education for FASHION-TECH

design and technology for future fashion creatives

Chiara Colombi, Livia Tenuta (eds)

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Digital has disrupted many industries. New values, new vision, new business models… and new actors! E4FT provides today's fashion leaders a unique opportunity to be in the driving seat for the next decades. The outcome of this European initiative express the challenge well beyond technologies: we tend to forget that innovation is not only about technology, but also about adoption. It includes social, cultural, emotional dimensions. Although these dimensions are obvious for the creation of a new product, they are usually forgotten when we start to speak about innovation. This essay express the strong connections between research, education, industry. Disruptive innovation requires new thinking, new tools, new skills, new profiles. It must be sustainable to provide return on investment. It means to create solutions, but also to educate and understand the impact, to make it last. E4FT is ambitious and pragmatic, inspiring and reliable. It's the new corner stone of an exciting and productive relation between the worlds of research and industry.

Nicolas Henchoz
EPFL+ECAL LAB

This roadmap is a great resource for those involved in fashion education and more broadly for companies, policymakers and individual designers in the clothing and textile industry. It clearly highlights the environmental, social and societal urgencies and how they are intertwined and expressed within fashion. It reflects on the opportunities that technology has to offer, while also holding a critical stance towards the role and effects of the merge of fashion and technology. It provides new ways of looking at the human body and emotional needs within a rapidly changing environment that challenges design students to reevaluate the fashion system as well as individual relationships with clothing. By giving both theoretical grounding and practical guidance, it can accelerate the convergence of disciplines that is necessary in order to bring new perspectives into the fashion system and promote conscious innovation. The proposed shift in education generates a new awareness and perspective for action for a new generation of students.

Pauline van Dongen
Wearable Technology Designer

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EXECUTIVE SUMMARY

The present volume is a comprehensive reflection on the research conducted within the framework of the Erasmus+ Strategic Partnership Project “Education for Fashion-Tech (E4FT)” and offers trainers, practitioners, students, Higher Education Institutions (HEIs), stakeholders, opinion leaders and policymakers research data and reference points for developing an integrated Fashion-Tech approach into curricula, didactic and learning approaches, product development processes, and programmes for social and economic growth. The volume highlights the benefits of the adoption of such an integrated approach into higher education and the labour market, thanks to the development of better-qualified professionals. Additionally, it envisions an enriched cross-disciplinary European higher education system and a more competitive transnational labour market, where fashion and technology ware fused boosting knowledge and economic growth. Based on the data and results produced along with the E4FT project, the present volume defines the framework for the adoption of an integrated Fashion-Tech approach, identifying desirable steps of change and how these can support HEI practices. Based on research findings of the Benchmarking Report, on the evaluations of Training and Learning Pilot activities, and project outcomes, the essay:

- identifies key areas that need to be addressed on the European policy level to support actions of development both at an educational level and market labour level in order to support the positive growth of European societies and market;
- reports on trainers’ and learners’ experiences and acquired knowledge and expertise;
- inspires HEIs across Europe to embrace the Fashion-Tech curriculum pedagogical method, include Fashion-Tech topics and approaches in their curricula, and to tap into innovative learning tools towards skills for employment in complex transnational and fast-changing Smart textiles, Wearable technologies and Digital manufacturing sectors;
- offers examples of didactic configurations of contents modules and simulations of applications and results in relation to the different level of skills and competencies of trainers and learners, and different industrial and business contexts and opportunities;
- encourage further experimentations and transnational partnerships for the exchange of good practices and the development of synergies and to nurture public debate.

FASHION-TECH; APPLIED RESEARCH; DESIGN DIDACTIC MODEL; TRAINERS; LEARNERS

01.

FASHION TECH TODAY

Livia Tenuta, Susanna Testa

01. FASHION-TECH TODAY

L. Tenuta, S. Testa

In February 2018, the Benchmarking Report - a foundational intellectual output of E4FT project - described the state-of-the-art of Higher Education programmes and other high-qualitative didactic experiences, Research Centres and Companies. The report analysed the intersection between fashion and digital technologies in different steps of the fashion processes: measuring, designing, producing and testing, embedding, communicating and retailing. Through desk research, complemented by face-to-face and long-distance interviews to HEIs, research centres, and companies, data has been collected, compared, and mapped following a qualitative analysis. Specifically, it was described the Companies' approach towards innovation starts (up) from scratch; Research Centres technicality's fail's to formulate scenarios and Universities' generic approach to innovation neglects to hit the market. This analysis underlines Fashion-Tech as a fragmented, disjointed reality that involves and activates various and heterogeneous professionals, disciplines, competencies, methodologies, trends, products, and applications. For this reason, it has highlighted the need to better understand the meaning of the three main areas of Fashion-Tech--Smart textiles, Wearables, Digital manufacturing-- and to create a shared and more comprehensive definition.

Wearables are on body products such as clothing, footwear, accessories and jewellery designed to create communication and interaction, enabled by technologies (digital and virtual) to amplify and extend the natural ability and performance of the human body or add new functions to the user connecting them to their body, other persons or objects and with the environment.

Smart textiles are knitted, woven, non-woven fabric systems designed to sense and respond to external stimuli (mechanical, thermal, chemical, biological, magnetic and electrical) enabled by advanced, physical and digital technologies.

Digital manufacturing iis an integrated approach to manufacturing that is centred around a computational system using tools such as 3D technologies, robotics, AI and AR and the integration between digital technologies for manufacturing processes and embedded digital technologies in products-services (IoT) to enable open and distributed manufacturing that can reshape design, production, distribution and retail processes. The extent of applications ranges from large scale industrial systems, in

The Benchmarking Report, Education-4Fashion-Tech, Available at https://www.e4ft.eu

industry 4.0 and DIY/ mini and micro-factory up to digital service platforms and bottom ascending innovative processes, on-demand manufacturing, collaborative and on-site manufacturing (fab-lab and maker space), and repairing and remanufacturing systems.

Combining desk research and the results of interviews, this report also provides an overview of current researches and emerging topics.
In particular, 5 macro areas emerged as a representation of possible directions for the future development of the Fashion-Tech sector:

1. Protection and body enhancement through artificial second skin: Wearables and Smart textiles with embedded sensors are able to monitor physiological, neurological and body kinematic parameters that are critical for healthcare.

2. Culture driven Wearable: Art, technology and innovation: generating thoughts and knowledge around human behaviours, interaction with the body, other people and the environment.

3. Hyper-body: Connecting senses and materials: involving three of the five senses (eyesight, hearing, touch) enhancing or "substituting" them.

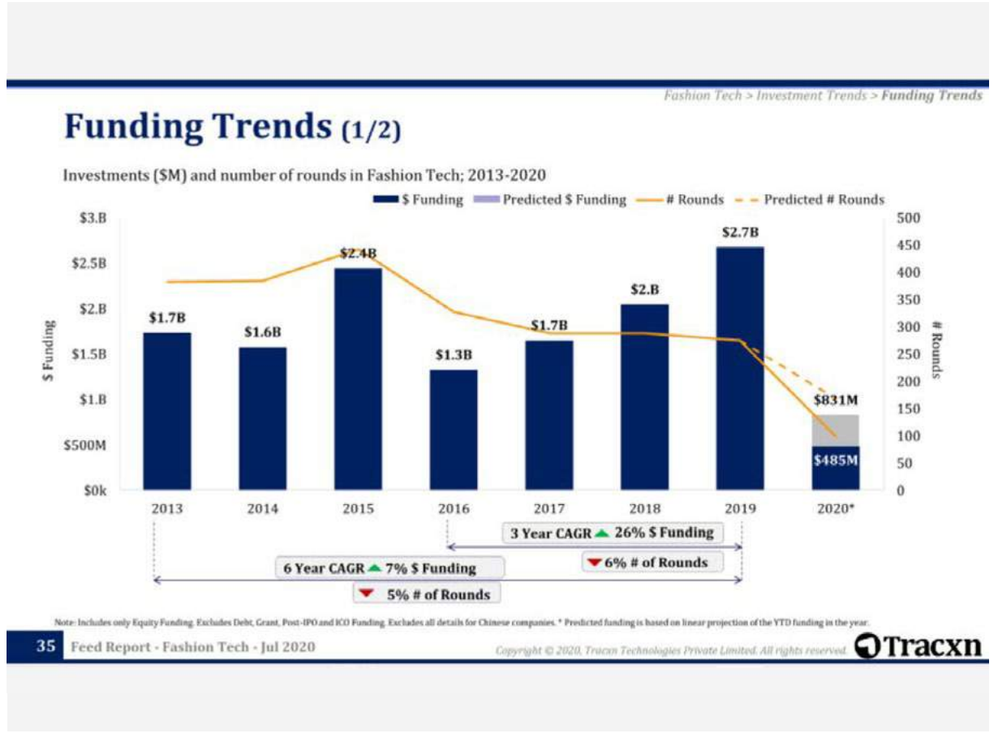
4. Fashion takes care: Sustainability across design, production and retail covering the entire supply chain. It is intended to provide efficiency, recyclability, transparency, mission orientation and ethical upgrades.

5. Real/Virtual mixed environments: analogical/digital places created and customized with mixed reality as a result of the addition of virtual and augmented reality; new dimensions for self-assembly and programmable materials; artificial intelligence for all the supply chain.

This analysis was carried out starting from a data collection in the second half of 2017, and although the transversality of Fashion-Tech from design to retail has remained a constant, in three years much has changed. "Innovation has been scaled-up along the entire fashion value chain and is here to stay" (McKinsey & Company). Thus, as expected, activities around Fashion-Tech have grown significantly.

According to The Tracxn Feed Report, investments in Fashion-Tech in 2017 were 1.7 billion dollars, 2 in 2018 and 2.5 in 2019. This constant growth confirms the market's interest in the topic but also leads to a significant increase in the complexity of the sector.

The interest in Fashion-Tech and the need to create a well-structured system to support



Funding Trends, Investments and number of rounds in Fashion-Tech, 2013-2020, 23 July 2020
Source: Tracxn Feed Report, Fashion-Tech, https://tracxn.com/a/reports

it emerge not only from the birth of new case studies, but also from the formation of new educational courses and companies academy. This confirms what was 'predicted' in the Benchmarking Report: to face the market we need specialized figures able to manage the different activities related to Fashion-Tech whether they involve products, processes or services. In addition, two major emergencies have had a decisive impact on the proliferation of Fashion-Tech: sustainability and Covid-19, which on the one hand have slowed down all those "non-essential" innovations, on the other hand, have pushed innovation and research on all those technologies that could represent a valid answer to the questions and problems raised by these two critical issues that have undoubtedly challenged what have been the pillars of the fashion system until now. Last but not least, the role of the leading companies in the technological field in the Fashion-Tech field will be deepened, starting from the proliferation of patents they registered.

EDUCATION GOES FASHION-TECH: COMPANIES' ACADEMIES AND NEW EDUCATIONAL COURSES

We will all need to become life-long learners", it was stated in the Jobs of the Future report at the World Economic Forum and the European Union has agreed on a 2020 Digital Education Action Plan to stimulate, support and scale-up purposeful use of digital and innovative education practices in Europe. Education and training represent crucial aspects in the context of Fashion-Tech and more generally for innovation practices. The development of new sectors automatically generates the formation of professions that need novel educational models, and therefore lead to the renewal of the system. Compared to the analysis carried out in 2017, the initiatives dedicated to the sphere of Fashion-Tech training have seen an increase. This, therefore, underlines not only the growing importance of the sector in the world of education and business training (Yu, 2020) but also a greater awareness of the characteristics and skills that professionals operating in the sector should have. Case studies of Educational Courses or Companies' Academies relating to Fashion-Tech are presented here below.

Tommy Hilfiger + STITCH: New Learning and Technology Capabilities

"The potential of 3D design is limitless, allowing us to meet consumer needs faster and in a more sustainable way," said Daniel Grieder, CEO, Tommy Hilfiger Global and PVH Europe (businesswire.com, 2019). Grieder technology plays a fundamental role within design practices and has the potential to significantly accelerate the speed of product placing on the market, avoiding sample production and discards, replacing traditional product photography. For this reason, Tommy Hilfiger announced in November 2019 the goal of incorporating 3D design technology into all clothing design teams at the Amsterdam headquarters. Tommy Hilfiger collections for SS 2022 will be entirely designed using 3D design platforms, in the broader future perspective of digitizing the entire value chain. The brand is investing in a training process that involves all the design teams at its headquarters in Amsterdam to design the Spring 2022 clothing collections entirely in 3D. For this purpose, Tommy Hilfiger has founded STITCH, a technological incubator aimed at digitizing brand design practices. From the digital library of fabrics, patterns and colours to 3D presentation tools and rendering technology: since 2017, a team of software engineers, 3D design experts and transformation specialists have oriented their practice towards the development of an ecosystem of proprietary tools enabling an entirely digital design workflow. The brand's goal is to train all teams of designers, model makers, technicians, product developers and merchandisers through the STITCH Academy to use 3D software and shift many of the traditional practices to the digital realm.

Nvidia AI Technologic Center and AI Academy

Nvidia AI Technologic Center (NVAITC), inaugurated on 16th January 2020 at the University of Modena and Reggio Emilia, is the first Italian technological centre dedicated to research on artificial intelligence (RUBEIS, 2020). The technopole founded by the Californian giant Nvidia has the aim of pushing the adoption of AI solutions, especially in the industrial field. The agreement signed by Nvidia and Cini, the National Inter-University Consortium for Information Technology, will lead to the opening of other avant-garde centres in Italy in the next three years. The Nvidia-based centre will be opened within the AImage Lab of the university's engineering department. Unimore has been working on the creation of an AI Academy. The aim is to transform the department into the largest Italian research centre, specialized in computer vision, machine learning and deep learning.

"We need to invest in technology and development to successfully design the artificial intelligence of today and the future. Taking advantage of Nvidia's experience will certainly help to maintain a position of excellence in training in our country. Our researchers will work to develop artificial vision systems aimed at recognizing human behaviours and its interactions, useful to predict movements and events in smart cities," said Rita Cucchiara, project manager and director of the Cini-AIIS national laboratory on intelligent systems and AI. A strong signal is the presence of companies such as Tetra Pak and Yoox Net-a-Porter Group and representatives of Cineca of Bologna, the inter-university consortium of 67 Italian Universities.

Fashion-Technology Academy (FTA)

The Fashion-Technology Academy (FTA) is a collaboration with Fashion Enter Ltd - a sister company to FashionCapital.co.uk - Haringey Council, DWP and global e-tailer ASOS.com. Opened in March 2016, FTA is an extension of the Stitching Academy and includes a range of qualifications, which cover the entire of the garment life cycle including stitching, production and pattern cutting. With the aim of training a new generation of professionals, the FTA operates alongside a live factory and fashion studio

ensuring that students gain exposure to actual manufacturing skills whilst training for their qualifications.

Fashion-Tech Programme by Startupbootcamp

The Startupbootcamp FashionTech programme (startupbootcamp.org) consists of a thirteen-week campus in Milan, during which selected start-ups will be able to acquire the tools needed to grow their business with the support of selected experts and a network of partner companies, including Accenture, Coin, Prada Group, PwC, Stone Island, Unilever and Withersworldwide. The FashionTech initiative sees companies taking part as supporting partners in the programme, including the selection and acceleration of the best 30 innovative start-ups able to offer advanced technological solutions to meet current and future market challenges. The areas of greatest interest for the group range from marketing and retail to the search for innovative solutions along the entire value chain. In three years the Startup-Bootcamp FashionTech programme leads to the acceleration of 30 start-ups, following the proven acceleration format developed by Start-up Bootcamp, which has been operating for 10 years with more than 20 sector programmes in each continent.

Specializing Master in Fashion-Tech

The Specializing Master in Fashion-Tech of the Politecnico di Milano, managed by POLI.design is dedicated to the futures scenarios of fashion, open to contamination between sport and fashion, competition and leisure, but also Wearable technologies for interactive accessories.
Since 2017, the Master meets the needs of the market that requires innovative products and designers with technical and creative skills and knowledge on new materials, technologies and fashion languages. The Master provides skills relating to product planning for both active and interactive sportswear, for lifestyle in terms of innovative contributions of materials and technologies, for Wearable accessories which can integrate fashion aesthetics with new contents and new functions given by integration with Wearable technologies. It trains designers as capable of working in the field of sporty clothing, sportswear and competitive wear, as in those sectors where one must know how to combine technical materials, new technologies and performance.

MA Fashion Futures: a new direction in Fashion-Tech

Starting in 2020/2021 LCF has added a pathway with a focus on Fashion-Tech to the MA Fashion Futures that places sustainability and forward-thinking at the heart of fashion practice to help shape the next generation of fashion practitioners who prioritise environmental, social, economic and cultural criteria. It derives from an insight that new technology is a strong force to help to make the industry sustainable. Students are encouraged to analyze the nature and purpose of design in a rapidly changing world, imagining and envisioning alternative ways in which fashion can create and experience in the future, whilst grounding their research in an understanding of the immense challenges that face the industry and wider society today. Students are encouraged to explore and develop experimental fashion practice and theoretical perspectives in parallel to conceptualise a transformed fashion system, one that values nature first and creates economic prosperity in service to this goal. Using your own knowledge, practice and experience as a starting point, you will identify new territories for fashion and work in new spaces with novel technologies, to communicate ideas in relation to design for sustainability to varied audiences. MA Fashion Futures offers a space to experiment with new ideas and physical/digital prototyping to challenge existing narratives as well as being a place to put principles into action in a manner that aligns with each student's individual strengths, interests and future aspirations. Aligned to the Centre for Sustainable Fashion, the course involves research and knowledge exchange led teaching, with contribution from a range of the Centre's members. Specialist technical teaching and support in the area of physical computing, e-textiles, creative coding, mixed and virtual reality and 3D print will be provided by the Digital Learning Lab.

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

"FTalliance: Weaving Universities and Companies to Co-create Fashion-Tech Future Talents" is a three-year (2020 – 2022) Knowledge Alliance Project co-funded by the Erasmus+ Programme of the European Union aims to facilitate the exchange and flow of knowledge within the Fashion-Tech sector to boost students' employability and innovation potential. The established alliance comprises partners from 6 Programme Countries: 12 full partners among which are higher education institutions (Politecnico di Milano, ESTIA École Supérieure Des Technologies Industrielles Avancées, Uni-

versity of Borås, London College of Fashion - University of the Arts London, Technische Universiteit Delft), research organisations (Centexbel) and small, medium and big enterprises (Decathlon International, Grado Zero Innovation s.r.l., Pauline van Dongen, Pespow s.p.a., Stentle (M-Cube Group), We Love You Communication). Along with the full partners, the Consortium will be supported by PVH Europe as an associate partner. The purpose of the Project is to ensure the ongoing innovation in the European Fashion-Tech sector by providing emerging talents with relevant competencies and know-how to enter the jobs market. Fashion-Tech means new products, processes, tools and professional figures that come about as a result of cross-disciplinary approaches. To keep up with this emerging field, there is an increasing urgency for organisations to adapt and advance collaborative practices, to find ways to integrate new technologies into fashion and design. FTalliance takes the challenge, by joining different realities into a multidisciplinary and intersectoral project that combines companies' technological, creative and market leadership with universities through theoretical and applied researches and experiences. Over the next three years, the Consortium will deliver a series of educational activities, from designing and piloting innovative mentoring formats for students to the development of a Fashion-Tech Residency, embedding young talents in the companies' innovation activities. The selected students will have the chance to develop concrete projects and products accessing coaching opportunities innovation spaces, facilities and equipment provided by host companies. In the long-term, the project aims at increasing the relevance, quality and impactfulness of Fashion-Tech innovations and also at enhancing the competitivity of the European Fashion system at a global level revamping the industry through innovative practices. In addition, the creation of a Fashion Academy by establishing a multidisciplinary and collaborative European network of Higher Education Institution aims at increasing better employability and preparation of students to the market needs.

Digital Fashion at Polimoda

Creativity and technology in the name of innovation. Polimoda in Florence offers a Master's degree in Digital Fashion, a 9-month programme which aims to train future Chief Innovation Officers for the main fashion houses. The programme, supported by industry experts and professionals who provide mentorship to the course, such as Lisa Lang, founder of The Powerhouse, and Ashley McDonnell, Global Luxury Account Manager at Google, through cross-field courses addresses topics of current interest and it provides tools to face the challenges of the sector, from the digitization and optimization of the value chain to the adoption of sustainable approaches not only for production but also for merchandising and retail. From hyper-personalization to new ethical materials, the teachings range from strategies for launching and promoting fashion brands online to defining fashion collections through the use of data, from identifying high-potential markets for fashion brands through AI to innovation management.

Big Do and Textile Challenge

The Swedish government has given the University of Borås the task of establishing and leading Textile & Fashion 2030—the national platform for sustainable fashion and textiles. The five-year assignment is led by Smart textiles, part of Science Park Borås at the University of Borås, in collaboration with the Swedish School of Textiles, the Swedish Fashion Council, the RISE Research Institutes of Sweden, and TEKO, the Swedish trade and employers' association for companies working in the textile and fashion industry.

Big Do is a design hackathon/sprint within Textile & Fashion 2030 that will inspire stakeholders in our industry to move into a transformative decade towards a new prosperous state for the textile and fashion industry. The Swedish School of Textiles and the Do-tank Center at Science Park Borås have provided knowledge and laboratory facilities, enabling the participants to keep full focus on creativity and innovation. It involved companies Gina Tricot, Craft Sportswear, Houdini Sportswear, Guringo Design Studio and Naomi Bailey-Cooper from LCF.

Textile Challenge is a series of activities aiming to inspire and challenge the textile and fashion industry and identify the obstacles to reach the Agenda 2030 goals. The activities welcome participants from all parts of the value chain within the textile and fashion industry.

The Business of Fashion, Textile and Technology (UAL), https://bftt.org.uk/

The BFTT SME R&D Support Programme is an ambitious research and development initiative providing structured support for UK SMEs looking to achieve sustainable growth through R&D. Started in 2019 the programme will disburse around £2.5m in funding (plus leveraged funds). Throughout the course of three and a

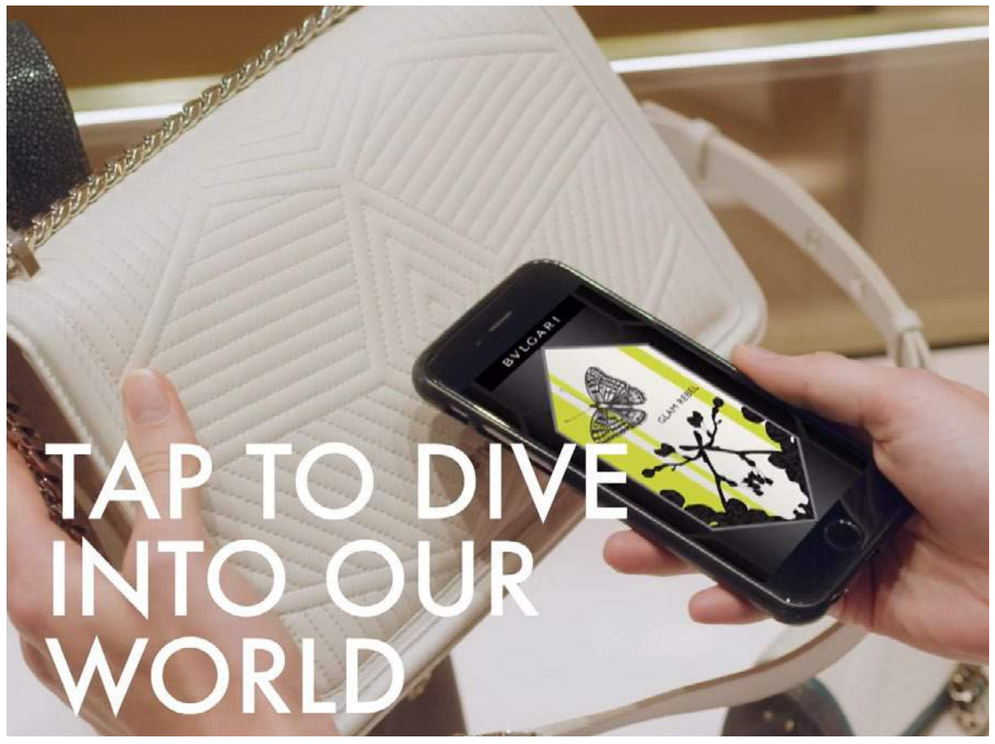
half years it will take forward up to 25 R&D projects led by SMEs in partnership with leading academic partners.
The programme provides SMEs - and any associated industry partners - with a targeted range of support including funding, mentoring, wide-ranging fashion, textiles and technology industry expertise and showcasing opportunities specifically designed to help SMEs turn bright ideas into commercial products. Interesting examples are Pinatex and AWAYTOMARS.
The program is built around the following visionary themes.
Reimagining materials and production
Can future-facing innovations, from bio-technologies to artificial intelligence be adapted for impactful applications within fashion, textiles and/or cosmetics; creating new materials and production processes that improve efficiency, quality, circularity and overall sustainability?
Inspiring sustainable consumers
What business model innovation, novel product-service-systems (PSSs) and/or design solution could lead to systemic change in the sector? What approaches could encourage more sustainable relationships with fashion and beauty?
Uncovering hidden data and insights
The FTT industry has access to the power of data throughout the supply chain to generate a positive impact and change businesses. How can the sector capture in new ways, and ensure that data collected is of high quality, scrutinised effectively, and communicated in ways that drive transparency, collaboration and sustainability throughout product lifecycles?
Designing new experiences
Can technologies like virtual and augmented reality provide new reasons to visit local high-streets?
Could innovations in virtual environments such as those in the gaming sector merge with design and creativity from the fashion world?

