to build an integrated Fashion-Tech curriculum model blending industry and academic knowledge. Finally, the last purpose of the research has been to generate recommendations for the design and delivery of courses developed by Polimi, UAL-LCF and Borås in WP 2.

In summary, the research findings yielded two distinct scenarios with regards to what constitutes the Fashion-Tech practitioner in a dynamic field that is truly interdisciplinary in nature. First, that they are multifaceted individuals who possess multiple skill sets and knowledge that span disciplines and are capable of working independently to develop tangible solutions to complex issues through single-handedly traversing borders. Secondly, that they are team workers equipped with the generic skills and a general awareness that enables them to work routinely in collaborative and interdisciplinary contexts and engage in activities that involve methods of co-creativity to develop solutions and solve complex issues. These two versions of the Fashion-Tech practitioner are not mutually exclusive however but rather represent two extremes on a scale from an individual possessing multiple subject specific capabilities to one who possesses all necessary generic competencies and insights to enable them to operate highly effectively in dynamic partnerships and team contexts. As this report reveals, both versions have been useful in helping evaluate and offer proposed additions and adaptations to the E4FT Fashion-Tech curriculum and to make recommendations for what learning opportunities should be offered in the three WP2 courses for learners who derive from diverse Fashion-Tech backgrounds and with varying skills, knowledge and competences.

In terms of the EF4T curriculum and its validation, whilst the model was appraised as supportive in the development of the Fashion-Tech practitioner – an individual who is well equipped in terms of both subject and generic specific, research findings from all three focus groups (as discussed above [section 5]), yielded deficits and proposed additions and areas for improvement. These insights constitute the recommendations to be considered in the design of the three WP2 courses and have already been adopted by POLIMI in the design of the first course ’Fashion-tech Interline’ which commenced in January 2021. Further insights such as the need for greater market intelligence, business awareness, addressing of sustainable issues and user interaction and testing in the design process will be incorporated into the design of the second and third courses focussing ’Textiles Business’ and ’Wearables’ respectively.

Finally, it is important to stress that since, as our investigations show, the field of Fashion-Tech is not a static one, but rather in a constant state of flux, further agitated by the ongoing Covid-19 pandemic, the curriculum and learning experience must follow suite. As such, a final recommendation of this report would be that we must seek to maintain an ongoing dialogue and process of knowledge exchange between industry and academia in the design of the Fashion-Tech curriculum and learning experience. This will enable relevance and currency to be maintained whilst ensuring the development of appropriately equipped graduates who possess the necessary practical, creative, intellectual and transferrable skills to enable them to thrive in this interdisciplinary field.

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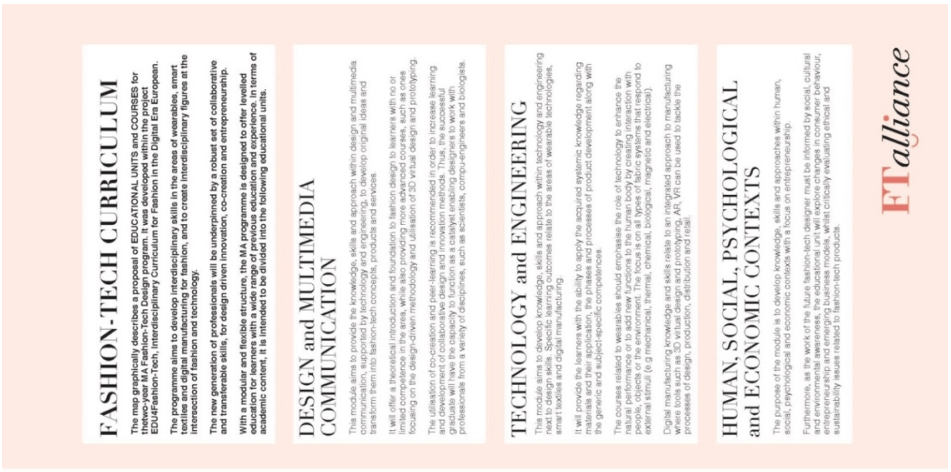
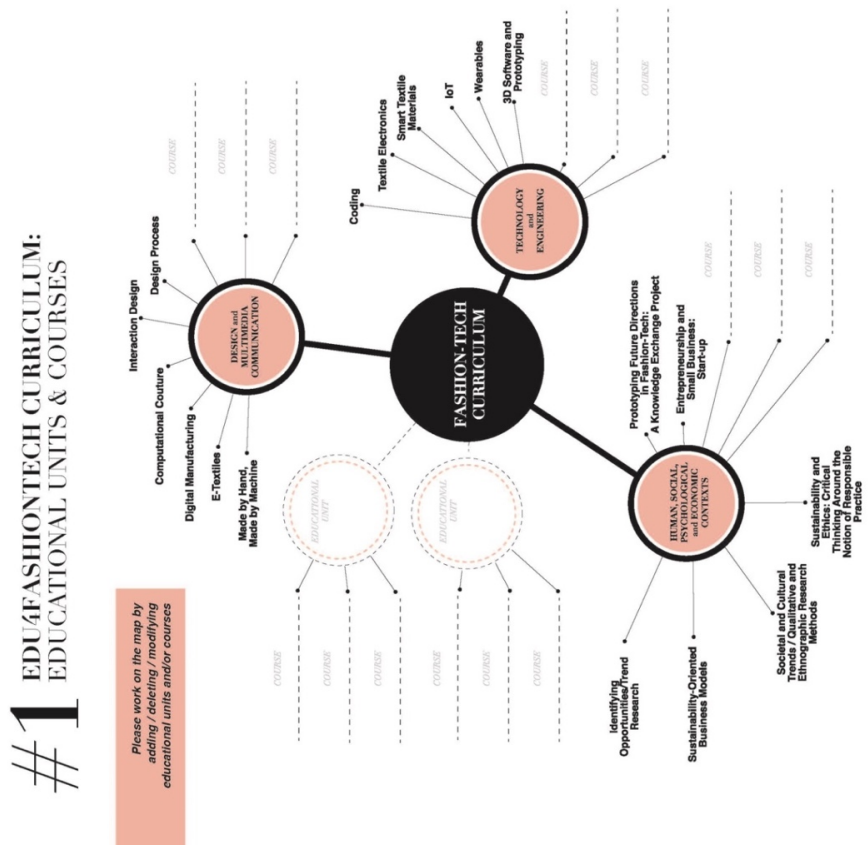
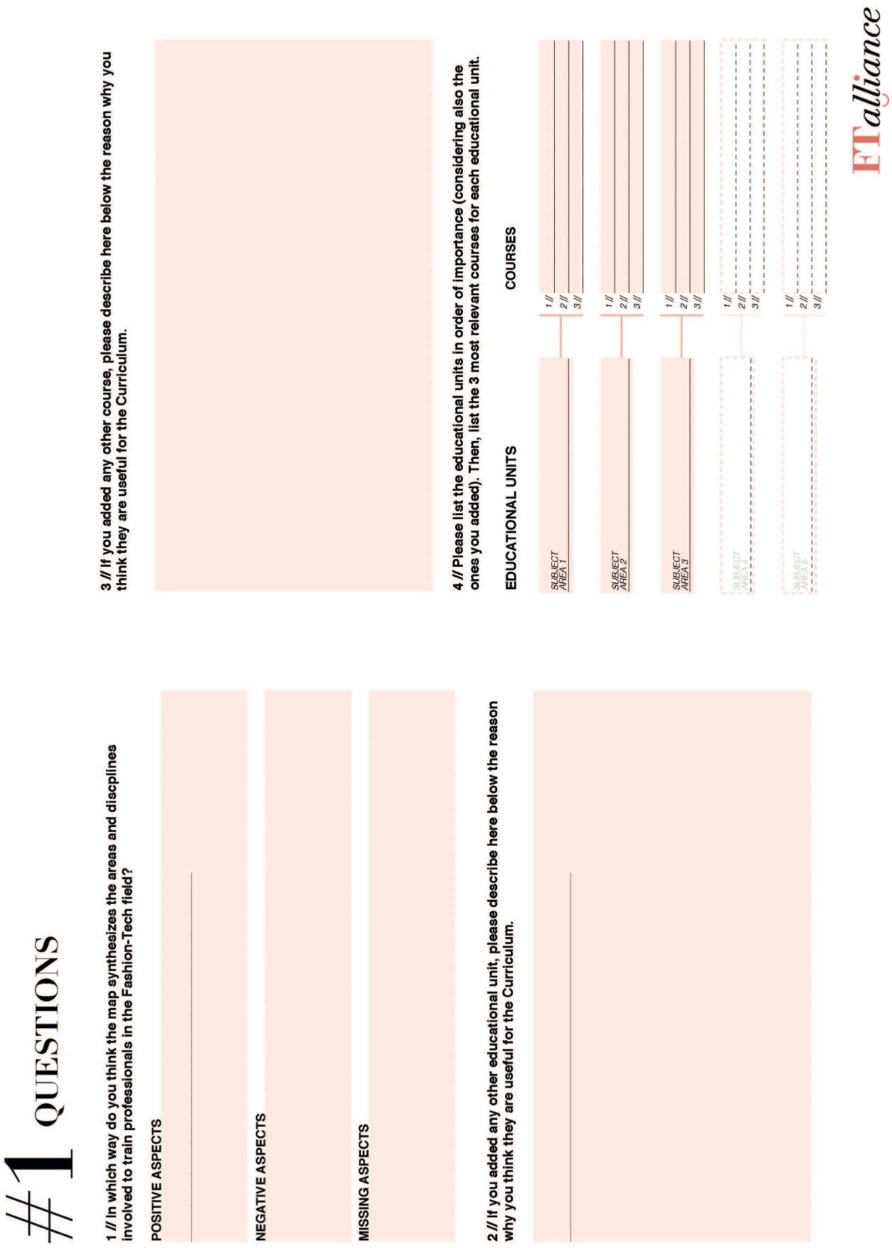
Annexes

Annex 1







#1 QUESTIONS

1 // In which way do you think the map synthesizes the areas and discplines involved to train professionals in the Fashion-Tech field?

POSITIVE ASPECTS

NEGATIVE ASPECTS

MISSING ASPECTS

2 // If you added any other educational unit, please describe here below the reason why you think they are useful for the Curriculum.

3 // If you added any other course, please describe here below the reason why you think they are useful for the Curriculum.

4 // Please list the educational units in order of importance (considering also the ones you added). Then, list the 3 most relevant courses for each educational unit.

EDUCATIONAL UNITS	COURSES
SUBJECT AREA 1	1 // 2 // 3 //
SUBJECT AREA 2	1 // 2 // 3 //
SUBJECT AREA 3	1 // 2 // 3 //
SUBJECT AREA 4	1 // 2 // 3 //
SUBJECT AREA 5	1 // 2 // 3 //

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Annex 2

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#2 EDU4FASHIONTECH CURRICULUM: AREAS, DISCIPLINES & COMPETENCES

Please, mark the competences that you think are the most needed (by placing a cross). Please consider to mark a maximum of 10 competences per Course.