FASHION-TECH PRODUCTS, PROCESSES AND SERVICES: AN UPDATE

«The magic of the best technology is receiving a great experience, and not knowing whether it's through a human being or artificial intelligence.»

Michael Klein
Director of Industry Strategy for Retail at Adobe
(Theblog.adobe.com, 2018)

Given the need to rise to contemporary challenges and to be innovative, the forms of cross-fertilization are becoming ever more frequent and daring, while the number of sectors involved is steadily growing (Testa, 2019). Over the past three years- since the Benchmarking report was published -, the exploration within the borderline area generat- ed by the interconnection of fashion and digital technologies hasn't certainly stopped, but on the contrary it continued constituting an area of growing interest for companies to face societal contemporary needs and to generate innova- tion. The experimentations of cross-contam- ination involved all stages of the value chain, with case studies ranging from products, to services and processes and strategies. As far as product is concerned, companies, from high jewellery to sportswear, continued exploring the possibility of creating enhanced and personalised experiences for consumers through embedded technology, using the product as an enabling tool capable of generating dynamic interactions with the wearer in different ways.
It is the case, for example, of Bulgari who launched Bulgari Touch, a worldwide product digitization project. Thanks to the NFC tag embedded in the accessories, the brand manages to communicate in a personalized way with customers through the product itself. From luxury to activewear. Nike included the NFC tag in the t-shirts of all NBA teams, in this way customers could interact with the shirt receiving special content related to the team, such as highlights and statistics. As a reward NBA teams offer discounted tickets to special events. Through a partnership with



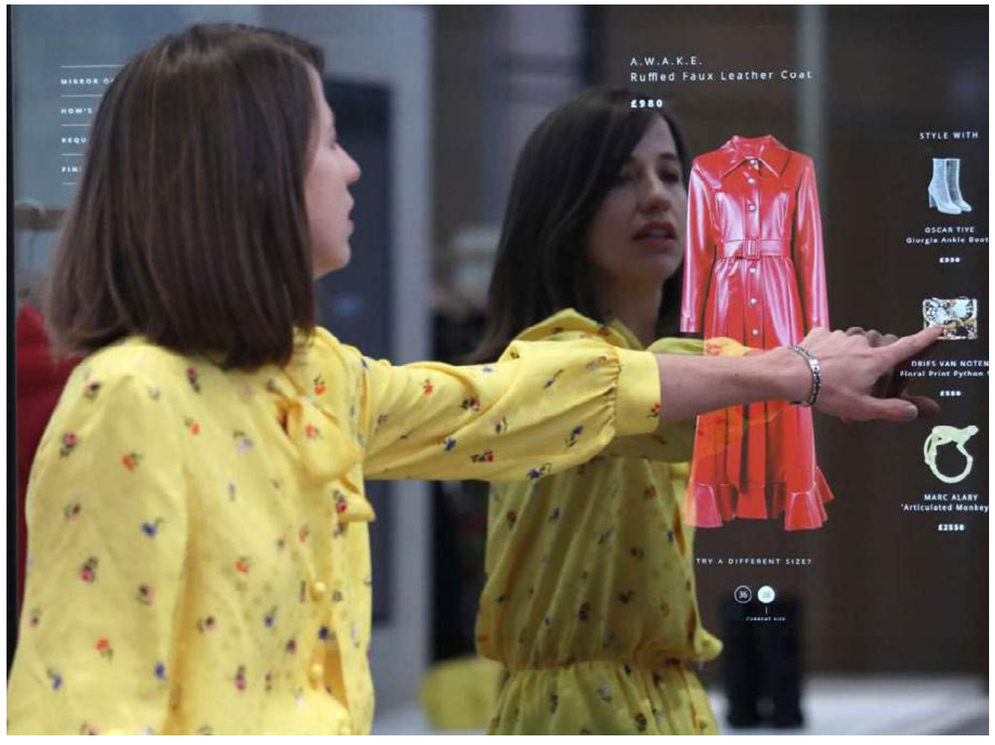
Bulgari Touch by Bulgari.
Source: Bulgari, https://www.bulgari.com/it-it/stories/bvlgari-touch.html

Smartrac, the leader in RFID based Internet of Things solutions, Spyder is powering a select collection of its U.S. Ski Team (USST) items to connect with NFC-enabled consumer devices globally. NFC Chips in the products allow customers to have real-time information on events, weather, slopes, social media and sports data on the current races of the US Ski Team. Puma, instead, developed projects by combining NFC and QR code allowing customers to activate special content on sneakers. Carlings, the historic Scandinavian clothing company, created the Last Statement T-shirt. Through a custom version of Instagram/Face- book filters, the design of the t-shirt can digitally be modified. So the shirt can display each time a different animated design to convey and amplify a message. xShüu works as well on customization: the products of the brand have digital surfaces that can be controlled by users through smartphones. Indeed embedding technologies in products enable users to engage in new interactions by connecting them with their body, with other users and with the surrounding environment. In order to provide users with new, enhanced performances these connections generate a mass of discreet data that may be used in real-time, or else exchanged with the system and stored in another spatiotemporal dimension. Screen-centred interactions, in which users dialogued with their devices by means of keyboards or screens, have been increasingly replaced by interactions that take place everywhere and originate new gestures. Indeed, the most cutting-edge project's promoted by big technology multinational companies strive to enable interactions with any kind of surface, and possibly even to eliminate the physical component altogether, thereby turning the gestures themselves into interfaces.

Companies increasingly target digital investments towards different ways to satisfy customers' desires and behaviours. Personalisation, waste reduction, authentication and protection are some of the objectives towards which fashion companies are orienting their practice today. Collection and use of data and artificial intelligence are indeed increasingly powerful tools capable of allowing companies in the sector - as in the case of Kering and Yoox Net-a-Porter programmes - to modulate the offer promptly based on latent (or even declared) consumers' needs, from advanced clienteling to smarter omnichannel shopping experiences, up to the use of data to design and develop products and services. Digital technologies are also a tool that can promote sustainable model

The Last Statement T-shirt by Carlings.
Source: www.dezeen.com

adoption practices. Some initiatives and business models have moved around the possibility of satisfying the need for continuous novelty, typical of the fashion sector, albeit with a view to limiting waste, through the implementation of rental and resale digital platforms: luxury brands such as Burberry have signed official partnerships with The RealReal and other resale sites, while Urban Outfitters Inc. has launched the Nuuly rental service. Sustainability and circularity are the trademark elements of the economic system that should be encouraged; modern-day consumers are increasingly becoming more informed and aware, and demand to know the provenance of the products they buy. Indeed other elements that nowadays plays an important role in enhancing the consumer experience are traceability, transparency, security and data protection. Fashion and luxury goods companies that collect, analyse and use big data to improve user experience and increase sales have been asked to implement data protection and privacy measures and strategies (Luxurysociety.com, 2016). Blockchain enables brands to tell the story behind the products they sell transparently, and also lets them give democratic credit to all the actors involved in the production process. Each object has a history that goes from raw materials to store sale, and Blockchain allows every stage of the production chain to be identified and appreciated. Brand trust and sustainability are especially important for younger consumers, and Blockchain is very efficient in tracing products. Moreover, companies enhance customer experience by widening the scope of their narrative dimension and by letting their customers discover their history as well as the origin of every product. While today an increasing number of companies invests on the traceability and sustainability of their production chains, and introduce consumers to their suppliers, also fashion retailers caught the potential of the blockchain: LVMH linked up with Microsoft on Aura, Ba&sh is offering resale through blockchain-enabled purchases and Farfetch joined the Libra Association. Another powerful instrument capable of originating an interactive experience for consumers is artificial intelligence. Big data and artificial intelligence are in the process of bringing about important changes for the fashion industry, with positive results affecting the whole production chain: these concern not only the way products are sold, but also how they are purchased, designed and commercialised (Futureofeverything.io, 2018). In 2016 the Business of Fashion magazine anticipated that artificial intelligence would soon penetrate every sector of society; the modern world seems to confirm their predictions. Suffice it to consider Alibaba, the e-commerce giant that has invested more than 15 billion dollars in artificial intelligence-related research and development, or even the fact that investments in this sector have triplicated since 2013. It would nowadays be unthinkable for online brands to manage customised sales processes without automatization (Exponea.com, 2018). Gartner has estimated that by 2025 85% of the relationships between consumers and companies will take place without any direct interaction between humans. Artificial intelligence will enable particularly busy customers to bypass in-store shopping, and to delegate the whole endeavour to algorithms and smart systems. The whole system is therefore moving towards automatization not just in terms of supply, but also as regards haggling, purchasing, and delivery (Trendwatching, 2018). Some companies find artificial intelligence a very useful tool, as it can optimise processes and provides consumers with a customised experience. This is the case of GhostWriter, an Italian start-up offering a tool or a proprietary technology dedicated to digital marketing, which allows identifying the target audience, knowing their needs and sharing language and objectives. GhostWriter has created a semantic engine, capable of decoding, interpreting and reworking texts. Algorithms can extract value from different contexts. One of the challenges of communication today is in fact to decode texts to identify user behaviours on the web. Modern consumers are well-informed and have higher expectations as regards their shopping experience, products and prices; the latter, in particular, can be checked instantly and worldwide (The State of Fashion, 2018). Many online fashion brands have come to appreciate the importance of dividing their market into sub-segments based on the data supplied by the internet. Some of them use this technology to improve the search function on their e-commerce websites. This kind of technology entails the use of algorithms which can predict consumer behaviour; these are based on consistent, frequently recurring parameters such as the number of accesses to a given website, the kind of device used to browse the net, and the geographical location. All of these elements help brands trace consumer profiles, and to tailor the offer on their website on the outcome. Algorithms can follow the online trail left by customers, and support them in identifying the most suitable products. Stitch Fix is based on an extremely innovative retail model which includes active cooperation between consumers,



Store of the Future by Farfetch, Source: Bloomberg, https://www.bloomberg.com/news/articles/2017-04-24/online-retailer-farfetch-and-the-retail-store-of-the-future

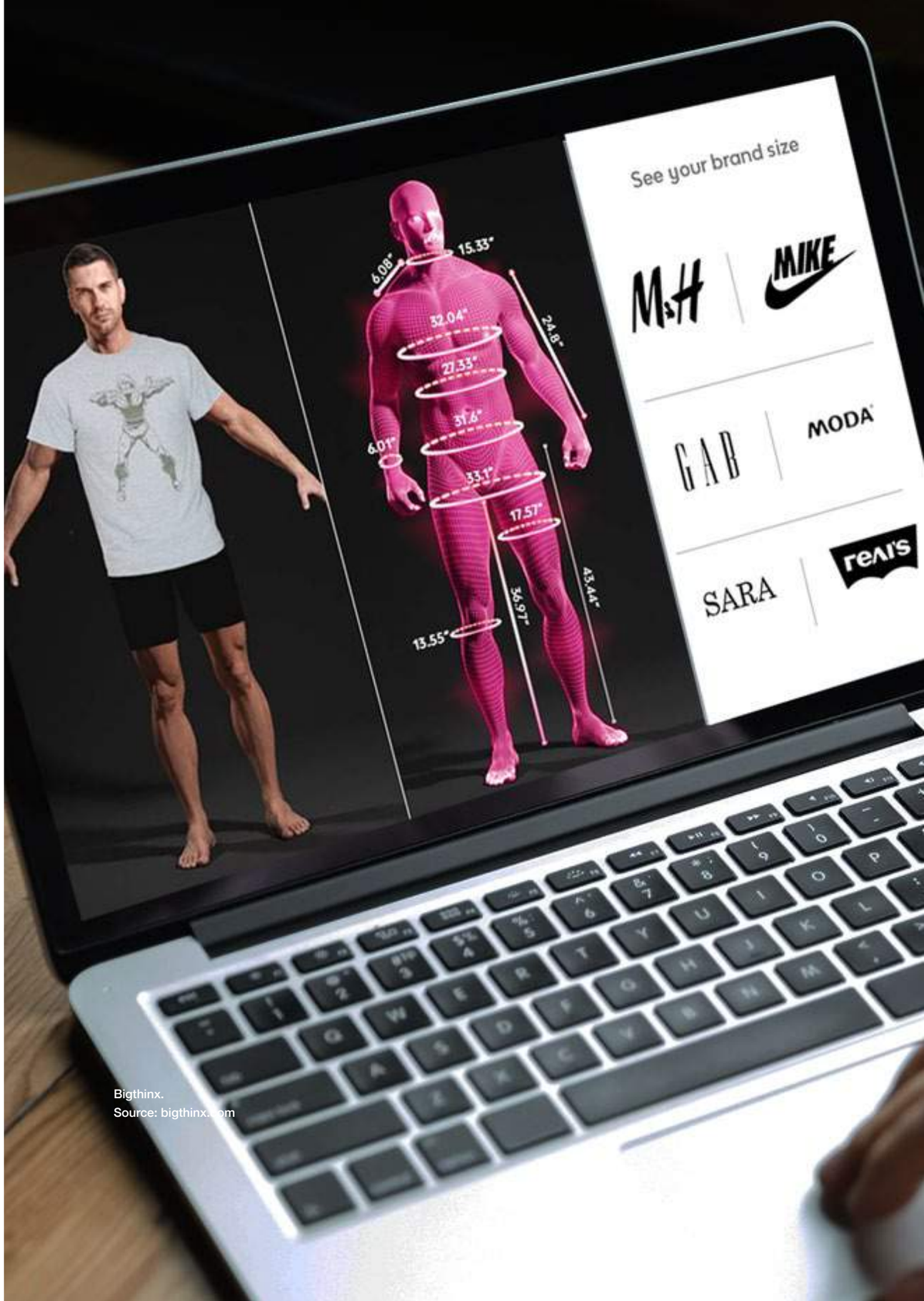
«In the age of mobile internet, the merging of online and offline [retail] is a trend, consumers don't distinguish between online and offline as long as it fulfils their needs.»

Jianzhen Peng
Secretary General of the China Chain Store
Franchise Association
(Technologyreview.com, 2017)

designers, and artificial intelligence. Thanks to its services, users no longer need to do their shopping in physical points of sale, and can even forego searching for products online: Stitch Fix delivers customised suggestions directly to their homes at regular intervals, and users are then free to decide whether to keep or return them. Feedback is constantly recorded to improve the algorithms that outline consumer preferences, but also to predict future trends. This model has been very successful: in 2017 this company generated revenues for 1 billion dollars and had 2.2million active customers (Forbes.com, 2018). Re- tailers such as Stitch Fix and Trunk Club have also adopted a mixed approach of machine learning algorithms with human personal stylists, in order to ensure a customised offer. To give but an example, an order placed with Stitch Fix is processed by anything between 5 and 10 algorithms before it reaches a human stylist; the whole process, moreover, is supervised by more than 85 scientists (Forbes.com, 2018). Artificial intelligence has made a great contribution to significantly boosting the development of eye-tracking tools for the fashion industry, which in turn has granted consumers more engaging shopping experience. Websites can nowadays provide advice and suggestions that simplify online user searches, with the consequent reduction of the steps required in the process. Indeed, users can now search for products they may have

seen online or on the street, upload images on a virtual platform, and have an algorithm select the relevant products from a virtual catalogue; users then select the appropriate images by clicking on them and completing their custom. An example of the application of artificial intelligence to a physical point of sale is Farfetch's Store of the Future: it is equipped with a consumer recognition system, shelves and clothing rails with embedded RFID technology, and monitoring mirrors which let users view items in different sizes and colours, before they buy them directly through the mirror itself. In occasion of the celebrations for the Chinese Singles Day, Alibaba launched FashionAI: it is an in-store app that jointly analyses the data from the scanning of the garments customers try on in the changing rooms, from the inventory of the available items, and from the information collected through fashion experts and designers to provide suggestions on fashion items similar to the ones being tried on. Alibaba's sales on that day alone were worth 25 billion dollars (technologyreview. com, 2017). A few brands have chosen a 'conversational' sales approach, which encourages consumers to use chatboxes or voice assistants to speak directly to brands. The system relies on smart agents that simulate human behaviour, conversation programmes (Mauldin, 1994), and customer support software with natural language processing systems that stimulate conversation with consumers and suggest the most suitable products. Brands like Louis Vuitton, Everlane, Burberry and Nike use Facebook Messanger, which also relies on artificial intelligence, to offer customers a guided shopping experience. Another relevant example is Bot, Levi's Virtual Stylist. Developed in conjunction with Mode.ai, it is a chatbox based on Facebook Messenger which supports consumers looking for a pair of jeans, thus reducing the number of returned products. The Virtual Stylist understands the users' language, analyses the content of the information it receives and infers the purpose of the consumers' query; its suggestions are synchronised with the products virtual catalogue, and only indicate those products that are listed on the inventory. Finery is an automated digital wardrobe management system that provides advice on the basis of predictive analysis: it collects information on the users' previous purchases, organises the relevant items in a virtual wardrobe, and elaborates several matching outfits based on either the individual user's wardrobe or other e-commerce portals.

The degree of customer satisfaction with this kind of experience is higher (73%) than



Bigthinx.
Source: bigthinx.com

with e-mail or phone interactions (Unbxd.com, 2017). Artificial intelligence can make the whole production chain from the design stage to the communication one more efficient, with the ultimate goal of giving users a positive experience and, by extension, of increasing profit. Bigthinx is an advanced technology start-up specialized in Artificial Intelligence for fashion, fitness and retail. The software the company uses performs a three-dimensional scan of the body from only two pictures taken by smartphone to calculate 44 measurements and identify body composition ratios with an accuracy greater than 95%. Bigthinx's neural networks not only create a personalized virtual avatar through given photographs but using AI to digitally recreate virtual clothing from any 2D image to show how it would look the garment in reality. The start-up has also ventured into digital models and virtual photoshoots, allowing brands to produce catalogues and organize fashion shows in an entirely virtual way and at a fraction of the cost of traditional physical procedures. AI can also contribute to the analysis of consumer preferences and the identification of the most popular items on a given company's inventory; once this information is passed on to designers, new products responding to the emerging trends may be created. Amazon, for instance, has developed a programme that determines whether a garment is fashionable by comparing it to images from the latest collections. This technology is not yet mature, so today it is difficult to provide a critical analysis based on real data. Nevertheless, it is possible to predict that applying artificial intelligence to fashion design may have significant impacts on the system and in particular on the trend research phase and the role of the designer. When it comes to technology and artificial intelligence, there are always conflicting opinions and, even in this case, there are dystopian views of those who claim that the adoption of this software could have negative effects on the role of the designer, who could shift from being a creative actor to a mere performer. However, the tools themselves are neither good nor bad, but their value largely depends on the way they are used. Avoiding technological progress a priori equates to cut oneself off from the games (Baricco, 2018).

Regarding services, in particular, the shopping experience has undergone substantial changes with the intervention of the technology. Younger generations tend to prefer to spend in order to benefit from immaterial experiences, rather than to acquire material goods (Fashionretail.blog, 2018): modern consumers have

Adidas flagship store, Oxford Street London
Source: https://www.rethink.industries/article/adidas-london-is-the-flagship-of-the-future/

replaced purchasing finished products with the quest for emotionally-gratifying solutions full of meaning (Iannilli, 2010, p.18). In this scenario, consumer goods are not identified with mere physical ownership anymore, but rather become associated with the personal enrichment which consumers experience within new contexts. Approaching the project becomes much more complicated, as the latter no longer meets the needs of an expanding society with finished products, but rather supports an evolving society either through services that establish interpersonal relationships or through communication strategies. Points of sale consequently acquire great importance in the interaction between objects and users and help to create a narrative structure around the product (Conti, 2012). Indeed, over the past few years, businesses have reorganised their structure to embrace new models which may generate positive consumer experiences (Simeone, 2001, p. 37). Points of sale are no longer merely devoted to trading, but have in fact turned into hubs of interaction to which consumers have to be attracted. Through their custom consumers become part of a narrative in which every element contributes to the creation of a new scenario; points of sale are thus turned into places favouring participation and interaction. The new technologies have helped develop new spaces, both virtual and physical, which can establish an immersive dialogue with consumers (Trevisan & Pegoraro, 2007). The new communications technologies have had a significant impact on retail. Flagship and showroom are ever more contaminated with digital technology and change profoundly. An example is constituted by the Adidas Megastore in central London, a space dedicated not only to the mere purchasing act but to a fully engaging experience: workshops, demonstrations, events are organized in-store, mixing media, where analogue practices and tools are mixed with all new technologies available - such as RFID chips in the dressing rooms to understand everything about the garment. It is nowadays no longer possible to draw a strict categorisation between the various types of sales channels: e-commerce and the physical points of sale have been supplanted by hybrid intermediate models which use diverse, context-related channels to enhance the consumer experience. Cloud4wi, an American company with Italian roots - they are a university spin-off created by students from Pisa - offers solutions for the provision of Wi-Fi networks in stores and, based on these, a system of analysis of customer behaviour in the store. A new business, that of Wi-Fi networks and shopping to increase customer engagement that has provided the cue for the birth of new fashion & tech start-ups. Hybrid systems, conversely, managed to combine the intuitive straightforwardness of online shopping with the physical advantages of traditional points of sale, thereby making the experience of digital purchasing immersive and highly customised. As further proof of this trend, research by NRF has highlighted that the aspects which make online shopping most appealing for consumers include, apart from app-store browsing (66%) and making payments through trusted portals (65%), the possibility to make a purchase online and collect it in-store (68%). Omnichannel shopping requires a revision of customer strategies and of the way in which products and services are offered. Against this backdrop, customer experience demands that the fashion in which products and information are presented, together with customer service, the architecture of points of sale, and warehouse management, be designed from scratch. Other retail solutions focus on customization. Like Viume: a web app that exploits artificial intelligence, combining human expertise and machine learning, to find the most suitable outfit, depending on the occasion, according to the personal characteristics and lifestyle of each customer. Or Scroble for closing the gap between online and physical shopping. Or Obsess and SKMMP focus on the practicality of the shopping experience. Ob- sess offers, “enhancing” e-commerce on behalf of brands and retailers, a shopping platform with 3D 360 experiences in HD quality through virtual reality and augmented reality, optimized for mobile phones. SKMMP is a B2B multi-brand digital showroom for men’s and women’s clothing. The “intelligent” showroom allows buyers to use voice, thanks to artificial intelligence, to process the order transaction. “Now, the contactless system in the fashion field not only stops at providing an online shopping platform but also allows people to experience fashion in detail at home with virtual reality (VR) and augmented reality (AR) technology. Soon we will be able to see fashion items in 3D at home showing the quality of the materials used and the decorations put on the items,” Kan Hosup, Korea Society of Fashion Business President, said. 5G will power augmented reality and live video shopping. The processing power of smartphones and their networks has limited effective augmented-reality projects, including shop-adjacent uses in fashion. As the fifth generation of wireless technology, 5G promises faster downloads and less latency. Combined with the influx of AR developer tools from main-

stream platforms like Apple and Facebook, 5G could facilitate the technology's presence on social media in 2020. For example, customers will be able to "try on" designs on social platforms before checking out in-app. According to Yoram Wurmser, eMarketer principal analyst, 5G will also allow streaming media formats with higher-definition graphics, sound and interactive technologies. Livestream video shopping is already generating $4.4 billion in sales in China as of 2018 and thanks with 5G will become even more popular. Monki and ShopShops, which connects Chinese shoppers with US boutiques, are some the early adopters.

THE TWO SIDES OF EMERGENCIES

«Don't let innovation stop, because this could be the window of opportunity. Use this time to reinvent how you do what you do, bring consumers new alternatives, new value, and in the process even reinvent your own brand.»

Doug Stephens
Retail Futurist
(The Business of Fashion, 2020)

Two main emergencies characterised the last years and strongly affecting the contemporary scene: sustainability - which is not a so-recent-issue but it has become a priority in the fashion industry in the last years - and Covid-19. On the one hand, the two emergencies have slowed down "unnecessary" innovations, while on the other hand, they have speeded up progress to face them. The pandemic that hit the planet at the beginning of 2020 overwhelmed, threatening profoundly, not only public health but also the economy and society. The fashion sector was severely affected by the crisis, and according to the Office for National Statistics (ONS), clothing store sales saw a sharp fall when compared with the previous month, at negative 34.8% in March 2020. In addition, the lockdown has made the management of e-commerce sites more complex, whose deliveries have been converted according to the rules of social distancing and decrease of personnel involved. The basic processes along the fashion system value chain slowed down drastically, if not a real and proper halt. In this context, for various companies in the sector, the digitization of some activities represented a fundamental opportunity. This is the case of Asos, the e-commerce retailer, which turned to digital fitting models with new garments, allowing it to continue promoting new products among consumers during the lockdown. Asos simulated

Shanghai Fashion Week 2020
Source: alizila.com

the fittings using a tool developed by Zeekit, an AR and AI company based in Tel Aviv, for up to 500 products every week using six real models. The technology works by digitally mapping each product on the model in a realistic way, taking into account the size, cut and fit of each piece of clothing.

Another example is provided by the format redefinition of the Fashion Weeks, starting from Shanghai, whose organizers have cancelled the physical events for the season, directing their organizational strategy towards a digital dimension: not only Live stream presentations of the collections but also allowing brands to sell the items of the current season through Tmall, Alibaba's platform, partner of the event. Likewise, the activities of the showrooms that deal with the wholesale of the Shanghai Fashion Week brands were largely conducted through live streams, videoconferencing appointments and online orders. The specialized technology platforms that turn to fashion - from the Joor digital showroom to the live stream Hero startup - recorded a significant increase in demand during the first half of 2020. In particular, Hero recorded a 20% increase in average orders placed during the first two weeks of March 2020 in the United States when the coronavirus epidemic was gaining speed (LIEBER, 2020).

In the dramatic nature of events, the current emergency highlighted several limits to the system. But these same limits can represent an opportunity for the relaunch of the sector according to new logic and in a more sustainable perspective. Through 3D technology, virtual sampling and planning based on artificial intelligence, fashion brands will have the opportunity to operate more flexibly along the value chain, reducing time to market and adapting more responsively to trends and consumer needs, avoiding waste.

TECH GIANTS TAKING POSITION IN FASHION-TECH

Tech industry's first steps towards a closer relationship with fashion were originally taken autonomously in the 1980s, as the myth of ubiquitous computing and the notion that computers could be essentially carried everywhere began to make their way through the sector. Fashion followed much after. Today the dynamics do not seem to have changed. In fact, while the fashion industry is defining strategies for adopting sustainability-oriented measures and getting ready for digitization, the technology industry has taken a stand (ThePowerHouse Group, 2020). Fashion and fabric companies are lagging behind in the wave of innovation and are not keeping up with the tech giants in asking and obtaining patents in the sector and fashion will be forced to pay expensive license fees to use these technologies. In fact, today various are the examples of IT companies patenting Fashion-Technologies. 2015 was a crucial moment in this context (O'Mahony, 2020). In fact, that year, Sarvint Technologies Inc filed a lawsuit against a number of brands, including Ralph Lauren Corp, Adidas and Sensoria. The lawsuit related to the alleged infringement of U.S. Pat. n. 6,381,482 (2002), 'Fabric or garment with integrated flexible information infrastructure' and U.S. Patent n. 6.970.731 (2005), an innovative tissue-based sensor for monitoring vital signs. Although Sarvint ultimately lost to Sensoria in 2017, the lawsuit kicked off tricks from industry players, prompting them to become more protective of their IP to avoid episodes of this nature. The tech giants are moving rapidly towards the industry monopoly: Google, Samsung, Apple and Microsoft are taking the lead in marketing smart clothing and fabrics and filing dedicated patents. In particular, in November 2019, Microsoft filed a patent for electronically functioning yarns and a second patent in which it brought its idea of smart fabric one step further with the smart glove project, made of electronically functional fabric (Jones, 2020). IDTechEx chief analyst, James Hayward, says that for the vast majority of textile companies, e-textiles are not an option. Online research shows that by typing the term "e-textile" between patents, the main assignees come from sectors such as electronics, software, medical devices, energy and sports clothing (O'Mahony, 2020).

02.

LEARNERS AND TRAINERS: FASHION-TECH PEDAGOGY AND SKILLSET

Chiara Colombi, Ann Vellesalu

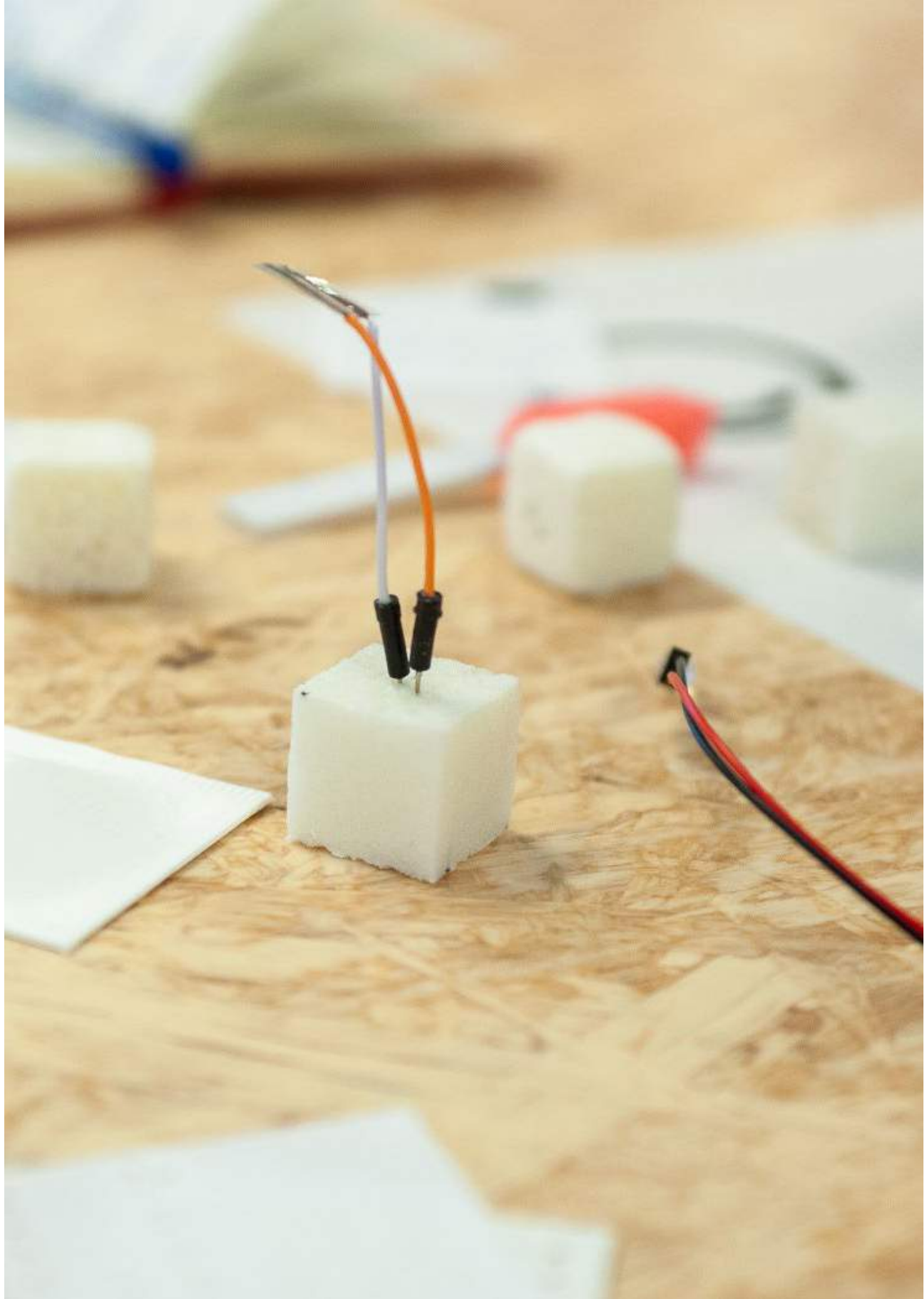
02. LEARNERS AND TRAINERS: FASHION-TECH PEDAGOGY AND SKILLSET

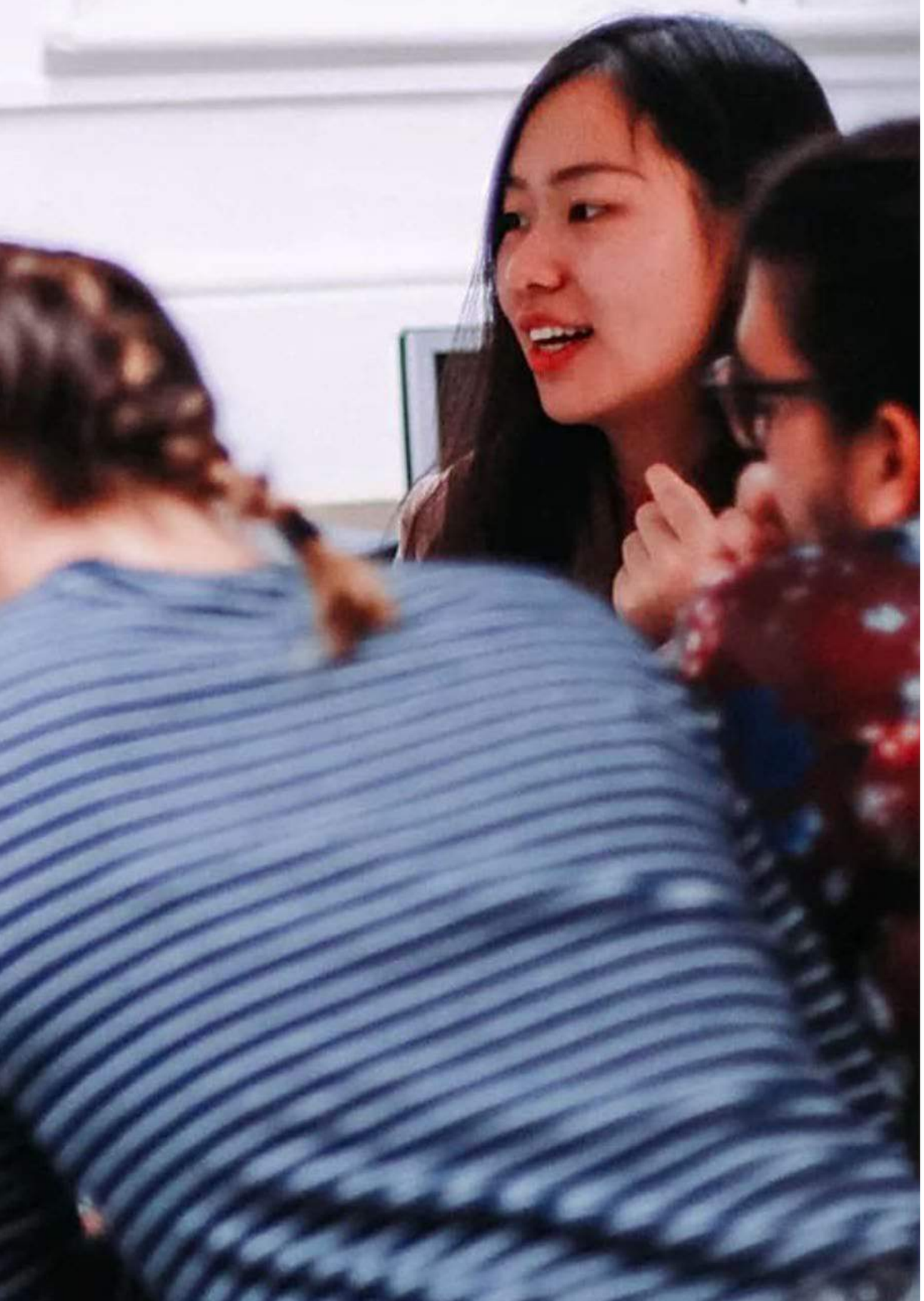
C. Colombi, A. Vellesalu

Five pilot workshops were organized during the 3-years E4FT project with the aim to test and evaluate different approaches to Fashion-Tech. Each workshop was designed to reach specific objectives of the Project.

The Fashion-Tech Hackathon was organized as an opportunity to map current levels of knowledge and skills of learners active and/or interested in fashion-tech. The Train the Trainers short workshop allowed the testing and refinement of the teaching methods identified, adjusted and compiled into a Teacher's Toolkit for fashion-tech, by the teachers of the project members. The following three intensive programs brought together both teachers and learners from the partner universities to test and refine the proposed fashion-tech approaches at the intersection of smart textiles, digital manufacturing and wearables, in real-life situations. Politecnico di Milano (POLIMI) held a 5-day workshop on digital manufacturing, University of the Arts London (UAL) on wearables, and the Swedish School of Textiles – University of Borås (HB) on smart textiles. The workshops were not only the key activities to interact and gain feedback/learn from the learners participating in the project but also aimed to ensure that the courses developed are relevant and transferable to different fields of fashion-tech, different institutions and different regions, ensuring the project results are truly adjustable and sustainable. As all activities had a transnational approach (involving trainers and learners from each of the partner universities), they contributed to the mobility of these participants providing the added benefit of shared learning experiences, greater opportunities for knowledge sharing between institutions and its teachers & learners, as well as for further collaborative opportunities beyond the project. During the pilot workshops, the monitoring process aimed to assess the overall quality and success of

each delivered training program. Central to this process it was the use of evaluation forms and questionnaires that the participants completed before and/or after each workshop. The methods were designed to provide accurate feedback and assessment relating to the depth and quality of the material delivered, the relevance of the subject matter, and the teaching practices employed throughout the intensive teaching and learning period. In addition, a peer observation process was adopted within the for the participating teachers. Peer observations offer critical insights into an instructor's performance and complement the student ratings and feedback forms. Combining both perspectives contributed toward a more comprehensive and accurate representation of the overall teaching quality. Lastly, informal group discussions were held at the end of each workshop to openly discuss and collate any additional areas or matters that they wish to raise or express, which may not be best achieved using feedback forms or questionnaires. An in-depth analysis of each learning, teaching and training experience follows.





FASHION-TECH HACKATHON

Observing the current state of skills and knowledge in Fashion-Tech at UAL

DATE

July - September 2018

PROJECT LEADER

UAL

GOAL

This Fashion-Tech hackathon aims to:

- Map the current state of skills and knowledge in Wearables.
- Document approaches/obstacles to cross-disciplinary collaboration.
- Identify requirements for supporting bespoke curriculum developments within this space.

PROJECT BRIEF

Fashion and technology are increasingly merging, specifically in three areas: wearables, smart textiles and digital manufacturing. Edu4Fashion-Tech team researched around these three areas and found out five emerging directions for Fashion-Tech:

1. Protection and body enhancement through artificial second skin: wearables and smart textiles with embedded sensors are able to monitor physiological, neurological and body kinematic parameters that are critical for healthcare.
2. Culture driven wearable: art, technology and interaction: generating thoughts and knowledge around human behaviours, interaction with the body, other people and the environment.
3. Hyper-body: connecting senses and materials: involving three of the five senses (eyesight, hearing, touch) enhancing or “substituting” them.

4. Fashion takes care: sustainability across design, production and retails covering the entire supply chain and it is intended as efficiency, recyclability, transparency, mission orientation and ethical upgrades.
5. Real/Virtual mixed environments: analogical/digital places created and customized with mixed reality as a result of the addition of virtual and augmented reality; new dimensions for self-assembly and programmable materials; artificial intelligence for all the supply chain.

Starting from the MACRO trend assigned, develop:

- DEBRIEFING
- RESEARCH TROUGH CROSSFERTILIZATION (research in different fields as architecture, art, science, industrial design, nature..);
- BLUE SKY RESEARCH (curiosity-driven science);
- ANALYSIS OF NEEDS (obvious, declared, hidden);
- CONTEXT RESEARCH (on the market)
- DATA ANALYSIS AND INTERPRETATION (metatrend)
- SCENARIO BUILDING (mood board and scenario of use for wearables or smart textiles or digital manufacturing).
- VISION DESIGN (orientation of ideas following the suggestions of professionals from science, art and technology field, storyboard)
- CONCEPT

LOCATION

Digital Learning Lab, School of Design and Technology - London College of Fashion, London.

ACTORS INVOLVED

- 22 students from MA programs of partner universities
- 1 moderator: Douglas Atkinson, Research fellow at the LCF - Digital Anthropology Lab
- 6 facilitators: (2 LCF, 2 HB, 2 POLIMI)
- 4 keynote speakers: Birgit Freundorfer (Adidas), Fredrik Timour (Neue Labs), Massimo Bianchini (Politecnico di Milano) and Matthew Drinkwater (Fashion Innovation Agency UAL)

METHODOLOGY

As presented in *Innovating Fashion Industry Through Digital Transformation, Research Journal of Textile and Apparel*, a hackathon in its origin entails collaborative practices to solve problems in short time periods [John Duhring], [David Altounian and Sarah Sharif], [E. Kolog, E. Sutinen and E. Nygren], while benefitting from continuous feedback and guidance from mentors and industry experts [S. Chandrasekaran, G. Juckeland, M. Lin, M. Otten, D. Pleiter, J. Stone, and F. Foertter] to accelerate innovation [J. Silver, D. Binder, N. Zubcevik, and R. Zafonte], [A.H. Suominen, J. Jussila, T. Lundell, M. Mikkola, and H. Aramo-Immonen]. With a central idea revolving around a ´rapid iteration of ideas`, participants allocated to a fast paced and high-energy environment [J. Wang, K. Pamnani, R. Capasso, and D. Chang] are enabled group-based learnings in inter-, cross- and multi-disciplinary settings [J. Silver, D. Binder, N. Zubcevik, and R. Zafonte], [A.H. Suominen, J. Jussila, T. Lundell, M. Mikkola, and H. Aramo-Immonen], [J. Wang, K. Pamnani, R. Capasso, and D. Chang]. With a solution-oriented structure, hackathons can be appealing as educational outlets [A.H. Suominen, J. Jussila,

T. Lundell, M. Mikkola, and H. Aramo-Immonen], [J. Wang, K. Pamnani, R. Capasso, and D. Chang], by using them as tools to give students an opportunity to develop problem-solving skills to prepare them for the market [David Altounian and Sarah Sharif], as schools today are not focused on developing the ability to solve 21st century problems [Brandon Zoras]. Furthermore, by urging students to brainstorm, plan and develop projects and prototypes, and pitch concepts [John Duhring], the hackathon model defines a structure and a process around conceptual development [Elizabeth Spaulding and Greg Caimi]. With similarities to project-based and problem-based learning [P.A. Horton, S. Jordan, S. Weiner, and M. Lande], a hackathon model shares the following key elements with the approaches to teaching and learning. Firstly, a challenging problem or question should be raised, along with directing the participants to investigate potential solutions through in-depth research prior to starting the project [P.A. Horton, S. Jordan, S. Weiner, and M. Lande]. Secondly, by allowing participants to have control over their chosen practice or strategy [NSW Department of Education], a sense of ownership is created, which further motivates them to find solutions [P.A. Horton, S. Jordan, S. Weiner, and M. Lande] by gaining a professional experience [John Duhring]. By enabling the participants to present their projects, their performance levels and authenticity of the projects are increased, as they are enabled to demonstrate their knowledge and skills to the community [P.A. Horton, S. Jordan, S. Weiner, and M. Lande]. Moreover, critique and revision on the projects should be enabled by the individuals themselves, teachers, peers and experts [P.A. Horton, S. Jordan, S. Weiner, and M. Lande], by also acting as a support system in the form of mentors and industry professionals for improvements in the development process [9]. By establishing connections between academia and the industry, and other organisations, the students are exposed to community issues [David Altounian and Sarah Sharif] that provides them with an authentic context, participants are motivated to solve problems directly faced by other people or themselves personally [P.A. Horton, S. Jordan, S. Weiner, and M. Lande]. Furthermore, the industry gains from identifying new professionals [David Altounian and Sarah Sharif] due to participants demonstrating their potential value [P.A. Horton, S. Jordan, S. Weiner, and M. Lande]. Furthermore, with a high focus on teamwork [13], participants are encouraged to develop collaborative and communication skills, besides competencies related to design and technology [A.H. Suominen, J. Jussila, T. Lundell, M. Mikkola, and H. Aramo-Immonen], [T. Aungst]. By forming teams of individuals that are not familiar with each other, their interest in new technology and motivation can be enhanced [P.A. Horton, S. Jordan, S. Weiner, and M. Lande], while a balanced set of skills and experiences is relevant [Brandon Zoras]. Additionally, a variety of cultural and linguistic backgrounds can be relevant to motivate the students' collaborative thinking [E. Kolog, E. Sutinen and E. Nygren]. As hackathons are planned on tight timelines to accelerate and encourage creativity and innovation [J. Silver, D. Binder, N. Zubcevik, and R. Zafonte], [A.H. Suominen, J. Jussila, T. Lundell, M. Mikkola, and H. Aramo-Immonen], time is the main aspect that has been found challenging in organising such events [P.A. Horton, S. Jordan, S. Weiner, and M. Lande]. While it can limit the

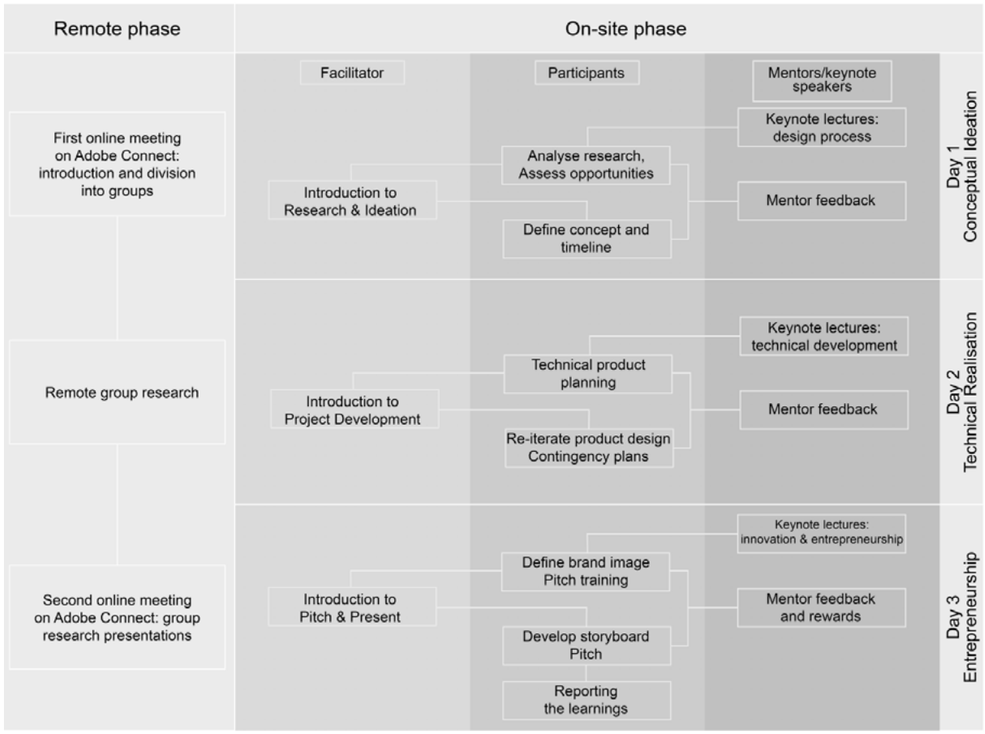
participants' ability to perfect their solutions, it aims to instead achieve functionality and innovation [P.A. Horton, S. Jordan, S. Weiner, and M. Lande]. As the concept of using the hackathon model has been tested and accepted in business settings [E. Kolog, E. Sutinen and E. Nygren], [14], and in education for example within health [J. Silver, D. Binder, N. Zubcevik, and R. Zafonte], [J. Wang, K. Pamnani, R. Capasso, and D. Chang], [T. Aungst] and computer science [E. Kolog, E. Sutinen and E. Nygren], [P.A. Horton, S. Jordan, S. Weiner, and M. Lande], and with its similarities to problem-based learning and a solution-oriented structure, utilising the model as a framework for teaching and learning is of interest within this study, aligned with the previously defined aims.

RESEARCH METHODOLOGY

The hackathon event was planned in two phases: a remote phase initiated 3 months before the event, and an on-site phase (see Fig. 1). The phases consisted of the four steps of the Fashion-Tech design methodology: research, conceptual ideation, technical realisation and entrepreneurship.

WORKSHOP STAGES

During the remote phase, the first online meeting was held 3 months before the hackathon event utilising the online platform Adobe Connect. The first meeting aimed to introduce the participants to their group members and to give them their first task of research. The participants were expected to research their given themes to understand the field and to be able to find problems and gaps on the market, and assess the opportunities.



Structure of the Hackathon Event, Source: Education for Fashion-Tech

Furthermore, all participants were required to answer an online survey, which will be explained below. After the research period, the second online meeting was held, where the participants were asked to present their research, focusing on design, technology and market. The on-site phase took place over three days at the London College of Fashion's Digital Learning Lab. Besides the participants, staff from the E4FT project and keynote speakers from the industry took part in the event, to make expert knowledge available to the participants. The role of the facilitator was to introduce the participants to the different parts of the hackathon and keep them on track with time, while E4FT staff and keynote speakers as mentors were providing support throughout the whole event. The on-site phase focused on the conceptual ideation, technical realisation, and entrepreneurship steps, with a solution-oriented aim of finding an opportunity in the market. To motivate the participants, a first and second-place prize was announced to the two best teams, settled by a peer vote at the end of the last day.

THE OUTPUT

In order to map the competencies related to the Fashion-Tech design methodology, the participants were asked to fill in two online surveys – one at the beginning of the remote phase and one after the hackathon event. The competences were divided into generic and subject-specific competences, defined by the Tuning Document, also produced by the project. Thus, the survey

results provided insights into the perception of the levels of knowledge and skills related to the Fashion-Tech methodology. The two surveys were defined to understand the changes in the perception of the participants, providing information on the value of utilising the hackathon model as a framework for teaching and learning in Fashion-Tech design. Furthermore, the second survey along with group reflections provided information related to student experience and satisfaction. Both surveys thus presented a list of 29 competencies to be evaluated on a 6-point Likert scale, with the second survey also focusing on aspects related to the programme, level of skills within the groups, expectations for the event, and any strengths or weaknesses. The Likert scale was defined based on the perceived level of competence from 'No level of knowledge and/or skills' to 'Excellent level of knowledge and/or skills'. The data was analysed based on a mean average for the perceived level of competences, and through a thematic analysis to pinpoint and examine patterns within the data related to student experience and satisfaction. A total of 23 international students from the partner universities took part of the hackathon event, with 6 students from University of Borås, 11 from the University of the Arts London, and 6 from Politecnico di Milano. For the online surveys, a 95,7% response rate was achieved for the first survey and a 78,3% response rate for the second survey. The response rates were assessed to be acceptable, as while not presenting a full set of data, the results were informative and the response quality was evaluated to be high. The results are divided into competence mapping, where the perceived levels of knowledge and skills are presented in four groups of generic and subject-

specific competences, along with presenting student experience and satisfaction with such educational setting. In total for all four groups of competences, the perceived levels increased on an average by 12,6% for the whole group of 23 students. The data from group reflections and the second survey was thematically analysed, and four main themes emerged as most relevant: content, structure, mentors and keynote speakers, and groups. In terms of content, most participants found the programme to be coherent with the topic of Fashion-Tech tackled intensely, where they learned about the development processes and how to apply them in their studies.