	COMPETENCES	EDUCATIONAL UNITS & COURSES																	
		DESIGN AND MULTIMEDIA COMMUNICATION						TECHNOLOGY AND ENGINEERING						HUMAN, SOCIAL, PSYCHOLOGICAL AND ECONOMIC CONTEXTS					
		Design Process	Interaction Design	Computational Couture	Digital Manufacturing	E-Textiles	Made by Hand / Machine	3D software & prototyping	Coding	Textile Electronics	Smart textile materials	IoT	Wearables	Trend Research	ethnographic research methods	Sustainability & ethics	Sustainability-oriented business models	Entrepren. / Start-up	Prototyping Future Directions
GENERIC COMPETENCES	1 // Problem formulation and solving																		
	2 // Creativity and innovation																		
	3 // Planning and management																		
	4 // Communication skills																		
	5 // Communication of information																		
	6 // Teamwork																		
	7 // Independent work																		
	8 // Critical thinking																		
	9 // Research ability																		
	10 // Interpersonal abilities																		
	11 // Information literacy																		
SUBJECT-SPECIFIC COMPETENCES	1 // Capacity to acquire knowledge of fashion design in relation to natural science, engineering, economics and management with regard to professional and/or experimental work																		
	2 // Capacity to acquire knowledge of design methodology and design theory with respect to both experimental and professional work																		
	3 // Capacity to use methods of composition, form principles and design expression as the basis for human-centred design																		
	4 // Capacity to develop original ideas and apply them in a systematic way, transforming concepts into design solutions, to develop them into products/services																		
	5 // Capacity to function as a catalyst that enables designers to plan, manage and lead design led interdisciplinary research and development process																		
	6 // Capacity to acquire knowledge of textile and smart materials and their applications																		
	7 // Capacity to acquire knowledge of wearable technologies, smart textiles and digital manufacturing and their processes																		
	8 // Capacity to acquire knowledge of collaborative design and innovation methods to deliver more effective ways of developing user driven innovations, disruptive products and services																		
	9 // Ability to research and transfer innovation with particular reference to materials, meanings and processes in various fields																		
	10 // Ability to integrate capabilities in the engineering area and the design area to develop innovative products and applications																		
	11 // Capacity to evaluate diverse and disruptive forms of innovation that contribute value to a fashion enterprise																		
	12 // Capacity to creatively and critically envision future possibilities of emerging technologies and propose both new and well explored concepts for opportunities and/or solutions in socio-cultural and economic context																		
	13 // Capacity to transfer knowledge from disciplinary fields to new sectors and applications, favouring the creative solutions of problems																		
	14 // Capacity to acquire and develop knowledge and understanding of the social and economic context																		
	15 // Capacity to acquire knowledge of socio-cultural and technological trends and practices to evaluate market scenarios and opportunities																		
	16 // Capacity to acquire knowledge of new and emerging business models of the fashion industry																		
	17 // Ability to demonstrate entrepreneurial thinking that optimises opportunities, products and markets																		
	18 // Ability to develop communication and distribution strategies																		

#2 EDU4FASHIONTECH CURRICULUM: AREAS, DISCIPLINES & COMPETENCES

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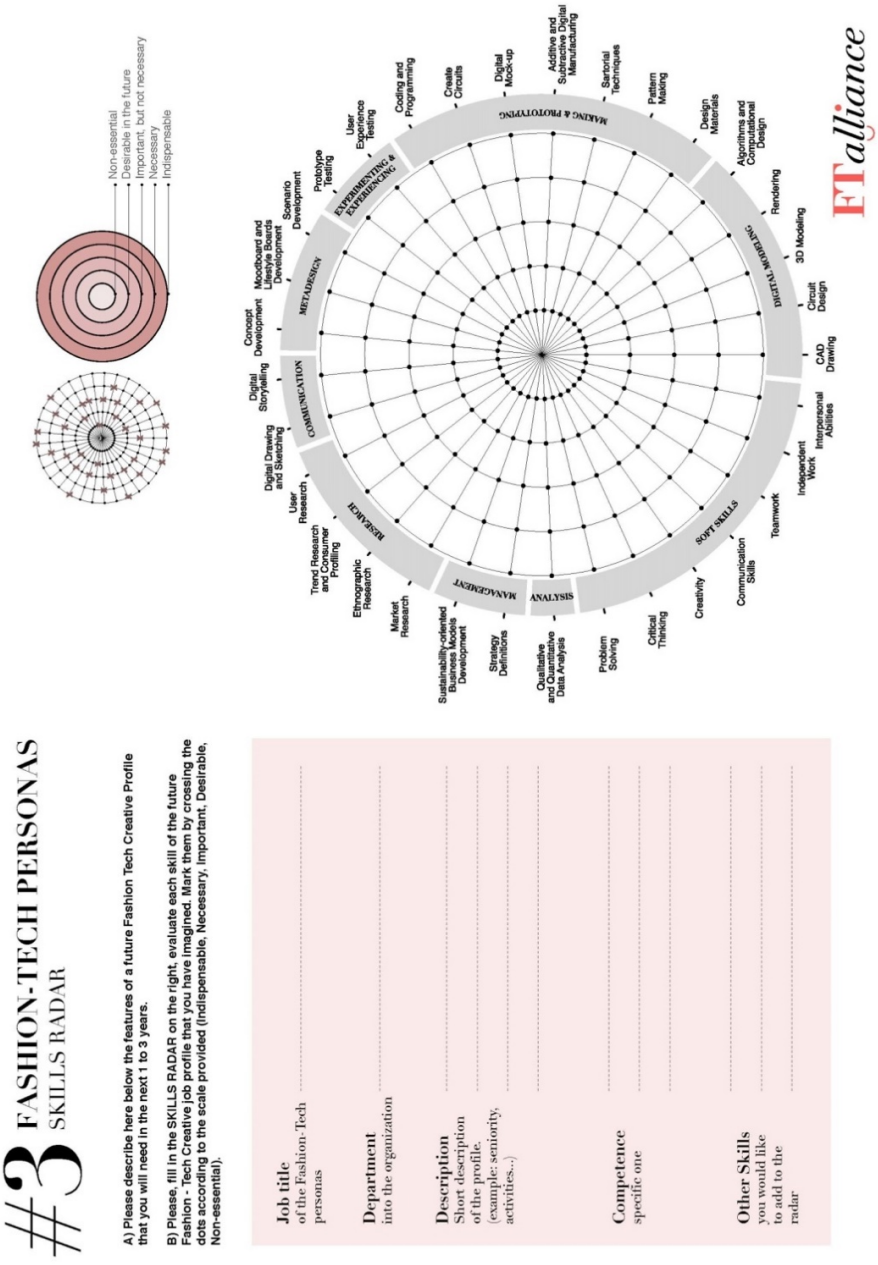
Please work on the grid by adding / deleting / modifying the competences that you think are required for the courses. Once agreed on the competences, please highlight the 3 ones that you think are the most important.