On the other hand, the participants found that a practical phase was missing, with an opportunity to carry out technological experiments or prototyping. Furthermore, they found that the given themes could have been narrower to facilitate defining a specific concept for an application. Regarding the structure, the participants found the event to be challenging and intense in terms of time, which was seen both positively and negatively. On one hand, the structure was positively challenging to achieve more than they thought they would be capable of. On the other hand, some participants found the time to be limiting, relating to adding additional time for research while designing and practical aspects, or even to the remote phase of the event, where the participants suggested allow additional time for presenting their research results in person. The participants also suggested involving computers in the development process, allowing them to use their time more efficiently, while also enabling more research being carried out during the event. The mentors and keynote speakers were found to be relevant, offering diverse lectures, ideas and input throughout the process. The keynote lectures were found important for giving an overview of the state of art in the Fashion-Tech field, while also offering inputs for rethinking their own concepts and designs. Similar to the feedback relating to content and structure, the participants found the technology side of the process to be lacking, especially related to specifically Smart textiles and Wearables. Furthermore, some participants mentioned the necessity of the mentors reminding the groups to stick to their given themes for more narrow applications and more diverse outcomes. As the groups were combined from design and management students, it was of interest how their different backgrounds and experience would enable them to maximise their combined knowledge and skills, and reaching common solutions. Firstly, the participants began by learning about the importance of working in a team, which also reflects in an increase of their perceived level of the competence `teamwork´. Most students found that their group members had complementary knowledge and skills due to their different backgrounds. On the other hand, some participants found the level of competences unbalanced within their groups and stated the necessity of adding a student from the marketing and engineering disciplines into the group.

TRAIN THE TRAINERS

Engaging Teachers in the Fashion-Tech Approach at HB

DATE

26th-28th February 2019

PROJECT LEADER

HB

GOAL

The transnational workshop was utilised to engage the academic team members from the partner universities delivering the intensive study programmers C3-C5 for higher education learners. The main aim of the workshop was to test and refine the methods and approaches to teaching and learning of Fashion- Tech, as developed by the project and compiled into the Teacher's Toolkit.

PROJECT BRIEF

The project brief of the Train the Trainers workshop was to develop an MA-level Fashion-Tech course (learning unit), responding to 7,5-15 ECTS, that would meet the modular structure of a proposed MA curriculum in the Tuning Document. The foundation for developing the course was based on the Tuning Document, and the Teacher´s Toolkit, defining open and innovative methods to teaching and learning Fashion-Tech in higher education. Each group was assigned an overarching topic, referring to the three areas of the proposed MA programme: (1) design and ideation, (2) technology and engineering, (3) human, social, psychological and economic contexts. The participants were also briefed about the philosophy of the project and previous intellectual outputs and activities to give an overview of the objectives of the

project, and its deliverables.

LOCATION

DoTank – Textile Fashion Centre, in Borås Sweden

ACTORS INVOLVED

15 teaching staff members from the partner universities: Douglas Simon Atkinson, Maria Dada, Mouhannad Al-Sayegh, Nathan Philpott, Ella Sharp-Mitchell, Susanna Testa, Livia Tenuta, Chiara di Lodovico, Laura Cipriani, Silvia Deborah Ferraris, Nils-Krister Persson, Erin Lewis, Tuser Biswas, Niina Hernandez, Vijay Kumar.

Their experience ranged from different disciplines related to Fashion-Tech, complemented with a variety of experience with teaching in higher education institutions. For example, the participants had backgrounds in textile engineering, interaction design, material technology, digital embroidery, jewellery design, fashion entrepreneurship and innovation, among others.

The participants were divided into groups based on their focus topic and length experience, to complement those of other group members, and the three focus areas of the to be developed courses.

The workshop was planned and held by the project members from the University of Borås, The Swedish School of Textiles.

METHODOLOGY

By giving the participants the project brief of developing a Fashion-Tech course, the Teacher´s Toolkit was tested and evaluated through practice. The participants were guided through a step-by-step process of developing a course. The steps involved were the following:

1. Define course goals
2. Define/decide competences based on the Tuning Document
3. Determine course content
4. Choose teaching and learning methods based on the Teacher´s Toolkit
5. Plan assignments and assessment
6. Select reading materials and other resources
7. Develop course schedule

The steps for course development were intertwined with group discussion and feedback based on the progress, and each individual tool in the toolkit.

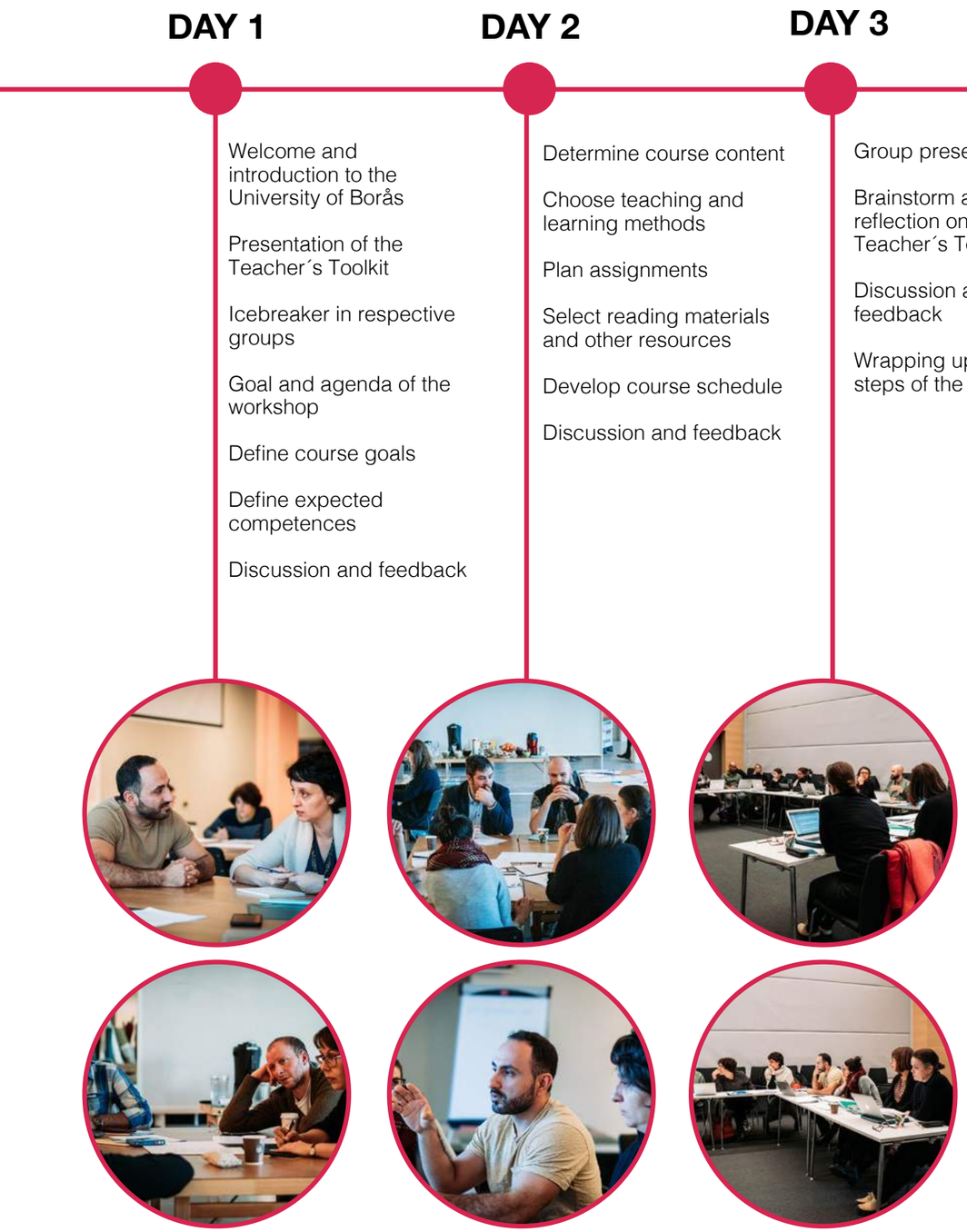
RESEARCH METHODOLOGY

Data from the workshop was captured through participant observation, individual and group discussions and feedback throughout the workshop, which were complemented by interviews with a few participants regarding their aspirations as a teacher of Fashion-Tech, and how they can implement the toolkit in their work.

WORKSHOP STAGES

Day 1

* Welcome and introduction to the University of Borås
* Presentation of the Teacher´s Toolkit



* Icebreaker in respective groups
* Goal and agenda of the workshop
* Define course goals
* Define expected competences
* Discussion and feedback

Day 2
* Determine course content
* Choose teaching and learning methods
* Plan assignments
* Select reading materials and other resources
* Develop course schedule
* Discussion and feedback

Day 3
* Group presentations
* Brainstorm and reflection on Teacher´s Toolkit
* Discussion and feedback
* Wrapping up and next steps of the project

THE OUTPUT

The resulting experience and feedback of working with the Teacher´s Toolkit was analysed and resulted in a refined version of the toolkit, available both online and pdf for print.

IAMLIGHT
Experiencing Additive Manufacturing at POLIMI

DATE

24th - 28th June 2019

PROJECT LEADER

Politecnico di Milano

GOAL

This intensive programme for higher education learners aims to:

- Test the designed curriculum's pedagogy and teachers' toolkit in real settings;
- Engage learners in an intensive transnational, multicultural and interdisciplinary collaboration, to test not only their technical abilities but also their interpersonal skills;
- Facilitate learners' ability to divergently personalise their learning within the fashion-tech fields thanks to the use of blended tools and on-field activities;
- Prototype and evaluate the quality of possible outputs as Fashion-Tech artefacts too, then, approve methodology and promote it beyond the partnership and into the European communities of HEIS, companies and shareholders;
- Highlight the further learning, teaching, and training opportunities based on the emerging needs of trainers and learners on the field.

PROJECT BRIEF

Design a jewellery piece for Maison 203 company using 3D Printing technique. A design concept that starts from the perception of surfaces depending on the presence or absence of light.

DAY 1

Brief launch

Basic elements of perception; Exercise, from theory to practice;

Peer review and comments + definition and identification of the elements useful for the design concept

Company presentation

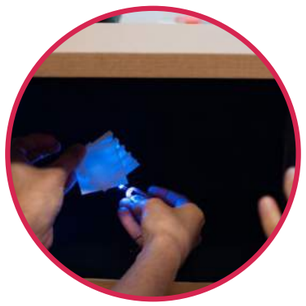
DAY 2

Lecture: Light as design tool

Peer review and identification of guidelines for the design concept

Lecture: Theory on 3D printing, case studies and exercises

Brainstorming + inspirations for research



DAY 3

Lecture: Augmenting/ connecting the human body through digital technologies

Lecture: Jewellery Design Today

Research + Concept definition

Shape definition and development for 3D printing

DAY 4

Collection development in 3D

Finalization of the presentation + prototype check

DAY 5

Presentation check (Inspiration, concept, sketches, technical drawings and 3D modelling)

Final presentation to Maison 203

LOCATION

Polifactory, the official makerspace and FabLab of Politecnico di Milano.

ACTORS INVOLVED

- 1 company: Orlando Fernandez Florez, Maison 203
- 5 Politecnico di Milano staff members from fashion and tech field, 2 (1 fashion 1 tech) with the role of trainers: Chiara Colombi, Patrizia Bolzan, Chiara Di Ludovico, Livia Tenuta, Susanna Testa
- 3 keynotes speakers with the role of expert trainers offering specialised contents to supporting trainers and learners' activities: Daria Casciani, Sara Colombo, Silvia Deborah Ferraris.
- learners from LCF, 6 from Polimi and 4 from HB selected through a call for students, for a total of 15 students, grouped in 5 teams of 3 students, one student forms each partner, to maximise the benefits of an international collaborative experience.

METHODOLOGY

The project envisaged a learning-by-doing part which was compounded by theoretical lessons imparted by experts in Digital manufacturing and 3D Printing, Fashion and Jewellery Design, Fashion-Tech and Communication Design. These supported the whole design process and guided the students through all of its stages.

[redacted]rvation + quantitative results through interviews and questionnaire.

[redacted]

Day 1

* Brief launch
* Basic elements of perception; Exercise, from theory to practice; Peer review and comments + definition and identification of the elements useful for the design concept // Silvia Ferraris
* Maison 203 presentation // Oirlando Fernandez Flores

Day 2

* Light as design tool + Exercise // Daria Casciani - Testing the surface through samples (distance, angle, the relation between light and material) and taking pictures
* Peer review and identification of guidelines for the design concept
* Theory on 3D printing, case studies and exercises // Patrizia Bolzan - Starting from the limits identified during the morning interacting with samples, students will work on 3D models to integrate light
* Brainstorming + inspirations for research

Day 3

* Augmenting/connecting the human body through digital technologies // Sara Colombo
* Jewellery Design Today // Livia Tenuta
* Research + Concept definition // Chiara Di Lodovico, Livia Te-

nuta, Susanna Testa
* Shape definition and development for 3D printing // Patrizia Bolzan

Day 4

* Collection development in 3D // Patrizia Bolzan, Chiara Di Lodovico, Livia Tenuta, Susanna Testa
* Finalization of the presentation + prototype check // Patrizia Bolzan, Chiara Di Lodovico, Livia Tenuta, Susanna Testa

Day 5

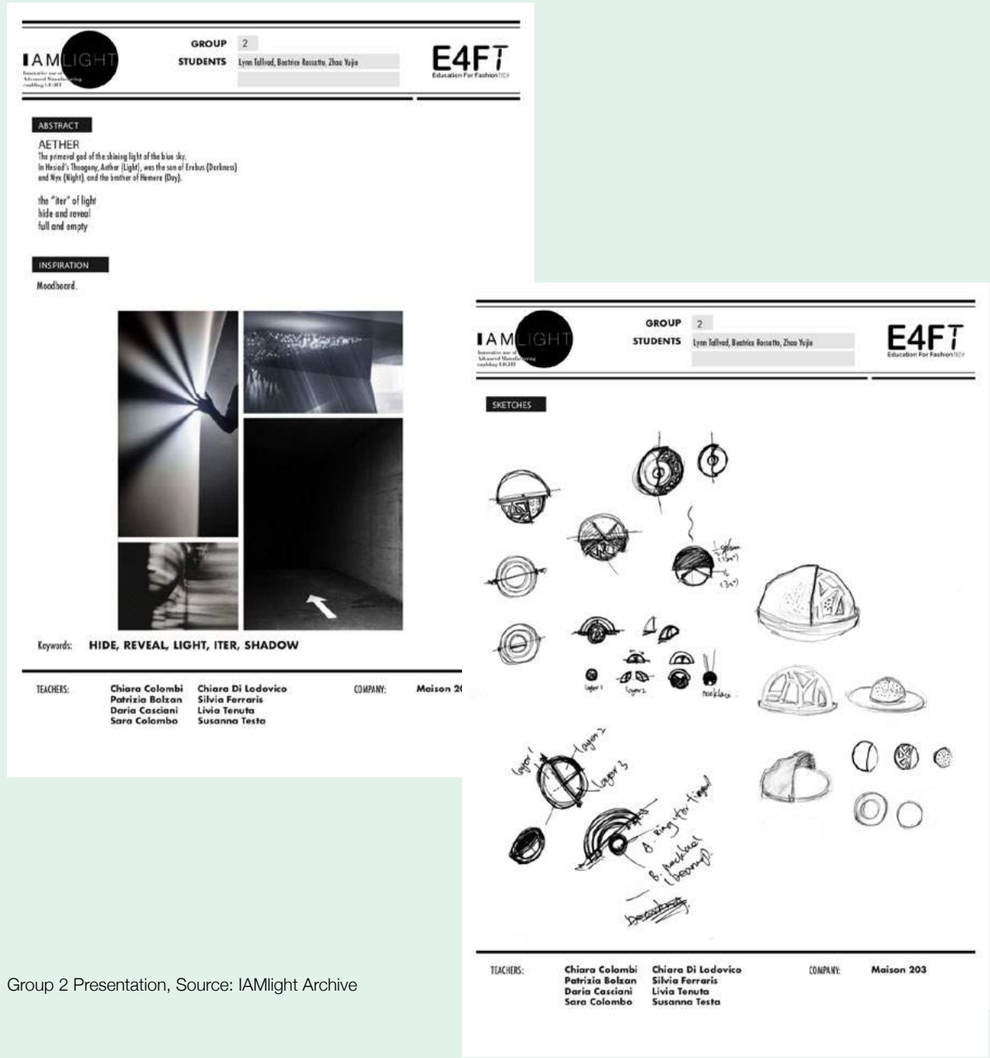
* Presentation check (Inspiration, concept, sketches, technical drawings and 3D modelling) // Livia Tenuta, Susanna Testa, Chiara Di Lodovico, Patrizia Bolzan
* Final presentation to Maison 203 // Orlando Fernandez Flores + workshop team

THE OUTPUT

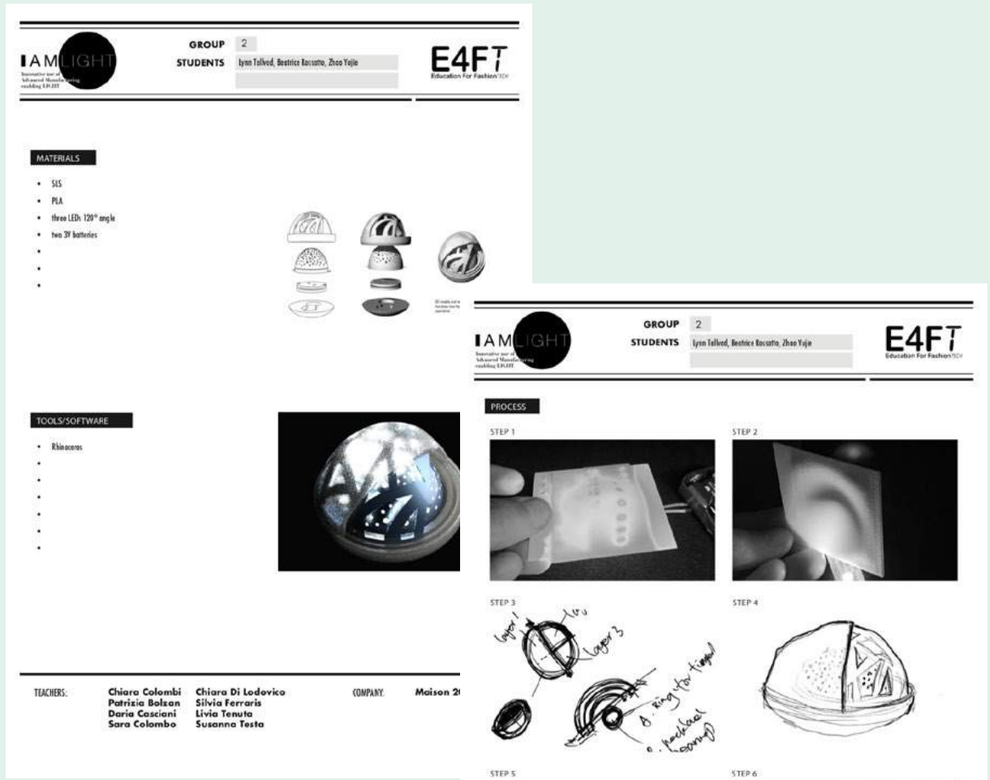
The intensive study programme produced 5 new Fashion-Tech product concepts, delivered with a physical prototype, addressing specific market opportunities in term of product-service, interaction with the users, supply chain management. The groups were asked to produce a presentation including research, concept, sketches, technical specifications and pictures of the prototype/mock-up.

THE OUTCOME

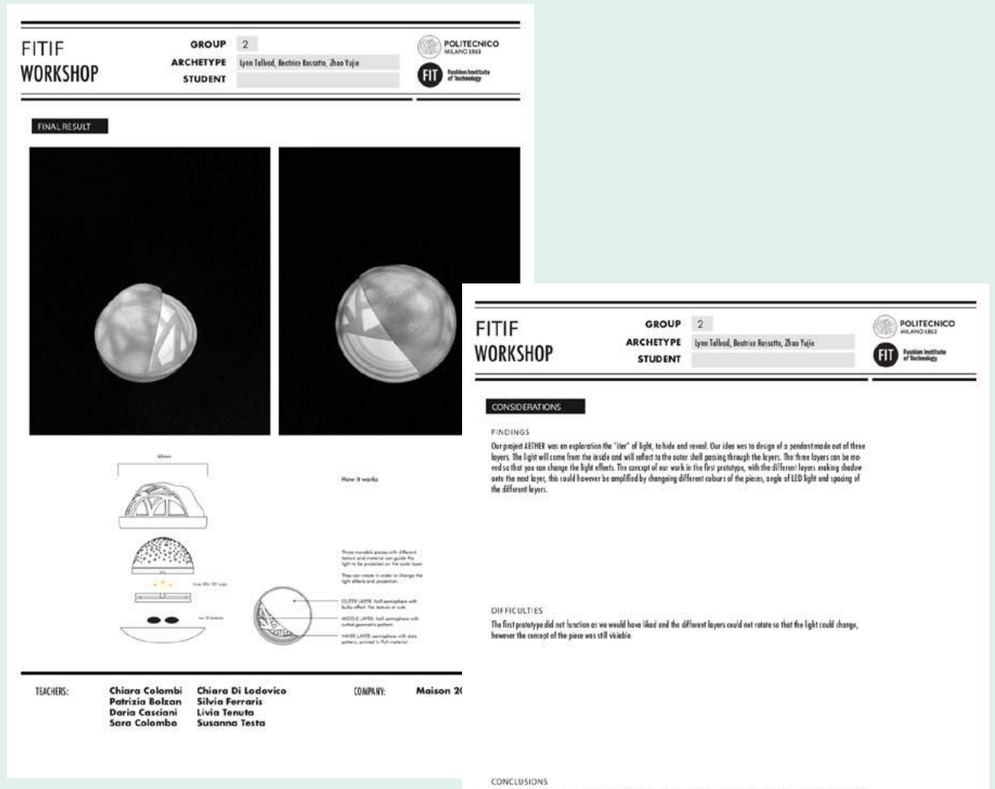
The products designed and prototyped by the various groups envisaged very diverse scenarios for the use of 3D printing and embedding light.



Group 2 Presentation, Source: IAMlight Archive



Group 2 Presentation, Source: IAMlight Archive



Group 2 Presentation, Source: IAMlight Archive

IAM LIGHT QUESTIONNAIRE.*

Was the programme coherent with the main topic of Fashion-Tech?
90% of the participants found the programme coherent.

And what would you change?
The implementation suggestions mainly concern the technical knowledge and range from the implementation of the technical knowledge of 3D software to the desire to have further experimentation with experts in the field of electronics such as circuit integration as well as programming with a microcontroller.

Which are the limits and the opportunities of IAMlight workshop?
Limits

- Time (to improve 3D modelling skills; learn technicalities about light; experimenting with machines)
- Use of Rhinoceros as a crucial skill
- Interdisciplinarity in teams (For example it would have to be preferred: a fashion/jewellery designer working together with a product designer/ architect or even a (mechanical) engineering or electronic student etc.)

Opportunities

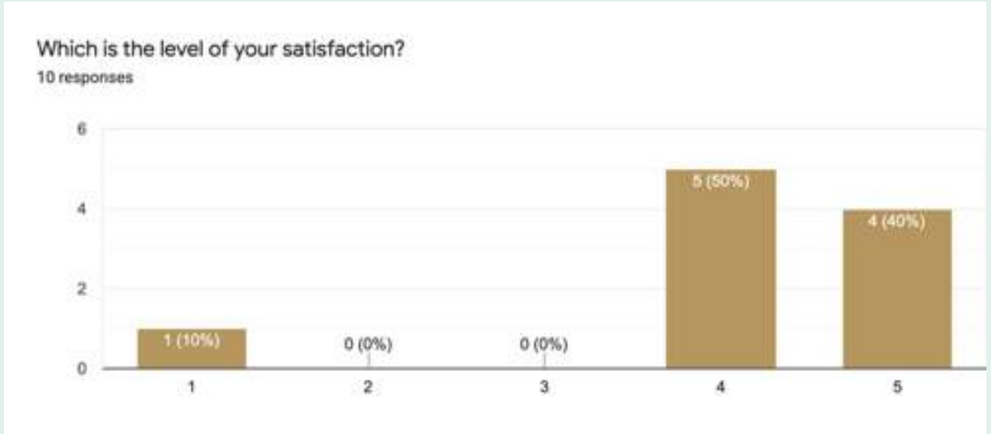
- Theory and practice merge
- Multidisciplinary experience
- Cooperate with a company
- Learning from experts
- Knowledge inputs
- Good simulation of design reality
- Work in a heterogeneous team in terms of knowledge, skills and cultural background

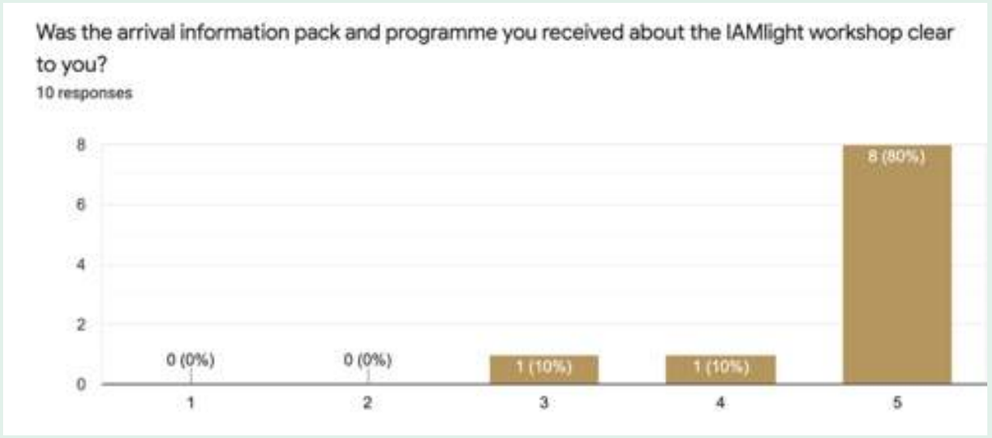
The level of satisfaction for the entire programme, the structure and the organization was very high.

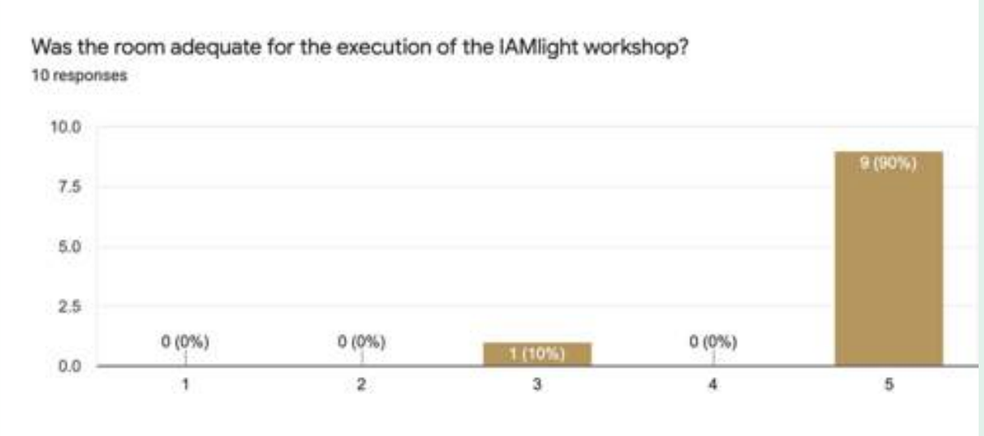
Which is the most important lesson learnt that you took from the programmeme and you will capitalize on your academic education and/or in your professional future?
Understanding the role what a designer could contribute to the field of Fashion-Tech; Need of changing the education curriculum; Importance of communication in group work; Design the piece to satisfy customer's demand; Fields of application of 3D printing.

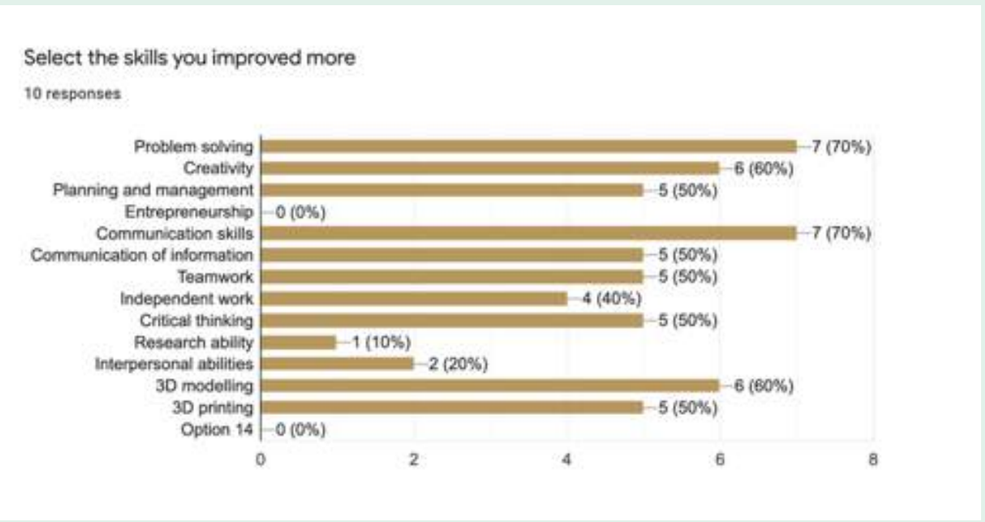
Which are the skills you improved the most?
Problem Solving; Communication Skills; 3D Modeling.

**10 out of 15 participants responded the questionnaire*

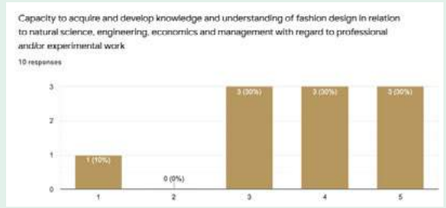


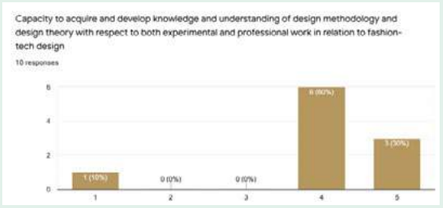


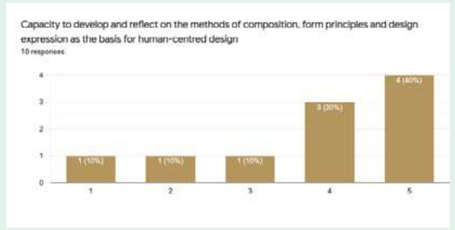


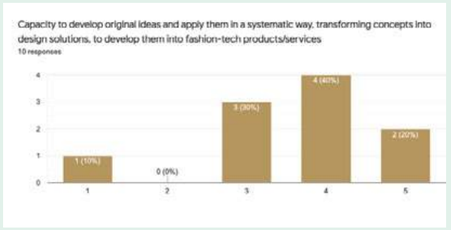


DESIGN AND MULTIMEDIA COMMUNICATION.*

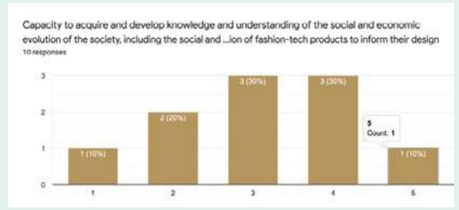


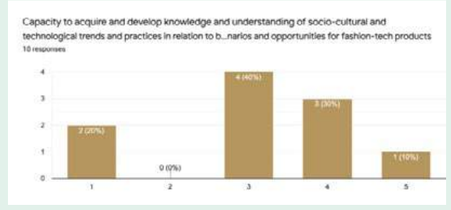


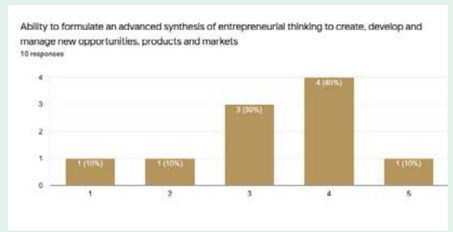


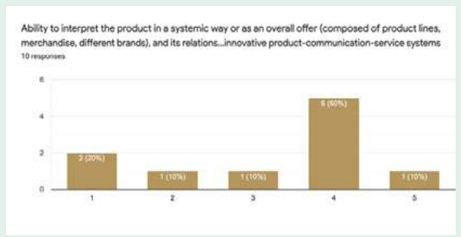


HUMAN, SOCIAL, PSYCHOLOGICAL AND ECONOMIC CONTEXTS.*







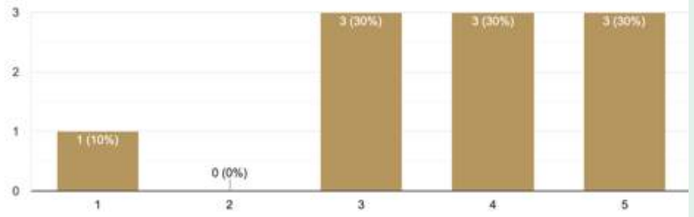


* 1 NO EXPERIENCE ACQUIRED // 5 EXCELLENT EXPERIENCE ACQUIRED

TECHNOLOGY AND ENGINEERING.*

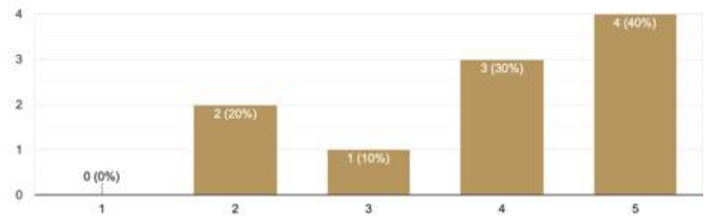
Capacity to function as a catalyst that enables designers to plan, manage and lead design led interdisciplinary research and development proces...r material, products for manufacturing processes

10 responses



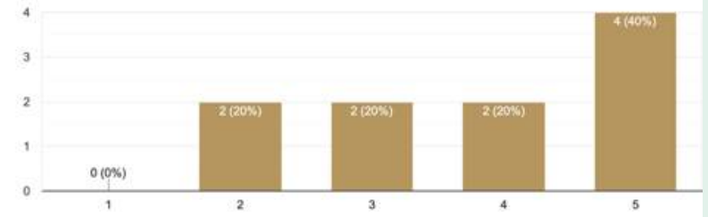
Capacity to acquire and develop knowledge and understanding of materials, processes and applications

10 responses



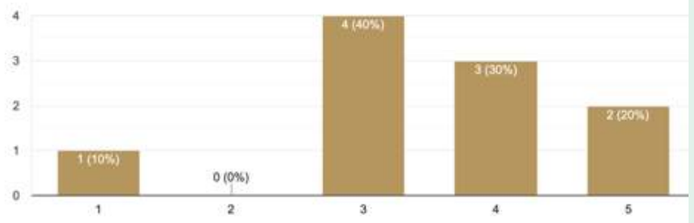
Capacity to acquire and develop knowledge and understanding of wearable technologies, digital manufacturing and their processes

10 responses



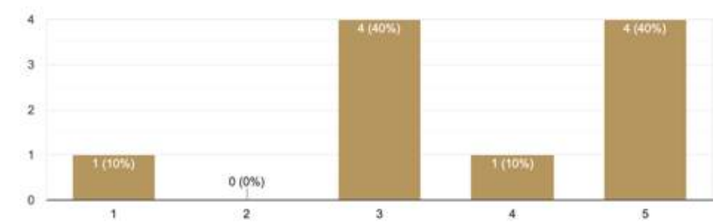
Capacity to acquire and develop knowledge and understanding of collaborative design and innovation methods to deliver more effective ways...ations, disruptive products and products/services

10 responses



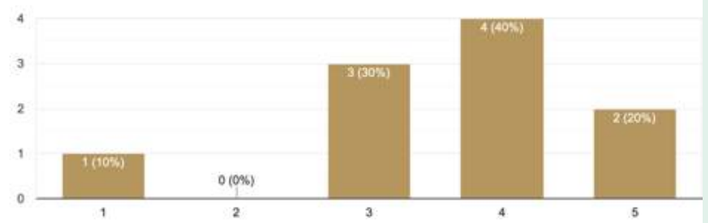
Ability to research and transfer innovation with particular reference to materials, meanings and processes in various fields

10 responses



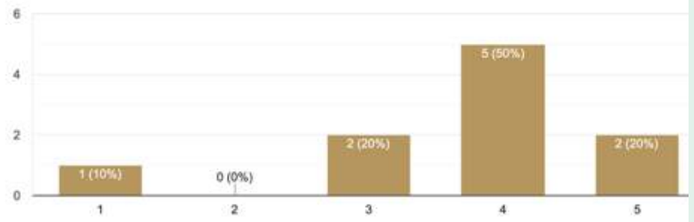
Ability to develop and integrate capabilities in the engineering area and the design area to obtain innovative products and applications

10 responses



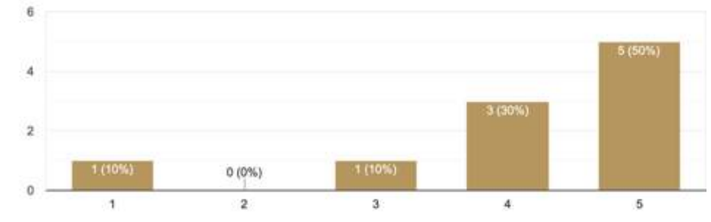
Capacity to evaluate diverse and disruptive forms of innovation that contribute value to a fashion enterprise and shape the future of the fashion/jewellery industry

10 responses



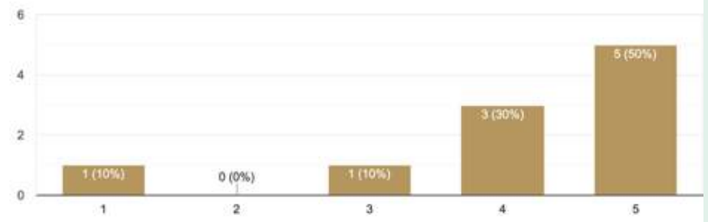
Capacity to creatively and critically envision future possibilities of emerging technologies and propose both new and well explored concepts for o...solutions in socio-cultural and economic context

10 responses



Capacity to transfer knowledge from disciplinary fields to new sectors and applications, favouring the creative solutions of problems

10 responses



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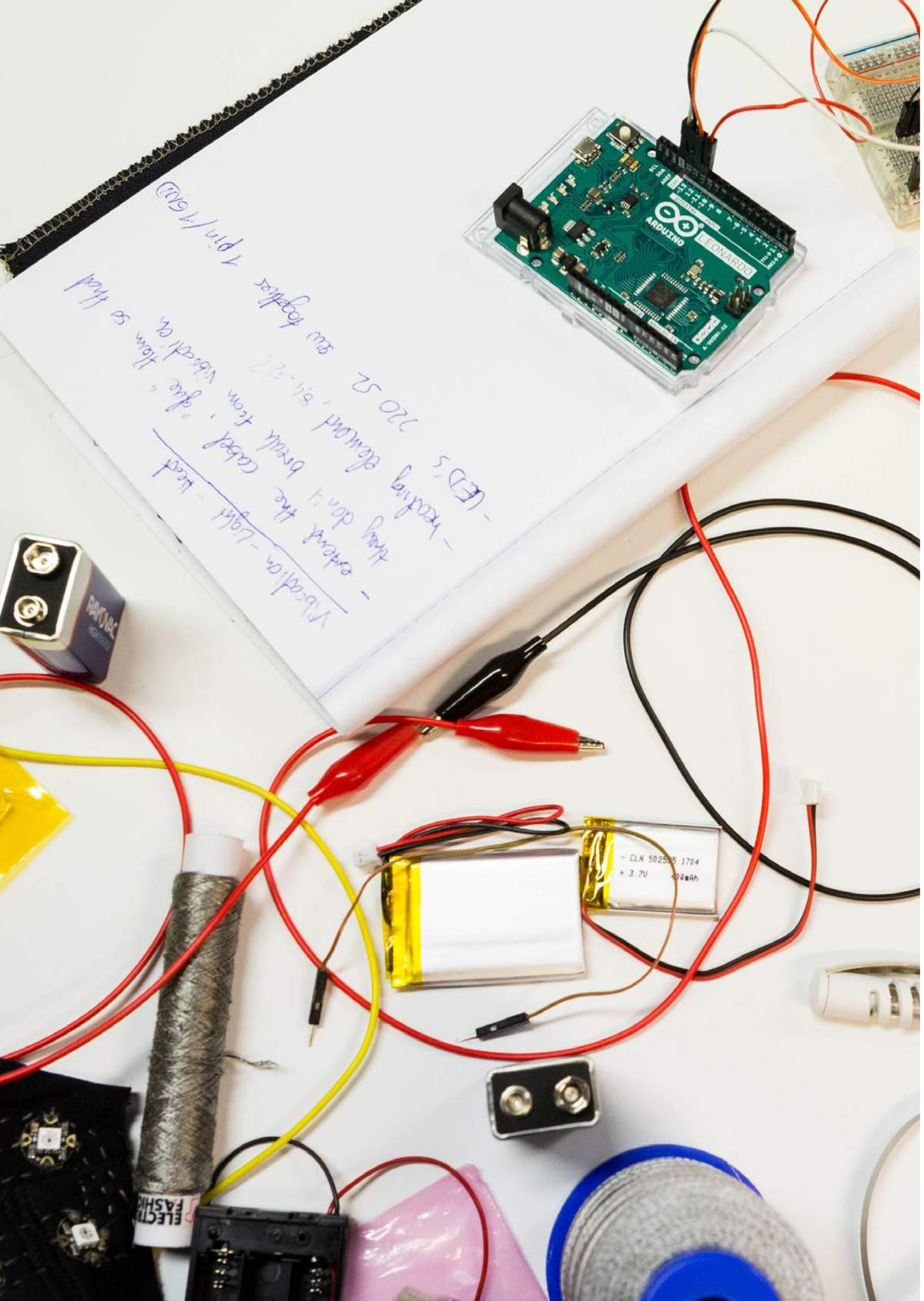


DESIGNING WEARABLES

Intensive programme for learners at LCF

D. Atkinson

DATE

18th - 22nd November 2019

PROJECT LEADER

LCF

GOAL

Introduce participants to real-world challenges experienced by Fashion-Tech businesses, introduce interaction design prototyping methods and physical computing technologies, leading to the creation of:

- a proposal for a Wearable tech product
- an interactive swatch, or sample of a part garment/shoe/accessory
- a detailed design for the interaction with the product

PROJECT BRIEF

Choose at least two INDUSTRY CHALLENGES to combine in your Fashion-Tech project.

PAULINE VAN DONGEN

TOUCH TECHNOLOGY FOR SOCIAL CONNECTION:

1. Explore touch through your own body and in collaboration with your fellow students. Develop your embodied awareness: study how your body touches things (objects, interior and architectural elements) and how your body touches or is “in touch with” other people.
2. Try to describe the type of physical interaction that you encounter or imagine: what are the related “touching” gestures (stroking/tapping etc.) what other qualities play a role (pressure,

direction, rhythm) and finally: try to explore the role of materials in relation to touch (tactility, texture, temperature).
3. Having gained this first-person embodied experience and having exchanged thoughts and ideas with others, now ask questions that will drive your concept development:
- What kind of touching can we invite people (wearers of the garment, but maybe also those who the wearer encounters) to engage in?
- How can the input from a touch-sensitive material/textile be of value for the wearer?
- What situations and what contexts can you imagine in which the act of touching or the experience of being touched play an important role?
- How can the input from a touch-sensitive material/textile be transformed into a useful and intuitively legible output?

KIREN PASSI
BONDING, LAMINATING AND LAYERING TO ADD TECH TO TEXTILES
How can you use a layered bonding process incorporating soft electronics to create practical modern armour? Collectively or individually brainstorm what type of clothing protection would be useful in the following scenarios:
a. Dancing
b. Yoga
c. Long-distance travel
d. Other- what scenarios can you imagine you would need modern protective clothing for?

1. Discover where on the body you would need protection. Can your sensors help discover pressure points? Be inspired by where your body touches the ground/ other objects and takes body-weight, or pressure. For example: experiment with the placement of fabric sensors on the body. Where do they restrict movement? Where will they capture the most useful information? How can you distribute an electronic system across the body, and how can you use it to enhance your design, rather than hiding the technology?
2. Consider the size, shape of the area that would need protection for your chosen activity. Create a series of quick sketches to inspire the type of silhouette/shape the layering should have. Create a silhouette template for your layering technique.
3. Concept questions to think about:
How deep should the protection be?
How many layers of material should be included?
What composition should the layering take?
Explore how many layers are helpful by referring back to the pressure sensors. Bond the layers into a composition that is of a luxury aesthetic.

FREDRIK TIMOUR / NEUE –
CREATIVE, CONNECTED BUSINESS MODELS & BRAND EXPERIENCE
Using the Neue App and NFC tags, how can you develop creative fashion business models or brand experiences which connect the physical world to digital content?
1. If you can turn anything into an Internet of Things (IOT) device with NFC tags, what items would you link to digital content?

What would this content add to your experience?
2. How could digital content connected to a physical object be motivational? For example to encourage people to behave more sustainably, to connect to one another, or to be loyal to your fashion brand?

LOCATION

Digital Learning Lab, London College of Fashion, 182 Mare Street, Hackney, London, E8 3RE.

ACTORS INVOLVED

- 15 students from London College of Fashion, MA Fashion Futures and MA Fashion Design and Technology Womenswear, Politecnico di Milano, MA Design for the Fashion System and University of Borås, MA Fashion Design and MSc Textile Engineering. The participants worked in five groups composed of one member from each partner institution to ensure a diverse range of skills and backgrounds.
- 1 workshop facilitator: Douglas Atkinson, London College of Fashion Research
- 1 tutor: Michèle Danjoux, London College of Fashion Research.
- 4 mentors:
  * Maria Dada – Student mentoring, Arduino coding and physical computing support, London College of Fashion Research.
  * Mouhannad Al-Sayegh – Student mentoring, Arduino coding and physical computing support, London College of Fashion Digital Learning Lab.
  * Fredrik Timour – Professional: Student mentoring & setting industry challenge on behalf of Neue AB & The Swedish Fashion Council.
  * Kiren Passi – Professional: Student mentoring & setting industry challenge on behalf of Kiren Passi Ltd.
- 2 lecturers:
  * Pauline Van Dongen – Professional: setting industry challenge on behalf of Pauline Van Dongen Studio
  * Dr Camille Baker – Visiting Academic, Reader in Interface and Interaction, University for the Creative Arts: student feedback and introduction to other European projects supporting Fashion-Tech.

METHODOLOGY

The workshop was delivered to interdisciplinary groups of students from the three partner institutions, encouraging collaboration between different nationalities, backgrounds and skillsets. The workshop was structured around three industry challenges delivered over consecutive mornings, with afternoon sessions providing technical introductions to constructing e-textile sensors, the Arduino physical computing platform and linking content to a product using NFC. The industry challenges framed a problem-based learning approach which invited students to critically assess the challenges and identify common, cross cutting themes which would allow them to address two or more challenges with their design proposal.
The fourth day of the workshop focused on design ideation and development, introducing UI and UX design methods and card

based design tools. Then refining the design concept and finalising an interactive swatch or sample to represent the technological solution adopted by the design.
The final day allowed time to finish the concept and develop a presentation to communicate it for critique and feedback from peers and mentors. Delivery involved intensive one to one work with each group by the Facilitator and Mentors, along with group demonstrations during the technical inductions.

RESEARCH METHODOLOGY

Participant observation was undertaken by the Workshop Facilitator, this is reflected in the Critical Issues discussed. A student facing questionnaire was conducted to better understand participant experience. Interviews were also conducted with student participants.
workshop video: https://www.youtube.com

WORKSHOP STAGES

Day 1 // SOFT ELECTRONICS
* Welcome - Introduction to the Digital Learning Lab
* Recap of Industry briefs & brainstorm of initial student ideas
* Workshop Induction - Health and Safety briefing for the LCF Open Access Fashion Studio
* Presentation - Kiren Passi - https://www.kirenpassi.com
* Demo - Maria Dada & Douglas Atkinson: touch sensing materials
* Textile sensor making activity - Douglas Atkinson / Maria Dada

Day 2 // NFC TECHNOLOGY & CONNECTED CONTENT
* Connect textile sensors from Day 1 to Arduino and trigger an interaction - Maria Dada / Douglas Atkinson
* Presentation - Fredrik Timour – Neue & The Swedish Fashion Council
* Connect an RFID tag to digital content using the Neue Playground App - Fredrik Timour

Day 3
* Connect an RFID tag to design digital content using the Neue Playground App - Fredrik Timour
* Video Presentations - Pauline Van Dongen - http://www.paulinevandongen.nl & Discussion with Douglas Atkinson. Develop design responses - Douglas Atkinson / Maria Dada / Fredrik Timour
* Design Ideation Activities - Douglas Atkinson/ Maria Dada / Fredrik Timour

Day 4
* Design iteration & Prototyping
* Present initial design ideas and prototypes for feedback - Douglas Atkinson / Mouhannad Al-Sayegh / Fredrik Timour / Camille Baker
* Presentation – Camille Baker - STARTS Ecosystem for science, technology and arts collaborations https://www.starts.eu
* Adapt and develop designs based on feedback

Day 5
* Project Pitching

DAY 1

Introduction to the Digital Learning Lab

Recap of Industry briefs & brainstorm of initial student ideas

Workshop Induction
- Health and Safety briefing for the LCF Open Access Fashion Studio

Presentation
- Kiren Passi
- Demo - Maria Dada & Douglas Atkinson: touch sensing materials
- Textile sensor making activity - Douglas Atkinson / Maria Dada

DAY 2

Connect textile sensors from Day 1 to Arduino and trigger an interaction - Maria Dada / Douglas Atkinson

Presentation - Fredrik Timour – Neue & The Swedish Fashion Council

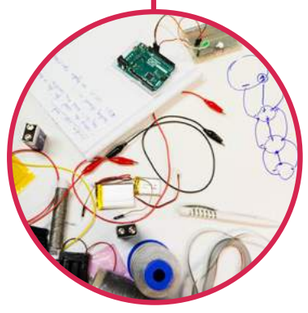
Connect an RFID tag to digital content using the Neue Playground App - Fredrik Timour

DAY 3

Connect an RFID tag to digital content using the Neue Playground App - Fredrik Timour

Video Presentations - Pauline Van Dongen & Discussion with Douglas Atkinson. Develop design responses - Douglas Atkinson / Maria Dada / Fredrik Timour

Design Ideation Activities - Douglas Atkinson/ Maria Dada / Fredrik Timour



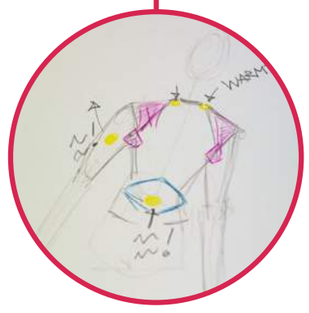
DAY 4

Design Iteration & Prototyping

Present initial design ideas and prototypes for feedback - Douglas Atkinson / Mouhannad Al-Sayegh / Fredrik Timour / Camille Baker

Presentation – Camille Baker - STARTS Ecosystem for science, technology and arts collaborations

Adapt and develop designs based on feedback



DAY 5

Project Pitching

Iteration & Prototyping
Design Iteration & Prototyping

Identify key IP and develop project pitch presentations

Project pitch presentations and feedback – Douglas Atkinson / Mouhannad Al-Sayegh / Jose Teunissen

* Identify key IP and develop project pitch presentations
* Project pitch presentations and feedback – Douglas Atkinson / Mouhannad Al-Sayegh / Jose Teunissen

THE OUTPUT

Interactive Sample 1 – Amplitutor: A posture and motion-sensing garment for music tuition. Using heat and vibration the music student can be prompted to change their form and receive remote, or one to many feedback from a tutor.
Interactive Sample 2 – Crystal Ball: Exclusive event invitations delivered via customised, themed clothing. Using NFC the garment becomes your ticket and allows you to access connected content.
Interactive Sample 3 – Untitled: An elegant connected garment to send emotional messages to a loved one when they are far away, using light, heat and vibration.
Interactive Sample 4 – Fōkus: An active knitted fabric to encourage presence and mindfulness through a focus on the sensations of it stroking the body.
Interactive Sample 5 – Let's Run, Let's Have Fun: touch sensing running top for gamified social exercise, encouraging wearers to play tag with one another and have fun while exercising.
All outputs captured in the Workshop Video on https://www.youtube.com/watch?time_continue=2&v=g2RsQIDBgNE&feature=emb_logo

GENERAL EVALUATION OF THE EXPERIENCE

The following quantitative survey data was provided by eleven respondents who participated in the workshop.