	COMPETENCES	EDUCATIONAL UNITS & COURSES: DESIGN AND MULTIMEDIA COMMUNICATION						TECHNOLOGY AND ENGINEERING						HUMAN, SOCIAL, PSYCHOLOGICAL AND ECONOMIC CONTEXTS					
		Design Process	Interaction Design	Computational Couture	Digital Manufacturing	E-Textiles	Made by Hand / Machine	3D software & prototyping	Coding	Textile Electronics	Smart textile materials	IoT	Wearables	Trend Funnel	ethnographic research methods	Sustainability & ethics	Sustainability-oriented business models	Entrepren. / Start-up	Prototyping Future Directions
GENERIC COMPETENCES	1 // Problem formulation and solving	●	●	●	●	●	●	●	●	●	●	●		●	●		●		●
GENERIC COMPETENCES	2 // Creativity and innovation	●	●	●	●	●	●		●	●	●		●		●				●
GENERIC COMPETENCES	3 // Planning and management				●						●		●					●	
GENERIC COMPETENCES	4 // Communication skills		●				●		●	●	●	●	●		●		●	●	●
GENERIC COMPETENCES	5 // Communication of information	●	●		●				●	●	●	●	●	●	●	●	●	●	
GENERIC COMPETENCES	6 // Teamwork	●	●			●			●	●	●		●	●	●		●	●	●
GENERIC COMPETENCES	7 // Independent work			●			●	●		●		●	●		●	●			
GENERIC COMPETENCES	8 // Critical thinking	●	●			●			●	●	●	●	●	●	●	●	●	●	●
GENERIC COMPETENCES	9 // Research ability	●	●				●			●		●		●	●	●	●		
GENERIC COMPETENCES	10 // Interpersonal abilities			●						●	●		●						
GENERIC COMPETENCES	11 // Information literacy							●	●	●	●	●	●	●		●	●	●	
SUBJECT-SPECIFIC COMPETENCES	1 // Capacity to acquire knowledge of fashion design in relation to natural science, engineering, economics and management with regard to professional and/or experimental work		●			●	●												
SUBJECT-SPECIFIC COMPETENCES	2 // Capacity to acquire knowledge of design methodology and design theory with respect to both experimental and professional work	●	●	●			●												
SUBJECT-SPECIFIC COMPETENCES	3 // Capacity to use methods of composition, form principles and design expression as the basis for human-centred design	●		●		●													
SUBJECT-SPECIFIC COMPETENCES	4 // Capacity to develop original ideas and apply them in a systematic way, transforming concepts into design solutions, to develop them into products/services	●	●	●		●	●												
SUBJECT-SPECIFIC COMPETENCES	5 // Capacity to function as a catalyst that enables designers to plan, manage and lead design led interdisciplinary research and development process																		
SUBJECT-SPECIFIC COMPETENCES	6 // Capacity to acquire knowledge of textile and smart materials and their applications								●	●	●		●						
SUBJECT-SPECIFIC COMPETENCES	7 // Capacity to acquire knowledge of wearable technologies, smart textiles and digital manufacturing and their processes							●	●	●	●		●						
SUBJECT-SPECIFIC COMPETENCES	8 // Capacity to acquire knowledge of collaborative design and innovation methods to deliver more effective ways of developing user driven innovations, disruptive products and services										●		●						
SUBJECT-SPECIFIC COMPETENCES	9 // Ability to research and transfer innovation with particular reference to materials, meanings and processes in various fields								●			●	●						
SUBJECT-SPECIFIC COMPETENCES	10 // Ability to integrate capabilities in the engineering area and the design area to develop innovative products and applications								●		●	●	●						
SUBJECT-SPECIFIC COMPETENCES	11 // Capacity to evaluate diverse and disruptive forms of innovation that contribute value to a fashion enterprise											●							
SUBJECT-SPECIFIC COMPETENCES	12 // Capacity to creatively and critically envision future possibilities of emerging technologies and propose both new and well explored concepts for opportunities and/or solutions in socio-cultural and economic context							●				●	●						
SUBJECT-SPECIFIC COMPETENCES	13 // Capacity to transfer knowledge from disciplinary fields to new sectors and applications, favouring the creative solutions of problems								●	●	●	●							
SUBJECT-SPECIFIC COMPETENCES	14 // Capacity to acquire and develop knowledge and understanding of the social and economic context														●	●		●	
SUBJECT-SPECIFIC COMPETENCES	15 // Capacity to acquire knowledge of socio-cultural and technological trends and practices to evaluate market scenarios and opportunities													●	●				●
SUBJECT-SPECIFIC COMPETENCES	16 // Capacity to acquire knowledge of new and emerging business models of the fashion industry															●	●	●	
SUBJECT-SPECIFIC COMPETENCES	17 // Ability to demonstrate entrepreneurial thinking that optimises opportunities, products and markets																●	●	●
SUBJECT-SPECIFIC COMPETENCES	18 // Ability to develop communication and distribution strategies																	●	

Annex 3


#3 FASHION-TECH PERSONAS
SKILLS RADAR
A) Please describe here below the features of a future Fashion Tech Creative Profile that you will need in the next 1 to 3 years.
B) Please, fill in the SKILLS RADAR on the right, evaluate each skill of the future Fashion - Tech Creative job profile that you have imagined. Mark them by crossing the dots according to the scale provided (Indispensable, Necessary, Important, Desirable, Non-essential).
Job title of the Fashion-Tech personas
Department into the organization
Description Short description of the profile. (example: seniority, activities...)
Competence specific one
Other Skills you would like to add to the radar
Non-essential
Desirable in the future
Important, but not necessary
Necessary
Indispensable
MAKING & PROTOTYPING
DIGITAL WORKFLOW
SOFT SKILLS
ANALYSIS
MANAGEMENT
RESEARCH
COMMUNICATION
METADESIGN
EXPERIMENTING & EXPERIENCING
Additive and Subtractive Digital Manufacturing
Sartorial Techniques
Pattern Making
Design Materials
Algorithms and Computational Design
Rendering
3D Modeling
Circuit Design
CAD Drawing
Interpersonal Abilities
Independent Work
Teamwork
Communication Skills
Creativity
Critical Thinking
Problem Solving
Qualitative and Quantitative Data Analysis
Strategy Definitions
Sustainability-oriented Business Models Development
Market Research
Ethnographic Research
Trend Research and Consumer Profiling
User Research
Digital Drawing and Sketching
Digital Storytelling
Concept Development
Moodboard and Lifestyle Boards Development
Scenario Development
Prototype Testing
User Experience Testing
Coding and Programming
Create Circuits
Digital Mock-up
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#3 FASHION-TECH PERSONAS

SKILLS RADAR

SOFT SKILLS

Soft skills enable people to navigate their environment, work well with others, perform well, and achieve their goals with complementing subject-specific skills.