- 5 of 11 rated their experience of the workshop as excellent, with the remainder rating it as very good.
- 4 of 11 rated the content of the workshop as extremely helpful in relation to their current studies. A further 4 rated it as very helpful, with 3 rating it only somewhat helpful.
- 5 of 11 rated the relevance of the invited speakers as extremely relevant, 3 as very relevant and 3 as somewhat relevant.
- 8 of 11 participants felt that they had enough introduction to the workshop technologies to design with them
- On average participants felt that the level of technical instruction was just right. Of those who did not think it was just right, two rated it as too complex and two rated it as too simple.
- The staff were unanimously rated as extremely helpful and friendly, with several participants mentioning staff enthusiasm and helpful instruction in their qualitative feedback.
- All participants felt that they were facilitated to work successfully as a group, with several also mentioning in their qualitative feedback that group work with new people was a highlight of the experience.
- 6 of 11 rated the workshop as extremely well organised, with the remaining 5 rating it as very well organized.

FINDINGS

Qualitative feedbacks

When describing the workshop, participants focused on the support for creativity, benefits of collaborative working and gaining new perspectives on Fashion-Tech.

When reflecting on the new skills and knowledge they had acquired, participants focused on the technical competencies they had gained in Arduino, NFC tags and coding. However, several commented on new perspectives on design development and new design approaches focused on the user:
“How to combine different themes and ideas into one product.”
“A different take on the design process, thinking about the users was a high priority.”
“I like the perspective of adding value to a product using technology, therefore enhancing the consumer-user relationship.” This indicates that the design ideation activities and the user-centred design perspective were both valuable and somewhat novel in the workshop context.

In answer to the question *What did you like most / what did you find most useful about the workshop?* Participant responses were diverse, but four themes recur:

- staff enthusiasm, helpfulness and facilitation of creativity
  “What I liked most during this workshop was how competent the staff were. They could guide us, without killing ideas and frustrating us. They were respectful and willing to share knowledge. There were times that they were more motivated and excited about our project than us :)”
- opportunities for hands on experience with technologies
  “The most helpful thing about the workshop was working with the instruments and applications in person that help us to really feel the idea.”
  “The best parts of the workshop were the hands-on tutorials, where we learned to physically build the technology and learned basic coding. I also enjoyed the speakers that came in, and introduced us to examples of how Wearable technology is used in art and design. It really helped me understand how this technology can be used and how varied the design solutions can be, based on very similar technologies.”
- inspirational speakers
  “I liked the lecture given by Camille. It was very inspiring to know what people are doing in this sustainable area and how they are connected.”
  “I liked to get inspiration from the different speakers and to hear about research in the field.”
- international group collaboration
  “It was really nice and interesting to meet and work with people from all over the world.”
  “I really appreciated that the workshop is organised in collaboration with different universities.”

In relation to the question ‘*What was missing, or what would you have changed about the workshop? What did you like least?’* responses generally focused on the timeframe of the workshop and the confusing, or overwhelming nature of the multiple industry challenges. Three participants indicated they would prefer more time to develop and prototype ideas, or orient themselves to the project. While conversely, one participant indicated they would like less group work and more hands-on introductions to tech, or inspirational speakers to help develop their own practice in future. Three participants noted the multiple industry challenges and a lack of clarity in the communication around how they should respond to them, were they to be viewed as separate,

could ideas from one be developed for another etc.
“The first few days there was a lot of brainstorming. We had a lot of ideas, maybe too much, that might have made it too complicated afterwards.” One participant suggests that more examples of existing fashion- tech garments, or sample Arduino circuits and NFC tags would have helped them to visualize how they could be applied.“I would have liked to see what technology can do, how it can look and more examples of how it could be applied to garments. I think that we struggle to link technology to a garment because we didn’t know exactly what it could do and how it would work; there was a missing link between the teaching part and the application part.” This is a useful comment which can be addressed in future iterations of the workshop through the provision of samples and references. These responses generally support the format of the workshop, with the exception of the multiple industry challenges and the timescale. The majority of participants felt that they would not require any additional information from the workshop. One participant would have liked a clearer overview of the Workshop aims and organisation at the beginning of the process. Another indicated they would like to have known more about smart garments beforehand. Thus, some contextual information could be provided, or form an independent learning task prior to the workshop. Two participants suggested that the workshop could have included more of a focus on sustainability in relation to Fashion-Tech products. This is a highly nuanced area and difficult to cover in a short timeframe, however, it is obviously a significant concern for participants and should at least be discussed in future iterations of the workshop.

One participant from an engineering background commented that they found the level of instruction in Arduino too basic, but that they felt it was appropriate for their peers. They also indicated that they would prefer more of a focus on design methods as they did not have any experience in this area. It will be important to scope the areas and levels of competence of participants prior to future iterations of the workshop (perhaps through a preliminary survey), to ensure different needs are met. This was echoed in a comment that the Health and Safety induction to sewing equipment was simplistic for participants from a fashion background. Broadly the final comments are to be expected when working in multi-disciplinary groups. That they were not seen as detrimental to the overall experience indicates that participants understood the rationale for their inclusion.

Amplitutor group presentation and sample garment
Source: E4FT Archive

Fōkus group presentation and sample textile
Source: E4FT Archive

Let's Run, Let's Have Fun group presentation and sample garment
Source: E4FT Archive

Crystal Ball group presentation and sample garment
Source: E4FT Archive

Connected garment to send emotional messages to a loved one, group presentation and sample garment
Source: E4FT Archive

Source: E4FT Archive

SMART TEXTILES
Intensive programme for learners at HB

A. Vellesalu

DATE

24-28th February 2020

PROJECT LEADER

HB.

GOAL

The goal of the last intensive workshop was to test the training resources developed by the project. An additional goal was to pilot the community platform in an educational experience to test its functions.

PROJECT BRIEF

The project brief was to develop a textile material based on a selection of the presented techniques (knitting, weaving, thermochromic printing, conductivity) by exploring the context of application around the body through an understanding of how to use Smart textiles to design a Wearable, by considering the whole system, including the power source.

LOCATION

Textile Museum and textile labs (sewing, knitting, weaving, printing, electronics) of the University of Borås, Swedish School of Textiles, located in the Textile Fashion Centre, in Borås, Sweden.

ACTORS INVOLVED

- 10 students in total, 5 from the Swedish School of Textiles and 5 from London College of Fashion, University of the Arts London. The background of the students offered a variety of

areas and levels of experience, ranging from fashion design, to textile engineering and sustainable design.

- Teaching staff involved in the workshop included:

*Delia Dumitrescu is a professor in the department of design. In her work she focuses on architecture, interaction design, and textile design - and everything in between - with the aim of developing new materials. She has extensive experience in machine knitting and is managing the Smart textiles Design Lab, which, among other duties, involves dissemination of their research, both within the industry as well as academia, and thereby stimulating research collaboration.

*Marjan Kooroshnia is a senior lecturer in the department of design. Her PhD work focused on exploring the design properties and potentials of leuco dye-based thermochromic inks when printed on textiles to expand the range of colour-changing effects offered by thermochromic inks on textiles, as well as to facilitate communication regarding, understanding of, and design with thermochromic inks. Currently she teachers and supervises both BA and MA students in subjects related to colour, dyeing, printing and finishing of textiles.

*Erin Lewis is a doctoral student in the department of design. Her PhD research explores magnetic and electromagnetic textile expressions through a process of material exploration and textile design experimentation. Prior to her studies in Sweden, Erin was an instructor at OCAD University in her beloved hometown of Toronto, Canada, where she taught Wearable electronics and Wearable computing within the Faculty of Design, and was a Senior Researcher within OCAD University's Wearable technology design lab, the Social Body Lab (2010-2015). From 2011-2015 she was the Coordinator of the Toronto Wearables Meetup. In 2015 Erin held the position of Education Manager at InterAccess, Canada's preeminent new media art gallery.

*Vidmina Stasiulyte is a doctoral student in the department of design. She started her career as a conceptual fashion designer and created various projects in this media: costume performances, individual costume collections, and textile installation (BA in Apparel Design and BA in Fashion Design). Later Vidmina expanded her practices in different media such as interactive sculpture, sound, and installation art (MA in Visual Arts). She is also experienced in teaching and evaluating fashion design programmes. Since 2015 she has been doing practice-based research in fashion design, within the ArcInTexETN programme, by investigating the non-visual aesthetics of fashion.

*Peter Ljungstrand is a studio director and senior researcher at RISE (Research Institutes of Sweden), in the department of interaction technologies. He has experience in building working prototypes of interactive Wearables by using electronics, sensors, software and smart fabrics.

*Fredrik Timour is the founder of Neue, a platform for digital fashion development including both hardware, software and cloud services, for fashion brands and end-user applications. Currently, he works for the Swedish Fashion Council as Head of Innovation, where he is setting up a new innovation centre for sustainable fashion. With a broad, deep and holistic perspective to digital fashion, he has been running

courses in Fashion-Tech at Fashion Institute of Technology - NYC, London College of Fashion - London, IFA - Paris, Beckmans - Stockholm.

* Lisa Lang is a European entrepreneur, technologist and international speaker. Her brands ElektroCouture and ThePowerHouse are leading agencies for FashionTech, Wearable technologies, Smart textiles manufacturing and making things glow. She is recognized as one of the top 50 women in tech (EU), top 100 most influential people in Wearable tech worldwide, one of 25 leaders in fashion and technology worldwide, and has been listed as one of the 50 most important women for innovation & start-ups in the EU.

- Further staff from the University of Borås, Swedish School of Textiles involved lab technicians supporting the students with their projects.

METHODOLOGY

The workshop aimed to allow the students enough time to experiment with the presented techniques and their ideas. While the structure was provided through planned lessons for each main area of the workshop, along with involving keynote speakers and an industry presentation, the students were asked to explore the context of application around the body through an understanding of how to use Smart textiles to design a Wearable, by considering the whole system, including the power source.

RESEARCH METHODOLOGY

Data relating to participant experience with the workshop

was collected through interviews and online surveys pre- and post-workshop. The interviews focused on teachers' experience with teaching Smart textiles and their perspective on the opportunities and limitations with the workshop, and students' perspective on the opportunities and limitations with the workshop, and their takeaways from the experience. The surveys focused on mapping the students´ skills related to the main areas of the workshop and development of generic competences as defined in the Tuning Document.

WORKSHOP STAGES

Day 1

* Introduction to the workshop
* Introduction to the labs and the Textile Fashion Centre
* Introduction to printing with thermochromic inks
* Introduction to conductivity in textile materials
* Reflecting on the day's activities on the e4ft.eu

Actors involved: Marjan Kooroshnia, Erin Lewis, Delia Dumitrescu, Ann Vellesalu, lab technicians

Day 2

* Gathering at the museum
* Company presentation – Inuheat
* Introduction to experimental knitting
* Introduction to experimental weaving
* Feedback
* Reflecting on the day's activities on e4ft.eu

Actors involved: Marjan Kooroshnia, Delia Dumitrescu, Vidmi-

DAY 1

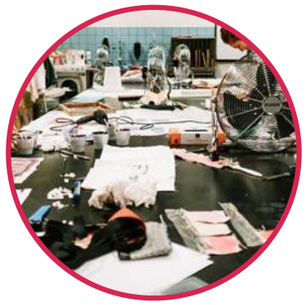
Introduction to the workshop

Introduction to the labs and the Textile Fashion Centre

Introduction to printing with thermochromic inks

Introduction to conductivity in textile materials

Reflecting on the day's activities on e4ft.eu



DAY 2

Company presentation – Inuheat

Introduction to experimental knitting

Introduction to experimental weaving

Feedback

Reflecting on the day's activities on e4ft.eu

DAY 3

Gathering at the museum

Presentation – Peter Ljungstrand (RISE)

Experimentation in the labs

Feedback on day´s progress

Reflecting on the day's activities on e4ft.eu

DAY 4

Presentation – Fredrik Timour (Swedish Fashion Council)

Making prototypes

Feedback

Finalising prototypes

Reflecting on the day's activities on e4ft.eu

DAY 5

Presentation – Lisa Lang (ThePowerHouse)

Develop project pitch presentations

Project pitch presentations and feedback

na Stasiulyte, Rickard Rosendahl (CEO – Inuheat), Ann Åström (Textile Engineer – Inuheat), Ann Vellesalu, lab technicians

Day 3
* Gathering at the museum
* Presentation – Peter Ljungstrand (RISE)
* Experimentation in the labs
* Feedback on day´s progress
* Reflecting on the day's activities on e4ft.eu

Actors involved: Marjan Kooroshnia, Erin Lewis, Delia Dumitrescu, Peter Ljungstrand, Ann Vellesalu, lab technicians

Day 4
* Presentation – Fredrik Timour (Swedish Fashion Council)
* Making prototypes
* Feedback
* Finalising prototypes
* Reflecting on the day's activities on e4ft.eu

Actors involved: Marjan Kooroshnia, Erin Lewis, Delia Dumitrescu, Fredrik Timour, lab technicians

Day 5
* Presentation – Lisa Lang (ThePowerHouse)
* Develop project pitch presentations
* Project pitch presentations and feedback

Actors involved: Erin Lewis, Delia Dumitrescu, Fredrik Timour, Lisa Lang, Ann Vellesalu, Jonas Larsson

THE OUTPUT

The intensive study programme produced 5 new Smart textiles, delivered with a physical prototype.

GENERAL EVAUATION OF THE EXPERIENCE

In summary, both staff and students were satisfied with the experience of participating in the workshop. While the schedule was intense and limited timewise, thus not leaving enough time for deeper investigation into the presented techniques, working in multi-disciplinary groups in an open space and a variety of labs allowed for innovation and concept development, facilitated by the fact that the resulting work was not assessed.

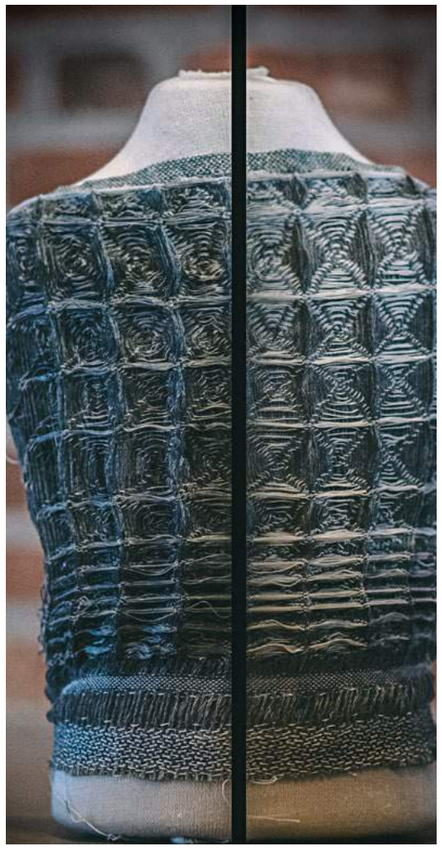
FINDINGS

Combining the experience of the staff and keynote speakers, and the variety of backgrounds of the students, the students were free to explore the application of conductivity and printing with thermochromic inks when designing Wearables. Through the pre- and post-workshop surveys, the students evaluated their knowledge and skills on knitting, weaving, sewing, printing and conductivity. Based on their evaluations, the perceived levels of knowledge and skills were evaluated higher for weaving, printing and conductivity after the workshop. Furthermore, several generic competencies were perceived to be higher post-workshop, especially those related to problem-solving, critical thinking and information literacy, all related to the experimental nature of the workshop.

CRITICAL ISSUES

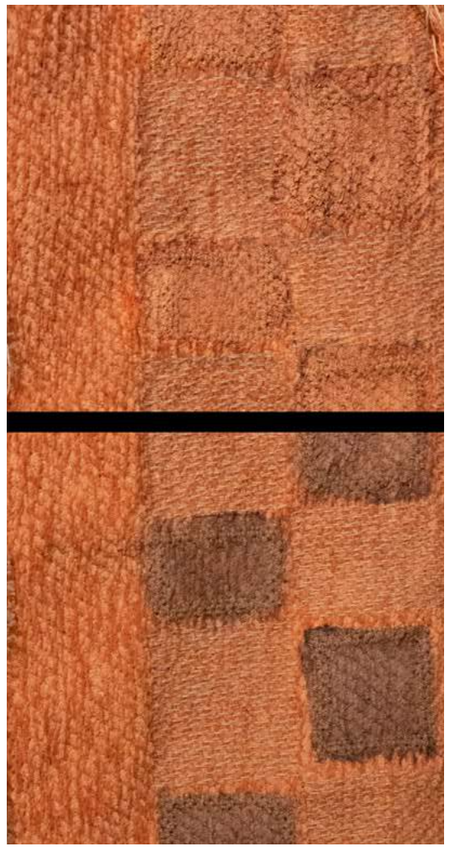
First, with the students from Polimi not being able to attend the

CONCEPT 1



Prototype of Ellinor (HB) and Carla (LCF)
Source: E4FT Archive

CONCEPT 2



Prototype of Xue (HB) and Joshua (LCF)
Source: E4FT Archive

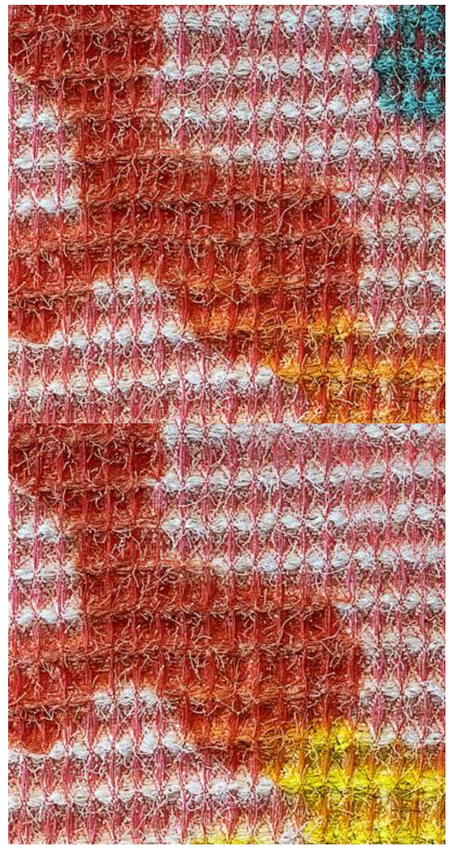
CONCEPT 3

Prototype of Bilel (HB) and Marie (LCF)
Source: E4FT Archive

CONCEPT 4

Prototype of Nicolas (HB) and Jiamin (LCF)
Source: E4FT Archive

CONCEPT 5



Prototype of Matilda (HB) and Diane (LCF)
Source: E4FT Archive

workshop, the groups were lacking of design skills, as the students were placed in groups based on their previous experience and education. This added some confusion in the beginning stages of ideation, where the students were more aware of the technical side of their idea but were struggling with the aesthetics.

Secondly, the experience of the involved staff and keynote speakers favoured a more experimental approach to teaching and learning Fashion-Tech design, while involving an industry representative meant including a very detailed problem presentation to be solved by the students. Based on the students´ feedback, the industry brief was too restrictive when learning about new areas of integrating fashion and technology.

A CRITICAL ANALYSIS: LEARNINGS FROM HANDS-ON EXPERIENCES

From the very beginning, all activities were designed to complement each other. Additionally, the results of the workshops fed into the development and finalisation of the Teacher´s Toolkit and Learning Units.

Train the Trainers short joint workshop allowed the testing and refinement of the Teacher's Toolkit by allowing the sampling teaching methods and approaches developed. Learnings from the workshop were fed back into the project to refine the toolkit. The structure and themes for the Learning Units were inspired by, and partly utilized during the intensive programs, that brought together learners and teachers. So each activity was affected by the previous one. Additionally, some common findings were identified, and it is interesting to highlight them as they start to trace the outline of what Fashion-Tech is and needs today.

Basic Knowledge both in Design and Technology.

What has emerged is how necessary it is to have a basic technical and technological knowledge for designers to understand, manage and design Fashion-Tech and at the same time for students with a technical specialization to have a basic knowledge of methods in design. Consequently, this requires more time in learning, no longer dedicated only to digital technologies or design-oriented subjects, but both.

Power of Interdisciplinarity in Teams.

Fashion-Tech involves different disciplines and it is unthinkable that a single individual is able to have knowledge in each specific subject. This is why collaborative working is essential because a multidisciplinary experience enriches all members of the team by creating an exchange of knowledge between them, facilitate learning and management of different topics that require different specializations..

Learning by Doing.

Learning by doing has its beating heart in concrete experience. It is based on the assumption that only through action, through doing, is a deeper understanding and true learning possible. Students do not learn through traditional frontal lessons, which transmit a defined amount of knowledge, but "learn by doing". The advantages of learning by doing related to Fashion-Tech are many, but can be summarised in four points:

- It increases the participants' engagement because they learn through engaging and dynamic experiences that reduce the distance with cryptic themes to approach such as the integration of technologies;
- It helps to bridge the training gap deriving from an exclusively theoretical approach: the learning processes are effective, fast and continuous.
- Helps to contextualize the notions, principles and tools learned in real situations
- It allows to test the skills being trained right away and do a test of what works - note that technology must be functional to be used.

In all organized activities the involvement of companies and professionals in the sector were perceived as an added value. Learning from experts, immersing oneself in reality with real challenges and problems such as cost management, industrial production or sales, the very tight deadlines stimulated participants in the production of results and made it easier to identify design constraints.

Contact with Reality.

03.

FASHION-TECH CURRICULUM: A NEW FRAMEWORK

Chiara Colombi, Jose Teunissen

03. FASHION-TECH CURRICULUM: A NEW FRAMEWORK

C. Colombi, J. Teunissen

The Fashion-Tech Design curriculum for higher education was designed to offer the Fashion and Design Higher Education sector points of convergence, and enable a wide up-take across Europe. The educational resources developed are aimed at HEIs in the European Higher Education Areas (EHEA).

In detail three outputs were developed to contribute to the Fashion-Tech curriculum: the Tuning Document, the Learning Units and the Teacher's Toolkit.

The Tuning Document aims to form a basis for education in the field of Fashion-Tech design. Furthermore, by responding to a market and industry need for hybrid professionals, the document will establish the interdisciplinary education within the field. The Teachers Toolkit aims to act as a resource for teachers with innovative teaching and learning methods and approaches. By complementing the basis for curriculum development defined by the Tuning Document, the toolkit further feeds into the development of the course modules and training units. The Learning Units aim to provide higher education teachers with guidelines for developing courses and programmes in Fashion-Tech. The purpose of the units is to provide learners with knowledge, skills and approaches specific to the 3 key areas: Design and Ideation, Technology and Engineering and Human, Social, Psychological and Economic Contexts.
The resources are presented in-depth in this chapter, and are free to use and adapt by HEIs within the EHEA, and globally.

The Tuning Document, Education4Fashion-Tech, Source: https://www.e4ft.eu

TUNING DOCUMENT: OUTLINING POINTS OF CONVERGENCE FOR MA LEVEL CURRICULA IN FASHION-TECH DESIGN

Due to the fast pace and variability of the field, and in order to tackle the issues related to fragmentation of the industry, the project and the Tuning document aims to define and establish the education and research of the field, in order to facilitate higher education institutions across the EHEA to find points of convergence and common understanding. Furthermore, the document will form a basis for the institutions to (re-)design, develop, implement, evaluate and enhance the quality of their current and planned degree programmes, that will educate and prepare professionals with interdisciplinary knowledge and skills of the area. The document follows an approach developed by the project Tuning Educational Structures in Europe, aiming to implement the Bologna Process at the institutional and subject area levels of higher education. It emphasises that universities should aim to find points of convergence and common understanding, rather than coordinating their programmes into a pre-defined set of European programmes. Thus, the Tuning Document aims to form a basis for education and research at the subject area level for a MA programme in Fashion-Tech Design, that can be utilised for designing curricula in the field. Furthermore, the TUNING Guide is utilised for guidance for formulating the Degree Profile (available in the Annex), to specify and summarise the subject area in terms of its level, distinctive features, key learning outcomes and competences. The following section defines the programme objectives, followed by the characteristics of the programme. Thereafter, the learning outcomes are defined, which are followed by generic and subject-specific competences. The next section describes how the basis can be utilised to design, re-design, evaluate or implement new or already existing programmes for education in Fashion-Tech design. Thereafter, the assessment criteria are defined, in which the learning outcomes are connected to the assessment criteria.