Problem solving: capacity to identify, formulate and solve questions and problems by applying knowledge in research and practical situations, and/or in a new context.
Critical thinking: ability to think critically in contexts of creativity, innovation, problem-solving, communication and collaboration (21-st century skills).
Creativity: capacity to be creative in developing ideas and in pursuing research goals.
Communication skills: ability to communicate effectively by being sensitive to the needs of diverse audiences.
Teamwork: capacity for collaboration in interdisciplinary teams and for assuming responsibility for tasks.
Independent Work: ability to work autonomously conducting original interdisciplinary research and development work in parallel to communicating concepts and critical values.
Interpersonal abilities: capacity to express, reflect and demonstrate one´s awareness, determination, promotion and self-critical abilities for lifelong learning.

DESIGN and MULTIMEDIA COMMUNICATION
TECHNOLOGY and ENGINEERING
HUMAN, SOCIAL, PSYCHOLOGICAL and ECONOMIC CONTEXTS

SUBJECT-SPECIFIC SKILLS

DIGITAL MODELING

Digital modeling is a design process that computing-aided design (CAD) or geometric three-dimensional modeling for solids and surfaces and digital representation of objects, with particular attention to aesthetics and the rules of realistic photo representation of fashion garments and accessories. In detail, the skills covered are related to the following: references to hardware systems for 3D graphics applications, three-dimensional graphic transformations, curves and three-dimensional surfaces; use of solid modelers and surface modelers; rendering softwares; circuit design and computational design.

- **CAD Drawing**
- **Circuit Design**
- **3D Modeling**
- **Rendering**
- **Algorithms and Computational Design**

MAKING & PROTOTYPING

This section is about being able to physically craft design ideas and make conscious decisions about material selection and the fabrication processes employed, from the more traditional ones to the more innovative ones.

- **Design Materials**
- **Pattern Making**
- **Sartorial Techniques**
- **Additive and Subtractive Digital Manufacturing**
- **Digital Mock-up**
- **Create Circuits**
- **Coding and Programming**

EXPERIMENTING & EXPERIENCING

It deals with discovering new possibility starting from the actual context is the ability to experiment, being able to explore new tools and new way to approach an issue.

- **User Experience Testing**
- **Prototype Testing**

METADESIGN

It refers to the design methodology that leads to the concept definition of a Fashion-Tech product or service, through a research process that synthesizes design goals, technological and productive constraints.

- **Scenario Development**
- **Moodboard and Lifestyle Boards Development**
- **Concept Development**

COMMUNICATION

In the digital context the skills linked to the communication regard the ability to tell a story using the most appropriate medium to drive a specific message.

- **Digital Storytelling**
- **Digital Drawing and Sketching**

RESEARCH

It is the capability to research and understand the market context, consumption trends for a consumers' group of reference, the users' needs and the interaction between people and the technology.

- **User Research**
- **Trend Research and Consumer Profiling**
- **Ethnographic Research**
- **Market Research**

MANAGEMENT

The business acumen relies on understanding innovation strategies and new way of organizing company. The area includes those skills which define or support the plan of the company in term of core business and decisions.

- **Sustainability-oriented business Models Development**
- **Strategy definitions**

ANALYSIS

It refers to the capability of being able to test a product/service through qualitative and quantitative data analysis.

- **Qualitative and quantitative data analysis**

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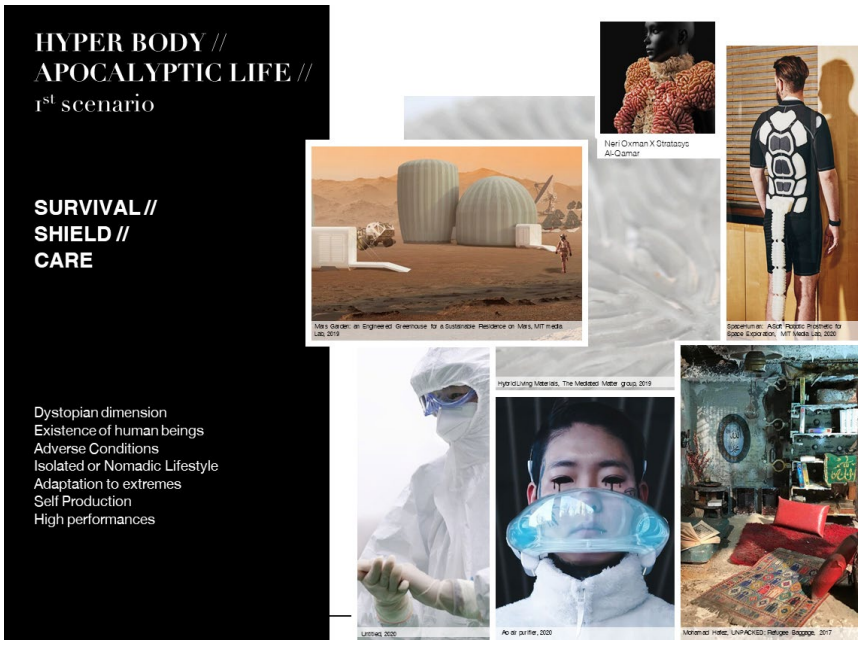
Annex 4

APOCALYPTIC LIFE 1st scenario



What if the world will be not human friendly anymore? In this dystopic scenario, pollution, viruses, nuclear wars, exodus to new unexplored spaces will question the existence of human beings. Surviving in polluted environments, the dynamism of an isolated or nomadic lifestyle, needs adaption to extreme climates, the space exploration: we can tackle this dystopic future thanks to a new generation of high-performance functional clothing or wearables. These items may be devoted to a wide range of hyperfunctional uses, from shielding to filtering, from curing to nourishing the body, from ensuring protection, to monitoring and preserving the existence of humankind.