OBJECTIVES

The following section describes the general objectives of the programme as a second cycle education, followed by programme objectives specific to a MA programme in Fashion-Tech Design.

General Objectives

Second cycle education shall essentially build on the knowledge that students acquire in first cycle education or corresponding knowledge. Second cycle education shall involve a deep-

ening of knowledge, skills and abilities relative to first cycle education and, in addition to what applies to first cycle education, shall:

– further, develop the students' ability to independently integrate and use knowledge;

– develop the students' ability to deal with complex phenomena, issues and situations;

– develop the students' potential for professional activities that demand considerable independence or for research and development work.

Programme objectives

The two-year Fashion-Tech Design MA programme aims to develop and deepen interdisciplinary skills in the areas of Wearables, Smart textiles and Digital manufacturing for fashion. The programme is intended to create interdisciplinary figures at the intersection of fashion and technology. The new generation of professionals will be underpinned by a robust set of collaborative and transferable skills, with an emphasis on 21st-century skills, for design-driven innovation, co-creation and entrepreneurship, while being aware of the area´s impact on the society, culture and environment. More specifically, the programme objectives are:

1. to research and transfer innovation with particular reference to the innovation of materials, meanings and processes with the aim to integrate new aesthetic and functional qualities into sustainable Fashion-Tech products;

2. to codify and interpret the social and cultural practices of interaction and consumption of Fashion-Tech products to inform their design, and critically evaluate
the effects of design practices on the social, cultural, environmental and economic context;

3. to interpret the product in a systemic way or as an overall offer - composed of product lines, merchandise, different brands - and in its relations with the dimensions of communication and distribution on the market;

4. to understand the evolutionary dynamics and business models of the supply chains and organizational systems of fashion companies;

5. to plan and manage the project by integrating design processes to inform strategies for product design, distribution and communication;

6. to understand, manage and coordinate a value chain of the complex project (which operates on components, semi-finished products, aggregated processing processes, services, etc.);

7. to understand and implement business logic and strategies to evaluate market scenarios opportunities for Fashion-Tech.

Programme characteristics

The purpose of the two-year MA Fashion-Tech Design programme is to provide learners with interdisciplinary knowledge and skills in the areas of Wearables, Smart textiles and Digital manufacturing, enabled by a design-driven methodology, and informed the area´s impact on the society, culture and environment. The programme is designed with a specialist focus, where the learners will develop a broad overview as well as a deep knowledge in Fashion-Tech design, aimed to build up knowledge and experience in a special field or discipline. Successful graduates are expected to demonstrate collaborative and transferable knowledge and skills, supported by the development of competencies required for sustainable design-driven innovation, co-creation and entrepreneurship. Furthermore, as a blend of art, business, science and technology, the learners will learn to apply the design-driven methodology next to STEM skills. A further aim of the MA programme is to create hybrid professionals, with the ability to combine and manage design skills with scientific knowledge, who can be easily integrated into the professional market of Fashion-Tech. As successful graduates will be equipped for working in Fashion-Tech enterprises combining cutting-edge technologies with 'intangible' factors, they will enter the industries as agile, proactive employees, 'intrapreneurs', or entrepreneurs initiating start-ups and generating new businesses and jobs. In terms of education, the programme will allow students to obtain competences for pursuing PhD programmes in the Fashion-Tech field focusing on design, technology and management at the intersection of Wearables, Smart textiles and Digital manufacturing. The degree programme presents distinctive features, relating to its approach, structure and orientation. First, with an interdisciplinary approach, where fashion design and digital technologies are integrated, the programme responds to market and industry demand by training future professionals in interpreting trends and creating Fashion-Tech concepts, that can be further developed into aesthetic and functional products. Furthermore, blended learning, that utilises conventional and virtual teaching methods, is implemented to promote simultaneous independent and collaborative ways of working. The utilisation of Problem Based Learning (PBL) enables the facilitation of knowledge development and generation, while enhancing group collaboration and communication to transfer knowledge into practical applications. The learners

will capitalise on opportunities and address constraints of the field of Fashion-Tech design through theoretical and applied research to the concept and product development and innovation management.

Expected learners can be from a variety of backgrounds with an ambition to develop and innovate Fashion-Tech concepts, supported by an open mind-set, along with creativity and curiosity. Furthermore, the structure enables the integration of learning mobility experience in the programme, promoting internationalisation, recognition and mobility in line with Bologna Process principles, that aim to facilitate mobility within the EHEA for further studies or work, increase the attractiveness of the programme for students outside the EHEA, and to provide high-quality knowledge base leading to further development of Europe as a community.

In terms of academic content, the programmeme is intended to be divided into the following educational units, or modules: design and multimedia communication; technology and engineering; human, social, psychological and economic context; electives; individual work. The courses within the modules are to be assessed based on the achievement of the programme learning outcomes, while also integrating generic and subject-specific competencies, linked to approaches to teaching and learning and student workload.

LEARNING OUTCOMES

The intended learning outcomes have been defined based on the Swedish Higher Education Ordinance (Högskoleförordningen), as they form a generic basis that can be easily transferable to the universities in EHEA, supplemented by more specific generic and subject-specific competences.

Knowledge and understanding

For a Master's degree, a student shall independently be able to:

1. demonstrate knowledge and understanding of the field of Fashion-Tech, including both broad knowledge of the field and a considerable degree of specialised knowledge in certain areas of the field as well as insight into current relevant research and development work;
2. demonstrate specialised methodological knowledge in Fashion-Tech design enabled by a design-driven methodology, and technological insights informed by social, cultural and environmental approaches.

Skills and abilities

For a Master's degree, a student shall independently:

1. demonstrate the ability to critically and systematically integrate knowledge and analyse, assess and deal with complex phenomena, issues and situations in a variety of fields even with limited information;
2. demonstrate the ability to identify and formulate issues or problems critically, autonomously and creatively, to contribute to the formation of knowledge and solutions;
3. demonstrate the ability to plan, manage and, using appropriate methods, undertake advanced tasks within predetermined time frames, as well as the ability to evaluate this work;
4. demonstrate the ability in speech and writing, both nationally and internationally, to report and discuss conclusions and the knowledge and arguments on which they are based in dialogue with different audiences;
5. demonstrate the skills required for participation in interdisciplinary research and development work or autonomous employment in some other qualified capacity.

Judgement and approach

For a Master's degree, a student shall independently:

1.demonstrate the ability to reflect on and make assessments in Fashion-Tech design informed by relevant disciplinary, social, ethical and environmental issues, and also to demonstrate awareness of ethical and sustainability-related aspects of research and development work;
2. demonstrate insight into the possibilities and limitations of research, its role in society and the responsibility of the individual for how it is used;
3. demonstrate the ability to identify the personal need for further knowledge and take responsibility for lifelong learning.

COMPETENCES

Competences are regarded as a combination of attributes related to knowledge and its application, attitudes, skills, responsibilities and values, that describe the level or degree to which a person is capable of performing them. Those that are generic are transferable to any degree programme and must be acquired (and build upon previously obtained competences) in the first phases of the studies to prepare the learners for lifelong learning. As transferable competencies are of rising importance, the generic competences described in the next section have been defined as most relevant for Fashion-Tech design and are adapted from the transferable skills identified by the first phase of the Tuning Project and its guide to formulating degree programme profiles. The generic competences must prepare the students for making complex judgements about their own

and others' work, while the emphasis is on their understanding of the importance of their meta-cognitive skills. The competences specific to the area of Fashion-Tech design are described as subject-specific competences. The achievement of those generic and subject-specific competencies are to be accomplished within the completion of the educational units, which are described further below. The following section defines generic and subject-specific competences for the MA programme of Fashion-Tech Design.

Generic competences

1. Problem formulation and solving; capacity to identify, formulate and solve questions and problems by applying knowledge in research and practical situations, and/or in a new context.
2. Creativity and innovation; capacity to be creative in developing ideas and in pursuing research goals.
3. Planning and management; capacity to plan and manage projects taking into account time, budgetary and personnel constraints.
4. Communication skills; ability to communicate effectively by being sensitive to the needs of diverse audiences.
5.Communication of information; ability to present complex information in a concise manner orally, visually and in writing by utilising a variety of appropriate channels.
6. Teamwork; capacity for collaboration in interdisciplinary teams and for assuming responsibility for tasks.
7. Independent work; ability to work autonomously conducting original interdisciplinary research and development work in parallel to communicating concepts and critical values.
8. Critical thinking; ability to think critically in contexts of creativity, innovation, problem-solving, communication and collaboration (21-st century skills).
9. Research ability; capacity to contribute to the advancement of knowledge through scientific research.
10. Interpersonal abilities; capacity to express, reflect and demonstrate one´s awareness, determination, promotion and self-critical abilities for lifelong learning.
11. Information literacy; capacity to find, analyse, use and understand facts and concepts.

Subject-specific competences

<u>Design and multimedia communication</u>

1. capacity to acquire and develop knowledge and understanding of fashion design in relation to natural science, engineering, economics and management with regard to professional and/or experimental work;
2. capacity to acquire and develop knowledge and understanding of design methodology and design theory with respect to both experimental and professional work in relation to Fashion-Tech design;
3. capacity to use and reflect on the methods of composition, form principles and design expression as the basis for human-centred design;
4.mcapacity to develop original ideas and systematically apply them, transforming concepts into design solutions, to develop them into Fashion-Tech products/services;
5. capacity to function as a catalyst that enables designers to plan, manage and lead design-led interdisciplinary research and development process, and to work with scientists, computer-engineers and biologists to develop and innovate for material, products for manufacturing processes.

<u>Technology and engineering</u>

1. capacity to acquire and develop knowledge and understanding of textile and smart materials and their applications;
2. capacity to acquire and develop knowledge and understanding of Wearable technologies, Smart textiles and Digital manufacturing and their processes;
3. capacity to acquire and develop knowledge and understanding of the collaborative design and innovation methods to deliver more effective ways of developing user-driven innovations, disruptive products and products/services;
4. ability to research and transfer innovation with particular reference to materials, meanings and processes in various fields;
5. ability to integrate capabilities and knowledge in the engineering area and the design area (e.g. 3D virtual design and prototyping, AR/VR, HMI, coding embedded in the design process) to develop innovative products and applications;
6. capacity to evaluate diverse and disruptive forms of innovation that contribute value to a fashion enterprise and shape the future of the fashion industry;
7. 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;
8. capacity to transfer knowledge from disciplinary fields to new sectors and applications, favouring the creative solutions of problems

<u>Human, social, psychological and economic contexts</u>

1. capacity to acquire and develop knowledge and understanding of the social and economic

context of Fashion-Tech design and products;
2. capacity to acquire and develop knowledge and understanding of socio-cultural and technological trends and practices to evaluate market scenarios and opportunities for Fashion-Tech products;
3. capacity to acquire and develop knowledge and understanding of new and emerging business models of the fashion industry;
4. ability to demonstrate entrepreneurial thinking that optimises opportunities, products and markets emerging from the Fashion-Tech space;
5. ability to develop communication and distribution strategies relevant to the Fashion-Tech space.

TRANSLATION INTO CURRICULUM

The allocation of credits within the program- meme is to be carried out with the top-down approach, where the whole programme consists of 120 ECTS, with 60 ECTS per year and 30 ECTS to be achieved per semester. The programme has an emphasis on a modular and flexible structure, thus the proposed credits allocated to a course unit vary from 7.5, 15 to 30 ECTS, as presented in Table 1. Furthermore, the semesters are to be divided into four terms or study periods, with possibilities of allocating ECTS per course depending on the specific purpose, learning outcomes, and teaching and learning methods of the educational unit (i.e. module). In terms of the actual length of the teaching period, one term must be allocated ten weeks, with a total of 40 weeks and 80 weeks per one and two years respectively. The proposed structure aims to ensure that each learner will achieve the intended learning outcomes during the nominal duration of the programme, while their knowledge and skills are expected to progress gradually throughout the studies and be supported by the development of competences achieved through co-curricular activities.

With a total of 120 ECTS, the distribution of credits between modules is defined in a range (as shown in Table 2) to enable the learners to meet their needs based on their previous educational and vocational background and experience, and individual interests and abilities. If a different modular or non-modular structure is utilised based on the country or higher education institution requirements, it is recommended to follow the guidelines in the table regarding the percentage of ECTS that must be offered within each unit.

Name of educational unit	Number of ECTS		% of total	
	Min	Max	Min	Max
Design and multimedia communication	37.5	52.5	31%	44%
Technology and engineering	15	37.5	13%	31%
Human, social, psychological and economic contexts	7.5	15	6%	13%
Electives	7.5	15	6%	13%
Individual work	22.5	30	19%	25%

Proposed educational units, Education-4Fashion-Tech, Source: e4ft, https://www.e4ft.eu/learning-units

As the programme focus is on interdisciplinary Fashion-Tech design, the learners are expected to choose 37.5 – 52.5 ECTS within the 'Design and multimedia communication' module, and 15 – 37.5 ECTS within the 'Technology and engineering' module to enable levelled education in both design and engineering for learners with different backgrounds and experience. Furthermore, 7.5 – 15 ECTS will be acquired from the 'Human, social, psychological and economic contexts' with a focus on entrepreneurship to enable successful graduates tto comprehend changes in economic, market and sociocultural trends and develop a capacity for entrepreneurial thinking. Additional 7.5 – 15 ECTS will be acquired through the 'Electives' module to enable the learners to take additional courses based on their individual interests and abilities with the goal of developing the capacity for explaining and applying knowledge and skills critically and constructively. Lastly, 22.5 – 30 ECTS will be chosen from the 'Individual work' unit consisting of an internship for a training opportunity and/or final thesis work.

In relation to estimating student workload, one credit represents approximately 25 to 30 hours of student work time, which in total for the programme stands for 3000 to 3600 hours. As the actual learning time depends on a variety of factors, including time employed by the student and their background, the amount of student workload within modules is calculated based on the 30-hour maximum per one ECTS. Thus, the workload for one semester is intended to consist of a maximum of 900 student working hours, with 1800 hours per year. In the following sections, the educational units are described based on their purpose, subject-specific competencies, educational activities and assessment methods.

Name of educational unit	Number of ECTS		% of total	
	Min	Max	Min	Max
Design and multimedia communication	37.5	52.5	31%	44%
Technology and engineering	15	37.5	13%	31%
Human, social, psychological and economic contexts	7.5	15	6%	13%
Electives	7.5	15	6%	13%
Individual work	22.5	30	19%	25%

Proposed educational units, Education-4Fashion-Tech, Source: e4ft, https://www.e4ft.eu/learning-units

LEARNING UNITS

The following section describes the educational units in terms of their academic content, allocation of ECTS, teaching and learning approaches, along with assessment methods.

Design and multimedia communication

The purpose of the module is to provide learners with the knowledge, skills and approach within design and multimedia communication, supported by competencies developed within technology and engineering. Thus, the successful graduate will have the capacity to function as a catalyst enabling designers to work with professionals from a variety of disciplines, such as scientists, computer-engineers and biologists. Furthermore, the aim is to equip the learners with knowledge and understanding of design methodology and theory as a basis for developing original ideas and transforming them into Fashion-Tech concepts, products and services.

The module must offer a theoretical introduction and foundation to fashion design to learners with no or limited competence in the area, while also providing more advanced courses, such as ones focusing on the design-driven methodology and utilisation of 3D virtual design and prototyping. The utilisation of co-creation and peer-learning is recommended to increase learning and development of collaborative design and innovation methods. The estimated student work time must stay within the limits of 1125 and 1575 hours for 37.5 and 52.5 ECTS respectively, based on a maximum of 30 hours of work time per one ECTS. In terms of assessment, it is recommended to employ methods such as written and visual documentation of the carried out design projects through developing concepts and prototypes, which are expected to stimulate active learning to develop the subject-specific competencies within the educational unit.

Within the module, the learner is expected to develop the following competencies:

1. capacity to acquire and develop knowledge and understanding of fashion design in relation to natural science, engineering, economics and management with regard to professional and/or experimental work;
2. capacity to acquire and develop knowledge and understanding of design methodology and design theory with respect to both experimental and professional work in relation to Fashion-Tech design;
3. capacity to use and reflect on the methods of composition, form principles and design expression as the basis for human-centred de-

sign;
4. capacity to develop original ideas and systematically apply them, transforming concepts into design solutions, to develop them into Fashion-Tech products/services;
5. capacity to function as a catalyst that enables designers to plan, manage and lead design-led interdisciplinary research and development process, and to work with scientists, computer-engineers and biologists to develop and innovate for material, products for manufacturing processes.

Technology and engineering

The purpose of the module is to develop knowledge, skills and approach within technology and engineering next to design skills. For the successful graduate to work in the interdisciplinary field of Fashion-Tech design, it is important to understand and be able to apply the acquired systemic knowledge regarding materials and their application, the nature of product development and its phases and processes along with the generic and subject-specific competences. Furthermore, specific learning outcomes must relate to the areas of Wearable technologies, Smart textiles and Digital manufacturing and their processes. Courses related to Wearables must emphasise the role of technology and how it can be utilised to enhance the natural ability and performance of the human body or add new functions to the body to create interaction with other people, objects or the environment.

Regarding Wearables, the focus is on all types of fabric systems that respond to external stimuli, such as mechanical, thermal, chemical, biological, magnetic and electrical. Digital manufacturing knowledge and skills relate to an integrated approach to manufacturing where tools such as 3D virtual design and prototyping, AR, VR can be utilised while reshaping design, production, distribution and retail processes.

The module must offer a theoretical introduction and foundation to the previously described areas, followed by applying the acquired knowledge and understanding through participatory and hands-on learning approaches in the form of developing concepts and prototypes (i.e. laboratory practice, workshops, etc.). Similar to the 'Design and multimedia' module, the utilisation of co-creation and peer-learning is recommended to further develop the capacity of working in interdisciplinary teams. The estimated student work time must stay within the limits of 450 and 1125 hours for 15 and 37.5 ECTS respectively, based on a maximum of 30 hours of work time per one ECTS. In terms of assessment, it is recommended to employ methods such as written exams to test theoretical knowledge, along with written and visual documentation of the carried out design projects for developing concepts and prototypes, or of specific exercises, such as programming or developing samples. Within the module, the learner is expected to develop the following competencies:
1. capacity to acquire and develop knowledge and understanding of textile and smart materials and their applications;
2. capacity to acquire and develop knowledge and understanding of Wearable technologies, Smart textiles and Digital manufacturing and their processes;
3. capacity to acquire and develop knowledge and understanding of the collaborative design and innovation methods to deliver more effective ways of developing user-driven innovations, disruptive products and products/services;
4. ability to research and transfer innovation with particular reference to materials, meanings and processes in various fields;
5. ability to integrate capabilities and knowledge in the engineering area and the design area (e.g. 3D virtual design and prototyping, AR/VR, HMI, coding embedded in the design process) to develop innovative products and applications;
6. capacity to evaluate diverse and disruptive forms of innovation that contribute value to a fashion enterprise and shape the future of the fashion industry;
7. 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;
8. capacity to transfer knowledge from disciplinary fields to new sectors and applications, favouring the creative solutions of problems.

Human, social, psychological and economic contexts

The purpose of the module is to develop knowledge, skills and approaches within human, social, psychological and economic contexts with a focus on entrepreneurship.

Furthermore, as the work of the future Fashion-Tech designer must be informed by social, cultural and environmental awareness, the educational unit will explore changes in consumer behaviour and interactions with Fashion-Tech, entrepreneurship and emerging business models, whilst critically evaluating ethical and sustainability issues related to Fashion-Tech products. The estimated student work time must stay within the limits of 225 and 450 hours for 7.5 and 15 ECTS respectively, based on a max-

imum of 30 hours of work time per one ECTS. In terms of assessment, it is recommended to employ methods such as reports, oral presentations and written exams.
Within the module, the learner is expected to develop the following competencies:
1. capacity to acquire and develop knowledge and understanding of the social and economic context of Fashion-Tech design and products;
2. capacity to acquire and develop knowledge and understanding of socio-cultural and technological trends and practices to evaluate market scenarios and opportunities for Fashion-Tech products;
3. capacity to acquire and develop knowledge and understanding of new and emerging business models of the fashion industry;
4. ability to demonstrate entrepreneurial thinking that optimises opportunities, products and markets emerging from the Fashion-Tech space;
5. ability to develop communication and distribution strategies relevant to the Fashion-Tech space.

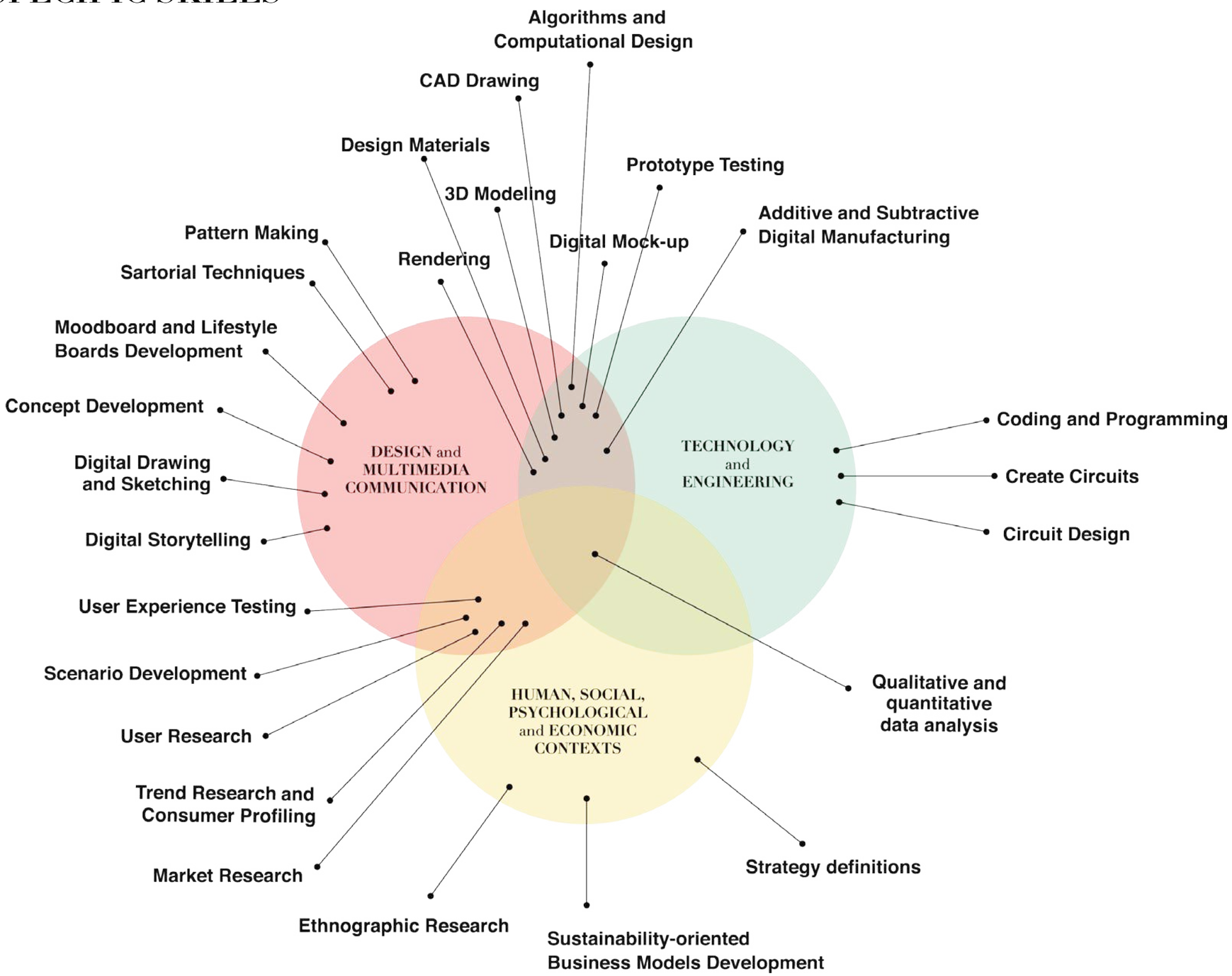
Electives

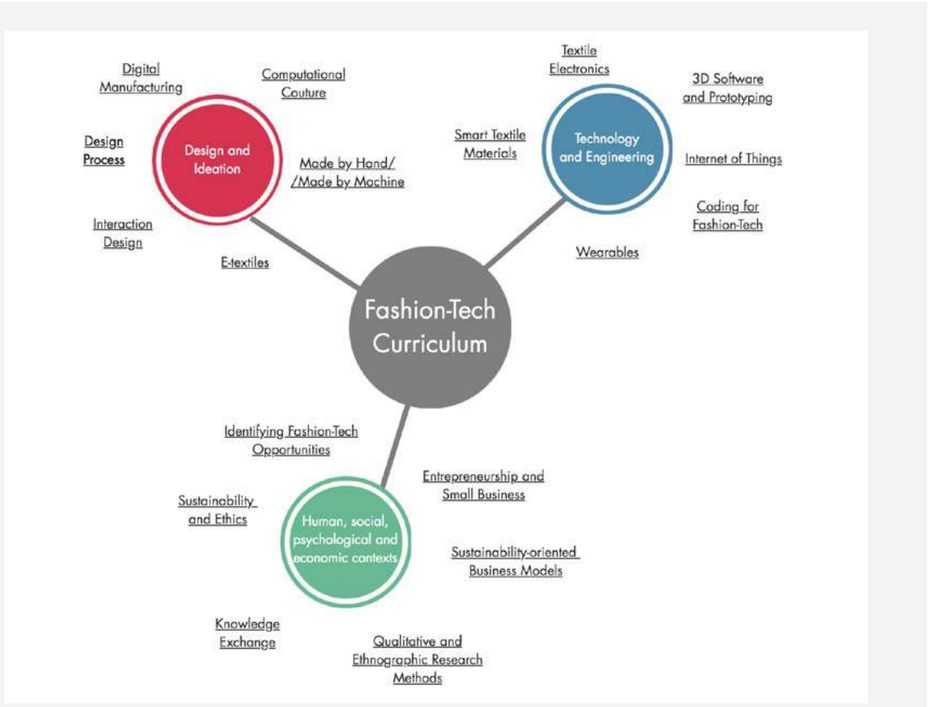
The purpose of the module is to further provide learners with the ability to explain and apply knowledge and skills in a constructive way for their professional and social needs. Furthermore, the aim is to offer the learners additional courses in design, technology and/ or entrepreneurship to meet their needs based on their previous background and experience, and individual interests and abilities as previously described. While the expected learning outcomes and educational activities are dependent on the chosen course(s), it is recommended that the offered courses´ learning outcomes match the ones of the programme along with the activities aiming to support the interdisciplinary context of the curriculum. The estimated student work time must stay within the limits of 225 and 450 hours for 7.5 and 15 ECTS respectively, based on a maximum of 30 hours of work time per one ECTS. The acquisition of the course-specific learning outcomes is recommended to be assessed through the previously described assessment methods suitable for the particular course(s).