In this scenario the questions are:

- What if customers are extremely healthy?
- What if customers are extremely unhealthy?
- What if customers will leave in a hostile environment? What if our living context will be hostile and mine human survival?
- What if customers need to adapt their existence to a synthetic/new nature or to a synthetic way of living?
- What if customers could not move or do sport or due to isolation and social distancing?
- What if customers could not move due to social distancing?
- What if your customers could not do sport due to social distancing and isolated living conditions?

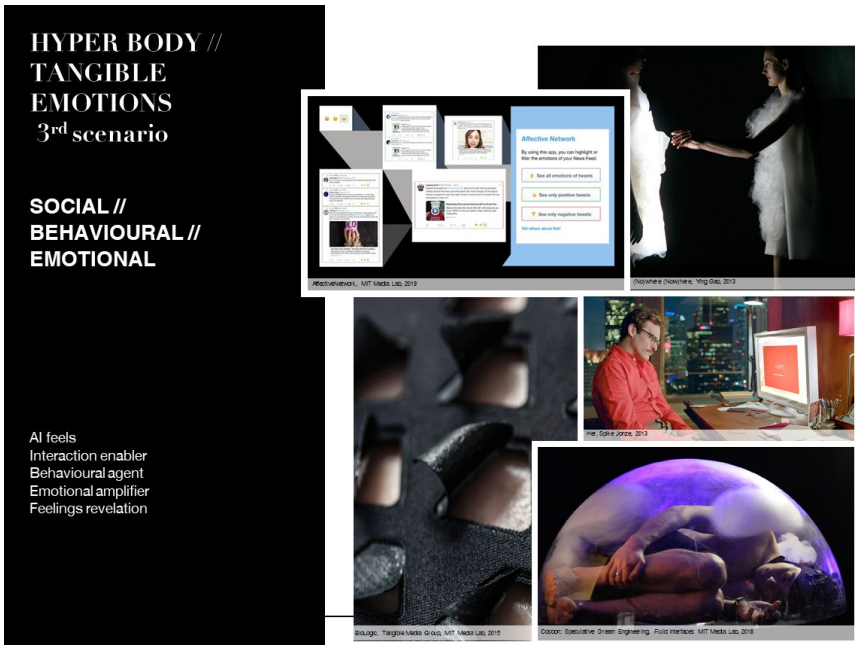
ORNAMENTAL NEEDS 2nd scenario

What if, humans become superheroes? This is a scenario were extra human power is enabling users with new performance, new expressiveness and new experiences. Garments and accessories will become functional as well as ornamental prostheses capable not only of overcoming physical impairment, but also of enhancing body performances. In this dimension, the body modification challenges a new definition of beauty. The supernatural empowerment encounters also the hyper personalization. With constantly evolving digital services and smart physical spaces, people would expect more than only human centred products but also services and experiences based on bio data and genetic analysis that constantly adapt around their changing needs.

In this scenario questions are:

- What if every product & service was custom made?
- What if customers could customize every single detail of your product?
- What if customer's could use DNA to customize product or service?
- What if products could serve the user modification needed during their all life, adapting and updating during their lifetime span?
- What if customers could have instant access to real-time health information provided by your products/services and so on?

TANGIBLE EMOTIONS 3rd scenario



What if the human and the digital world could interact at the same level? What if human beings could build a strong relationship with technological products and consider them as equals? What if the artificial intelligence would be humanized? In this scenario the body equipment is not only a medium enabling different types of interactions, but it also behaves in an autonomous way, amplifying the emotions, touching the intimate dimension of the wearer. Fashion products feels and reveals the feelings. In this regards, we can also consider the experience of buying products and services that is becoming more and more digital and mediated by machines that can interact like humans, that can drive behaviours, and they would in the future interpret emotions and know deeply the customers.

In this scenario the questions are:

- What if customer behaviour is to predict?
- What if customers could interact with their objects?
- What if artificial intelligence could deal with new customers an fully guide their experience?

PHYSICAL AVATAR 4th scenario

What if reality and on-line presence are merging? This scenario describes the hybridization of digital and physical life, where is normal to transit dynamically from one world to the other. These new dimensions define the emergence of digital avatars, for which creativity and freedom of self-expression have no boundaries. Some products lose their physical essence to become virtual, enabled by virtual experiences. Body equipment becomes a channel through which to communicate and generate different identities. Physical and digital mediators enable imagining and deceiving, revealing and concealing. Filters overlap reality and create multiple layers altering the sensory perception. Challenging aspects of this digital-physical and social media landscape are misinformation and privacy, along the data treatment, possess through archival and storing.

In this scenario questions are:

- What if everyone had a digital log-book with data starting from birth?
- What if customers were charged with a fee for delivering a bad customer experience?
- What if customers received bad feedback when they do not care about health and sport?
- What if customers could pay public services with an exercise?

Annex 5

Questions for Episode 1

Dear experts, please fill in this questionnaire on the current state of revenue streams in your organization. It will inform discussion on the current use of digital technologies to enhance profitability of fashion industry and business opportunities offered by engaging with Fashion-Tech business models. There are 14 questions in total, which are mostly multiple-choice type of questions, so it should not take longer than 15-20 minutes. Thank you very much for your time!

1. What does Fashion Tech mean for you? (Open/text question)

2. What are your current revenue streams? (All choices can be selected)

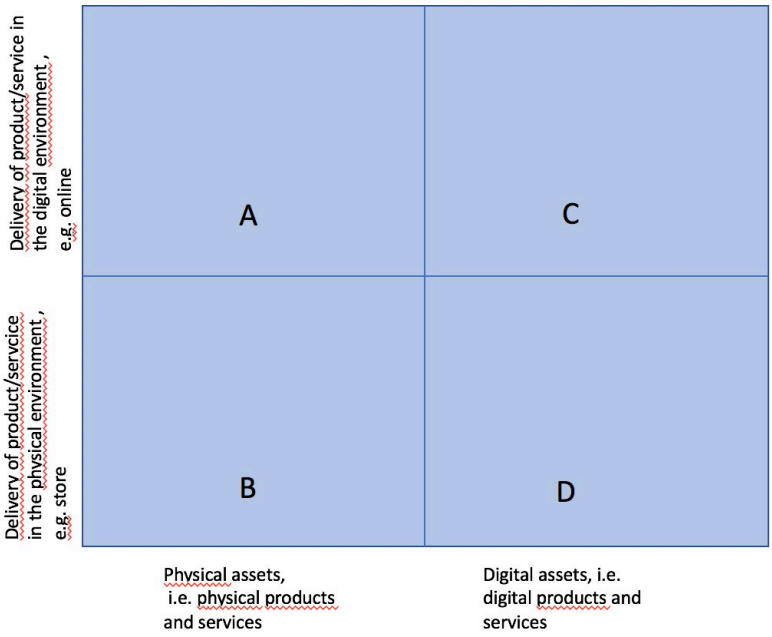


Figure 1. (Figure 1 is essential, since it is referred to in many questions, namely questions 1, 3, 5, 7 and 8, so it would be really good to visualize it for participants).

A. Revenue streams are generated from physical assets including selling, renting, servicing physical products. Product/service delivery takes place in the digital environment/through virtual distribution channels, e.g. online

B. Revenue streams are generated from physical assets including selling, renting, servicing physical products. Product/service delivery takes place in the physical environment/through physical distribution channels, e.g. stationary store

C. Revenue streams generated from digital assets, such as provision of digital products and services. Product/service delivery takes place in the digital environment/through virtual distribution channels, e.g. online

D. Revenue streams generated from digital assets, such as provision of digital products and services. Product/service delivery takes place in the physical environment/through physical

distribution channels, e.g. stationary store

3. What revenue stream generates major part of profits (A,B, C or D, see **Figure 1**)? (One choice only can be selected)

   o A
   o B
   o C
   o D

4. Please specify primary ways (max three) of generating this major revenue stream. (Up to three choices can be selected)

   o Asset sale
   o Usage fee
   o Subscription fee
   o Freemiums
   o Renting/leasing
   o Licensing
   o Brokerage fee
   o Advertising
   o Other (in case this option is selected, please specify, if possible)

5. What revenue stream generates minor part of profit? (A,B, C or D, see **Figure 1**)? (One choice only can be selected)

   o A
   o B
   o C
   o D

6. Please specify primary ways (max three) of generating this minor revenue stream. (Up to three choices can be selected)

   o Asset sale
   o Usage fee
   o Subscription fee
   o Freemiums
   o Renting/leasing
   o Licensing
   o Brokerage fee
   o Advertising
   o Other (in case this option is selected, please specify)

7. Which revenue streams (see **Figure 1**) appear to be most negatively affected (i.e. changing rapidly and unpredictably for the worse) in the times of high risk and uncertainty, such as COVID-19? (Up to two choices can be selected)

   o A
   o B
   o C

- o D

8. Which revenue streams (see **Figure 1**) appear to be rather intact (i.e. least negatively affected) or even possibly improved in the times of high risk and uncertainty, such as COVID-19? (Up to two choices can be selected)

   - o A
   - o B
   - o C
   - o D

9. How current revenue streams are improved/enhanced by digitalization? (All choices can be selected)

   - o Digitalization enhances efficient operations/productivity
   - o Digitalization allows improving customer value propositions, delivering better customer experience and engagement
   - o Digitalization enables platform business that requires less capital investments and physical assets
   - o Digitalization allows launching new types of digital products and services in new markets/adjacent industries
   - o Other (in case this option is selected, please specify, if possible)

10. If possible, please elaborate what are the main digital initiatives (**top 3**) you have launched/planning to launch in the near future to improve/enable revenue streams? (Up to three choices can be selected)

    - o Digital design tools
    - o Digital product development
    - o Simulations and digital twins
    - o Real-time performance tracking and management
    - o Factory and process automation
    - o Digital ID technology to trace the supply chain
    - o Digital data-driven marketing
    - o Digital ID labels to educate consumers about relevant product information
    - o Digital products and services to supplement/enhance existing product mix
    - o Other (in case this option is selected, please specify, if possible)

11. If possible, please elaborate what are the key digital technologies (**top 3**) that you have deployed/planning to deploy in the near future to improve/enable revenue streams? (Up to three choices can be selected)

    - o Internet of Things (IOT)
    - o Augmented Reality
    - o Virtual Reality
    - o Cloud Computing
    - o Big Data Analytics
    - o Machine Learning
    - o Autonomous Robots
    - o Additive Manufacturing/3-D Printing
    - o 3-D Simulations

- o Smart sensors
- o Blockchain
- o Others (in case this option is selected, please specify, if possible)

12. Do you have KPIs to measure effects of digital transformation on your revenue streams (e.g. how 'going digital' affects revenues, profit margins, market shares, operational efficiencies etc.)? (One choice only can be selected)

- o Yes
- o No

13. For how long do you think you can you maintain your business operations if your clothing collection fails/is not sold at all during one of the seasons? (I tried to formulate this question based on Kim's suggestions. Please feel free to edit/change). (One choice only can be selected)

A. Immediate business termination within few weeks
B. 1-2 months before the successful release of clothing collection
C. 3-6 months before the successful release of clothing collection
D. 6-12 months before the successful release of clothing collection
E. Other (in case this option is selected, please specify, if possible)

14. If your business operations are terminated for few months due to crisis situation, such as COVID-19 , how high are the chances that you can re-open to continue business-as-usual? (One choice only can be selected)

A. High chances to re-open to continue business-as-usual
B. Low chances to re-open to continue business-as-usual
C. Other (in case this option is selected, please specify, if possible)

Questions for Episode 3

The idea of F-Tech business model for new ecosystem/platform enabled revenues has been identified as preferred for the industry. It allows creation of new and diversified revenue streams, combining complementary business models within and between organizations across different industries (e.g. fashion, tech, gaming, movie, telcos). These business models are characterized by servicification and customization/personalization enabled by smart B2B and B2C data, virtualization of products (e.g. digital clothing) and customers experience (e.g. digital fashion shows), improved sustainability and circularity performance where user and usage data can be accessed to inform better product/service concept, design and more efficient supply chain operations.

1) Please select from the following list which skills in your opinion are required for realising this business model idea (multiple choice option, and ranking of the selected option on the scale 1/non-essential to 5/indispensable)

- Digital Modelling to create digital twins of products, processes and assets for supporting operational excellence and enabling virtual customer experience (e.g. digital fashion shows, virtual clothing).

(rank on the scale 1/non-essential to 5/indispensable)

- Digital making and prototyping skills, e.g. 3D printing/Additive Manufacturing, 3 D product development, creation and use of virtual material libraries to support designers decision-making

(rank on the scale 1/non-essential to 5/indispensable)

- Data collection and management, e.g. collecting and identifying 'right' data (turning big data into smart data), getting access to relevant user and usage data while ensuring data privacy

(rank on the scale 1/non-essential to 5/indispensable)

- Skills associated with use of computational tools to analyse data (e.g. Machine Learning, creating models and algorithms for data analysis)

(rank on the scale 1/non-essential to 5/indispensable)

- Data interpretation skills to identify solutions for optimising production, product/service concept, design, consumption and end-of-life management, with focus on improving sustainability and circularity performance

(rank on the scale 1/non-essential to 5/indispensable)

- User Experience skills associated with ensuring on-demand/on-time/one click smooth experience, virtual reality and interactive experience, where customers can be engaged in co-creation/co-design of products and service contents

(rank on the scale 1/non-essential to 5/indispensable)

- Creativity and research skills to identify customers/user needs and value propositions that can be addressed/enabled by Fashion-Tech

(rank on the scale 1/non-essential to 5/indispensable)

- Leadership and management skill to pivot and re-structure existing Business (e.g. implementing data-driven innovation, integrating model predictions into the business, renew organizational structure and competences if required)

(rank on the scale 1/non-essential to 5/indispensable)

- Skills of digital strategy development, aligning digital transformation with value capture opportunities

(rank on the scale 1/non-essential to 5/indispensable)

- Soft skills (e.g. creativity, critical thinking, communication, teamwork, interpersonal abilities)

(rank on the scale 1/non-essential to 5/indispensable)

- Collaboration skills (ability to collaborate across organizational and industry borders to e.g. collect smart data, create new value propositions and better customer experience)

(rank on the scale 1/non-essential to 5/indispensable)

- Research and development skills (to identify new relevant and cost-efficient technologies and innovations, e.g. fiber innovation, with specific focus on sustainability and circularity-related innovations)

(rank on the scale 1/non-essential to 5/indispensable)

- Digital communication and marketing skills, including digital storytelling, digital drawing and sketching

(rank on the scale 1/non-essential to 5/indispensable)

- Skills associated with tracing and tracking products and materials, including its transformations, movements and sustainability performance along the supply chain, including use and post-use/end-of-life management phases

(rank on the scale 1/non-essential to 5/indispensable)

2) Which of these skills are missing or yet insufficiently developed/established?

- Digital Modelling to create digital twins of products, processes and assets for supporting operational excellence and enabling virtual customer experience

(e.g. digital fashion shows, virtual clothing)

- Digital making and prototyping skills, e.g. 3D printing/Additive Manufacturing, 3 D product development, creation and use of virtual material libraries to support designers decision-making
- Data collection and management, e.g. collecting and identifying 'right' data (turning big data into smart data), getting access to relevant user and usage data while ensuring data privacy
- Skills associated with use of computational tools to analyse data (e.g. Machine Learning, creating models and algorithms for data analysis)
- Data interpretation skills to identify solutions for optimising production, product/service concept, design, consumption and end-of-life management, with focus on optimising sustainability and circularity performance
- User Experience skills associated with ensuring on-demand/on-time/one click smooth experience, virtual reality and interactive experience, where customers can be engaged in co-creation/co-design of products and service contents
- Creativity and research skills to identify customers' needs/value propositions that can be addressed/enabled by Fashion-Tech
- Leadership and management skill to pivot and re-structure existing Business (e.g. implementing data-driven innovation, integrating model predictions into the business, renew organizational structure and competences if required)
- Skills of digital strategy development, aligning digital transformation with value capture opportunities
- Soft skills (creativity, critical thinking, communication, teamwork, interpersonal abilities)
- Collaboration skills (ability to collaborate across organizational and industry borders to e.g. collect smart data, create new value propositions and better customer experience)
- Research and development skills (to identify new relevant and cost-efficient technologies and innovations, e.g. fiber innovation, with specific focus on sustainability and circularity-related innovations)
- Digital communication and marketing skills, including digital storytelling, digital drawing and sketching
- Skills associated with tracing and tracking products and materials, including its transformations, movements and sustainability performance along the supply chain, including use and post-use/end-of-life management phases.

3) Are there other skills that are highly relevant for realising this business model, but missing or not yet sufficiently developed/established? (free text)

4) Can you specify professional roles within which required skills are/can be located? (multiple choice and free writing, in case last option is selected)

- o Digital Knowledge Manager
- o Digital Product Manager
- o Software Developer
- o Analytics Specialist
- o Data Science
- o Digital Strategist
- o Social Media Manager
- o User Experience Experts
- o User Researcher
- o Interactive Developer
- o Digital Content Creator
- o Chief Digital Officer
- o Other (please specify)

5) Which important roles are not yet established or sufficiently represented? (multiple choice and free writing, in case last option is selected)

- o Digital Knowledge Manager
- o Digital Product Manager
- o Software Developer
- o Analytics Specialist
- o Data Science
- o Digital Strategist
- o Social Media Manager
- o User Experience Experts
- o User Researcher
- o Interactive Developer
- o Digital Content Creator
- o Chief Digital Officer
- o Other (please specify)