Individual work

The purpose of the module is to provide learners with the ability to conduct independent interdisciplinary development or research work that has scientific relevance and is informed by social, cultural and environmental approaches. Furthermore, the aim is to combine knowledge of fashion design and digital technologies with collaborative and transferable skills through theoretical, experimental or experiential approaches for materials, design and function. The individual work must be carried out within an internship and/or (project based) thesis work. Regardless of the required course(s) within the unit, the work must demonstrate the maturity and critical skills of the graduate in the areas of Fashion-Tech design in relation to:
– deeper knowledge related to an underdeveloped topic and its potential applications, or a major contribution to the advancement of knowledge with respect to a specific research area;
– critical analysis of collected research material according to scientific principles and international standards of scientific knowledge (i.e. databases, scientific articles, conference proceedings, etc.);
– co-operation with companies or other organisations to practice the previously acquired skills in a professional setting, while additionally enabling learners to create contact with future employers or clients;
– synthesis of the outcomes to generate original, innovative and well-argued concepts, products or product-service systems combining Wearables, Smart textiles and Digital manufacturing;
– assessment and evaluation of the effects of the development work, which will be of direct value to the industry or education, along with self-reflection on the need for further knowledge.
The estimated student work time must stay within 675 and 900 hours for 22.5 and 30 ECTS respectively, based on a maximum of 30 hours of work time per one ECTS. The work carried out within an internship is to be presented and assessed through a written report and/or oral/visual presentation. The individual thesis work is to be supported by seminars and supervision throughout the length of the course to develop and present a final exam collection for display and/or exhibition. The seminars are aimed to act as a setting for discussion between the learners and the supervisor(s) initiating critical analysis of the ongoing work. The assessment is based on the evaluation of the interdisciplinary design work, and oral and visual presentations, and self-reflection.

FASHION-TECH
SUBJECT SPECIFIC SKILLS





Learning Units, Education4Fashion-Tech
Source: https://www.e4ft.eu/learning-units

LEARNING UNITS: MIX AND MATCH SUBJECT AREAS

M. Danjoux

The Learning Units is the fourth intellectual output, that aims to provide higher education teachers with guidelines for developing courses and programmes in Fashion-Tech. The purpose of the units is to provide learners with knowledge, skills and approaches specific to the 3 key areas:

- Design and Ideation
- Technology and Engineering
- Human, Social, Psychological and Economic Contexts

The units are designed as both stand-alone and/or as intersecting learning opportunities that complement an existing programme of learning and support the development of the hybrid professional required for the Fashion-Tech industry.
There are 18 educational units divided equally into 3 contexts as listed below:

<u>Design and Multimedia Communication</u>
- Made by Hand, Made by Machine
- Computational Couture
- E-Textiles
- Tools for Designing
- Interaction Design: Fashion as Interface of the Body
- Digital Manufacture for Fashion: from Laser Cutting to 3D Printing
- The Design Process: Exploring and Building New Scenarios in Fashion-Tech

<u>Technology and Engineering</u>
- 3D Software and Prototyping
- Coding for Fashion-Tech
- Internet of Things (IoT)
- Smart textiles Materials
- Textile Electronics
- Wearables: Workshop

<u>Human, Social, Psychological and Economic Contexts</u>
- Identifying Fashion-Tech Opportunities
- Prototyping Future Directions in Fashion-Tech: A Knowledge Exchange Project
- Sustainability-oriented Business Models
- Qualitative and Ethnographic Research Methods
- Entrepreneurship and Small Business – Start Up Introduction
- Sustainability and Ethics

As outlined in the **Tuning Document**, the field of Fashion-Tech is characterised by the convergence of these 3 areas. Here design is defined

as including aspects related to the product, user experience and communication; technology to purely technical knowledge and skills, and economics and management to topics related to business management, supply chain management and market intelligence.
The purpose of the units is to provide learners with knowledge, skills and approaches specific to the 3 key areas:

- The design and ideation units seek to develop competences and understanding relating to design methodology and theory as a basis for developing original ideas and transforming them into Fashion-Tech concepts, products and services.
- The technology and engineering units, which are designed to offer competencies that underpin the design units, offer a theoretical introduction and foundation followed by the opportunity for learners to apply the acquired knowledge and understanding through participatory and hands-on learning approaches in the form of developing concepts and prototypes (i.e. laboratory practice, workshops, etc.).
- The units connected to human, social, psychological and economic contexts explore changes in consumer behaviour and interactions with Fashion-Tech, entrepreneurship and emerging business models, whilst critically evaluating ethical and sustainability issues related to Fashion-Tech products.

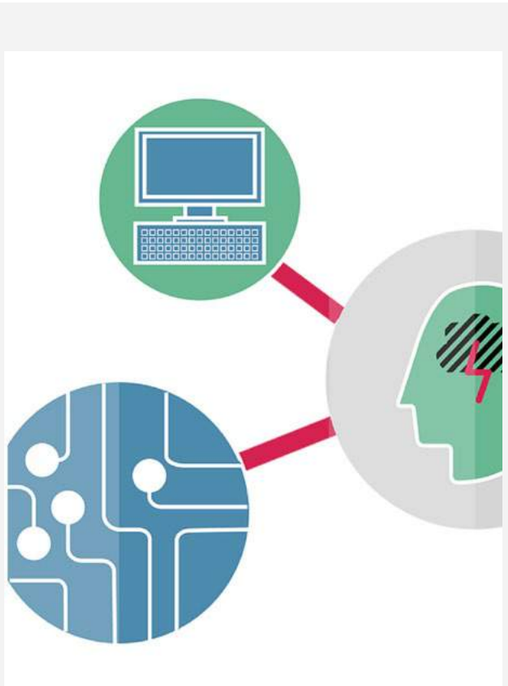
The units are designed as both stand-alone and/or as intersecting learning opportunities that complement an existing programme of learning and support the development of the hybrid professional required for the Fashion-Tech industry (see ‘Unit Mapping’). In certain instances, we also propose the units follow a certain sequencing. For example, it is envisioned that the technology units form pre-requisites for the design units, and that it would be useful to view them in this way. There are however no prescribed routes, only suggested ones (see ‘Unit Progression’).

The format of the units

Each unit descriptor consists of the following:

- Title
- Introduction
- Unit Outline
- Indicative Content and Learning and Teaching Methods
- Learning Outcomes
- Additional Tutor’s Notes*
- Assessment Methods
- Reading and Resource List

The introduction aims to provide a brief explanation of the topic of study for the unit. It is a quick way for you to gain insights into what specific aspects of learning will be addressed for the future Fashion-Tech designer.
More detailed information can then be found in the Unit Outline where the premise of the unit, its aims and the student assignment are defined together with any other important information or factors you should consider as an educator choosing to adopt the unit.
The Indicative Content and Teaching and Learning Methods section provides specific information on the type of input the unit should offer together with modes of delivery and engagement. In some instances, proposed lecture and workshop titles etc., are given and other guidance intended to assist you in running such a unit.
The Learning Outcomes for each unit explain what the student/s should be able to demonstrate on completion of the unit such as ‘in depth knowledge’, an ability to ‘critically evaluate’ etc. Some of the units have Additional Tutor’s Notes* which offer further insights into how each unit might align with others and thus form part of a larger curriculum, and direct you to pedagogic methods and resources available in the **Teacher’s Toolkit**.
The Assessment Methods and assessment criteria for these units are suggestive and flexible and you should aim to link these methods directly to the intended learning outcomes of your programme/course i.e. tailor these assessment methods to align with the knowledge, skills, and attributes that your programmeme/course of study is aiming to develop.
Finally, the Reading and Resource list provides with additional support through essential and suggested reading and a list of references that can be directed to students.



The Teacher's Toolkit, Education4Fashion-Tech, Source: e4ft, https://www.e4ft.eu/learning-units

TEACHER'S TOOLKIT: RESOURCE FOR TEACHERS WITH APPROPRIATE METHODS AND APPROACHES TO TEACHING AND LEARNING FASHION-TECH

The Teacher´s Toolkit aims to act as a resource for teachers with innovative teaching and learning methods and approaches. By complementing the basis for curriculum development defined by the Tuning Document, the toolkit further feeds into the development of the course modules and training units.

The pedagogic methods presented below, that make up the Teacher's Toolkit, have been chosen due to their relevance to teaching and learning in the interdisciplinary field of Fashion-Tech. The toolkit consists of 10 different methods and approaches, that are designed in a modular way, enabling to mix and match to create high-qualitative learning units. The tools contain a short description, a brief, a facilitator guide, and if applicable, presentations and hand-outs that can be customised. Most tools can be mixed and matched with each other, with recommendations provided under each tool.

LECTURES

The lectures provided in this tool offer four presentations:

- the definition of Fashion-Tech
- the design approach for Fashion-Tech
- the impact of digital technologies in the

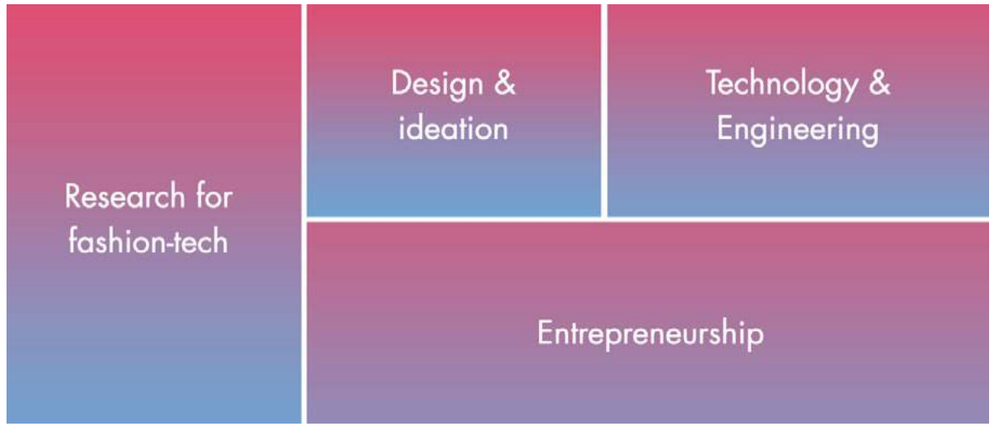
Toolkit, Education4Fashion-Tech, Source: https://www.e4ft.eu

fashion supply chain
- best practice in Fashion-Tech

The lectures are recommended to be delivered to BA students or first-year MA students to provide the basics of Fashion-Tech to those with little or no background related to the field. As the lectures are developed in a modular structure, they can be used to mix and match with each other, and most other tools in the toolkit. Mix and match with work-based learning, problem-based learning and blended learning.

WORKSHOPS

Workshops prepare students for the industry and academia by encouraging students to develop transferrable soft skills, such as teamwork, communication (of information), critical thinking, and problem formulation and solving, among others. The workshops provided in the toolkit are developed in a modular way, to enable to mix and match them with each other, and other tools in the toolkit. The workshops consist of briefs, facilitator guides, hand-outs, and presentations that can be customised.



Toolkit, Education4Fashion-Tech, Source: https://www.e4ft.eu

Mix and match with interdisciplinary group work, problem-based learning, learning through research and blended learning.

INTERDISCIPLINARY GROUP WORK

The hackathon format, implemented through interdisciplinary group work, encourages students to brainstorm, pitch concepts, build teamwork skills, plan projects and develop design ideas in a fast-paced and dynamic way. The creativity, teamwork and problem solving unleashed in a short period of time through collaborative projects at hackathons often stimulate participants to engage more deeply in their professions and academic interests. These interactions serve to “open up” a classroom environment and enables an active, rather than passive, learning experience for students.

To be competitive in the emerging field of Fashion-Tech, graduates need to respond to the demands of the market with a variety of skills. The following have been identified as critical for the sector and to be developed through the hackathon activities:

- Equipping designers with collaborative design and innovation capabilities to deliver more effective ways of develop- ing disruptive products and product/services;
- Mastering co-creation and user-driven innovation processes;
- Strengthening capabilities to interpret socio-technological trends, consumer insights and narratives;
- Industrially relevant transferable skills necessary for innovation management and product development;
- Enhance creativity and innovation, critical thinking and problem-solving, communication and collaboration (21st-century skills).

Working in small interdisciplinary teams, during this hackathon students will share their existing knowledge and skills and learn from each other. Mix and match with workshops, problem-based learning, learn- ing through research, blended learning, and self-directed learning.

WORK-BASED LEARNING

Work-based learning is founded on the principle of “learning by doing” and It is a series of educational courses which integrate the school or university curriculum with the workplace to create a different learning paradigm.

Work-based learning strategies include the following:

• Apprenticeship or internship involving the student working for an employer where he or she is taught and supervised by an experienced employee of the chosen organisation;
• Job Shadowing introducing the student to a particular job or career by pairing the student with an employee of the workplace;
• Field trips offering the students an insight into the latest technological advancements and business strategies of an enterprise;
• Entrepreneurial experience including setting up of specific business, right from the planning, organising and managing stage to the risk control and management aspects of a business;
• Cooperative education in which the work experience is planned in conjunction with the technical classroom instruction;
• School-based enterprise as a simulated or actual business run by the school.

The advantage of teaching through workshops made in cooperation with companies is useful to allow students to make proto-

types, practically test the design assumptions and combine manual experimentation with the most advanced modelling technologies. Mix and match with workshops, field trips, learning through research and self-directed learning.

PROBLEM-BASED LEARNING

Problem-based learning (PBL) is a student-centred, rather than instructor-centred, teaching method with the origin in the medical field. The teaching strategy has gained wide acknowledgement outside medicine as the students gain practical experience applying their content knowledge to solve real-world challenges in the safe environment of the classroom. PBL is a good fit for Fashion-Tech since the methodology is very practical. When utilising PBL, students are mostly faced with a problem that practitioners in their industry are confronted with on their regular workplace settings. Students should then locate suitable information and resources for solving the problem. The teacher has an advisory role throughout the process. It is the students' responsibility to choose the best solution, present findings and support for their teamwork. It is often stressed that apparel designers of the future must be strong team members, communicators, and problem solvers — all skills that are enhanced by the PBL teaching method. Mix and match with most other tools, for example, lectures, workshops, and interdisciplinary group work.

FIELD TRIPS

Field trips are organised by teachers identifying local Fashion-Tech resources useful for student's learning. Field trips offer the students an insight into the latest technological advancements and business strategies of an enterprise. Students also gain awareness of the various career opportunities available and understand the driving forces of the community's economy. The purpose of the trip is usually observation for education, non-experimental research or to provide students with experiences outside their everyday activities.
Field trips are most often done in 3 steps:

• Preparation applies to both the student and the teacher. Teachers often take the time to learn about the destination and the subject before the trip;
• Activities that happen on the field trips often include lectures, tours, worksheets, videos and practical demonstrations;
• Follow-up activities are generally discussions that occur once the field trip is completed.

Mix and match with research-focused workshop, work-based learning and learning through research.

LEARNING THROUGH RESEARCH

The roles of research and innovation, which are considered to be the driving forces in our world economy, are continuing to increase. Therefore, it is important for students to receive the opportunity during their studies to participate in research and faculty-guided projects. As probably the best careers in the future will likely require strong research skills, students within Fashion-Tech design will benefit from opportunities that enable to apply their knowledge in respective research projects. The students might work on research projects in collaboration with a faculty member, a research centre, or on a project sponsored and funded by an industry stakeholder. Depending on their interests, they are encouraged to work on an academic paper; market research project; scientific experiment or engineering project. It also provides opportunities for students to be a part of applied research in a corporate or industrial setting.
Mix and match with research-focused

workshop, work-based learning, field trips, and self-directed learning.

BLENDED LEARNING

Blended learning is an approach where conventional teaching and learning practices are integrated with those online, where the student has some control over time, place, path and/or pace. According to the International Association of Blended Learning, the approach is defined:

"Blended learning is an educational approach, which integrates face-to-face classroom practices with online and mobile delivery methods. It aims to provide the learner with a well-planned, managed, and well-structured teacher-facilitated interactive learning environment, where high-quality content, activities, and experiences can be customised to learner needs and preferences, unrestricted by time and location."

Thus, key rules for implementing blended learning are: (1) the integration of face-to-face and online learning approaches; (2) optimising student engagement through rethinking the course design; and (3) restructuring and placing traditional classroom hours. This allows for enhancement of the properties and possibilities of each to create a unique combination of different modes of communication for a purposeful, open and disciplined community. Mix and match with all other tools in the toolkit, to facilitate and enhance student learning by incorporating technology.

SELF-DIRECT LEARNING

Learning independently can be challenging, even for the most motivated students. There are understood to be four key stages to independent learning, known as self-directed learning: being ready to learn, setting learning goals and time management, engaging in the learning process, and evaluating learning.

In relation to the Fashion-Tech field, an ability to self-direct and self-evaluate is critical. The Fashion-Tech sector requires graduates to be capable of planning and research, to creatively problem solve and innovate solutions with entrepreneurial mindsets. Self-directed learning promotes the development of self-confidence, initiative and perseverance. Both independence and the ability to collaborate in interdisciplinary teams are necessary skills in Fashion-Tech, as such self-directed projects can be conducted by students individually or as part of a group. Mix and match with work-based learning, problem-based learning, learning through research and blended learning.

RESOURCES

The last tool in the toolkit provides teachers with relevant terms that have been used in the project, to provide points of convergence and common understanding to those in the European Higher Education Area (EHEA). Furthermore, a bibliography has been developed (2019), to provide teachers and students with relevant resources (such as reading materials and videos) related to e.g. fashion theory, mixed reality, sustainability, etc.

04.
FUTURE SCENARIOS

Livia Tenuta, Susanna Testa

04. FUTURE SCENARIOS

L. Tenuta, S. Testa

The world of Fashion-Tech is not only growing but also evolving. This is confirmed by the state-of-the-art , from which emerges, on the one hand, the growing interest of the market for products, processes and services related to Fashion-Tech.

On the other hand, the need is clear for systems capable of training professionals with interdisciplinary skills, who are also able to have a global vision on the theme of Fashion and Technology. The world of Fashion-Tech is not only growing but also evolving. This is confirmed by the state-of-the-art, from which emerges on the one hand the growing interest of the market for products, processes and services related to Fashion-Tech, but on the other hand also for the creation of systems capable of training professionals with specific skills but at the same time able to have a global vision on the theme of Fashion and Technology. The experiences implemented during the whole E4FT project - the Hackathon in London and the three workshops in the three partner universities in particular - have explored exactly what are the fundamental aspects to create these professional figures. In particular, it emerged that: they need have basic knowledge in the areas involved in the Fashion-Tech world that we have seen to be multiple, complementary but heterogeneous; it is essential that they are able to work in teams in which all participants have a shared language but each of them, with their own specialisation, can develop and control the different phases of the design process; the need to have direct contact or a constant confrontation with business realities

to get out of the pure research field and face the limits of industrial production in terms of feasibility, saleability and timing. Starting from this awareness, a common structure or framework for the training of university students has been built and useful tools have been created to help teachers and students with different training to learn the practices useful to manage Fashion-Tech projects.

All this, as we will see in Chapter 5, has to be put in touch with the real world. A dynamic and fluid world that changes rapidly, not only because of the continuous innovative drives that renew technologies but also because of the continuous changes in behaviour and habits that involve not only the realities that operate in the sector - Companies, Higher Education Institutions and Research Centres - but more generally people, even consumers, who will then benefit from the products, processes and services offered by Fashion-Tech.

To be ready for these changes it is useful to draw guidelines on how the fashion world will evolve. Similar work was already developed within the Benchmarking Report combining desk research and the results of the interviews with Companies, Research Centres and Higher Education Institutes, to obtain an overview of current researches and emerging topics. In particular, 5 macro areas emerged that may represent a direction of future development for the Fashion-Tech sector:

- 1. Protection and body enhancement through an artificial second skin
- 2. Culture driven Wearable: art, technology and innovation
- 3. Hyper-body: connecting senses and materials
- 4. Fashion takes care
- 5. Real/Virtual mixed environments

To trace Fashion-Tech directions, recent case studies had been identified directly or transversely related to Wearable technologies, smart textiles or Digital manufacturing, along with analysing their area of origin. Most of the products, technologies, fabrics or techniques came from worlds apparently far from that of fashion design, and are only the result of the meeting of different disciplines and fields. Medicine, architecture, gaming, robotics and automotive were just some of the areas where most of the innovations we are seeing are being implemented.

The 5 macro areas were the applications of the 2017 research that foresaw a development time of 1-3 years and which automatically were concepts for the near future - so today already outdated.

Obviously, in recent years these future trends have changed and it was necessary to identify new scenarios characterizing the next decade. So big changes that involve society in general and that cross the fashion world. In particular, the research has been conducted according to the following steps:

1. Identify the great changes that characterize the contemporary world and that will have an impact on the future, not only in relation to the field of fashion
2. Identify how today fashion and technology are approaching these scenarios with more or less advanced products
3. Mapping existing products today in a more or less advanced state that characterize these scenarios according to two axes (function-interaction)
4. Identify possible opportunities for the world of Fashion-Tech.

In particular, the four scenarios that have been identified and that will be explored in-depth in the following pages are: **Apocalyptic Life; Extra-Humans; AI Feels; Phygital Self**.

This research confirms how the Fashion-Technology sector is in continuous evolution but is not intended to be an answer but rather a starting point to trigger a conversation with companies and to push companies to go beyond the technical problem of product feasibility to embrace innovative scenarios involving products, processes and services.

Fluidity - of the themes, professions and actors involved - is the key word.

2030 // SCENARIOS

AUTONOMOUS INTERACTION

FUNCTIONALITY

EXPRESSIVITY

APOCALYPTIC LIFE

SURVIVAL / SHIELD / CARE

Mars Garden: an Engineered Greenhouse for a Sustainable Residence on Mars, MIT media Lab, 2019. Source www.media.mit.edu

AI FEELS

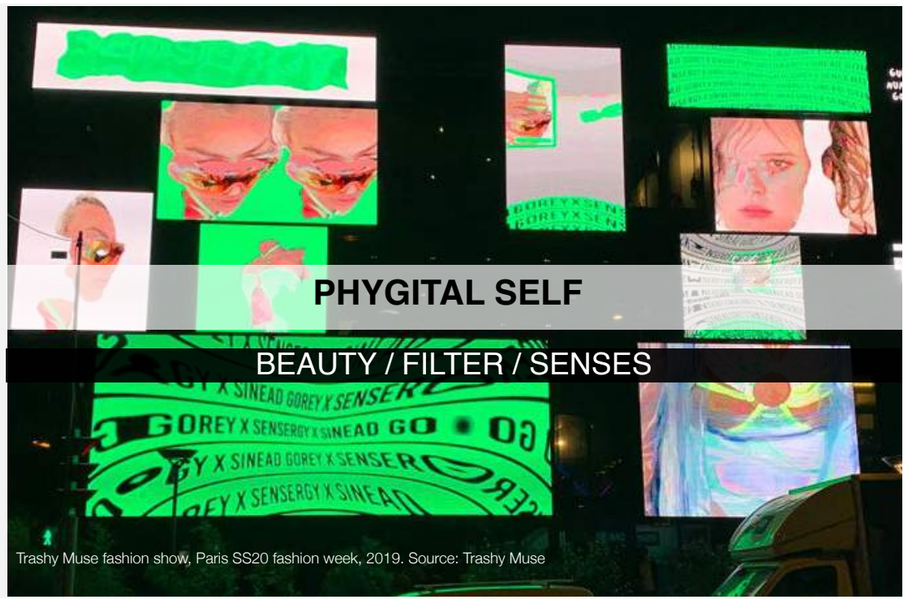
SOCIAL / BEHAVIOURAL / EMOTIONAL

Dormio by Fluid Interfaces, MIT Media Lab, 2018. Source: Fluid Interfaces Group, MIT Media Lab

EXTRA-HUMANS

PROSTHESIS / MEDICAL / BODY ENABLER

'I Want To Believe' photobook by David Vintiner and Gemma Fletcher, 2020. Ph: David Vintiner. Source: David Vintiner Photographer



PHYGITAL SELF

BEAUTY / FILTER / SENSES

Trashy Muse fashion show, Paris SS20 fashion week, 2019. Source: Trashy Muse

CONTROLLED INTERACTION

FASHION-TECH SOLUTIONS

APOCALYPTIC FASHION

SURVIVAL / SHIELD / CARE

Air's Atmos by Ao Air, 2020. Source: Ao Air

TANGIBLE EMOTIONS

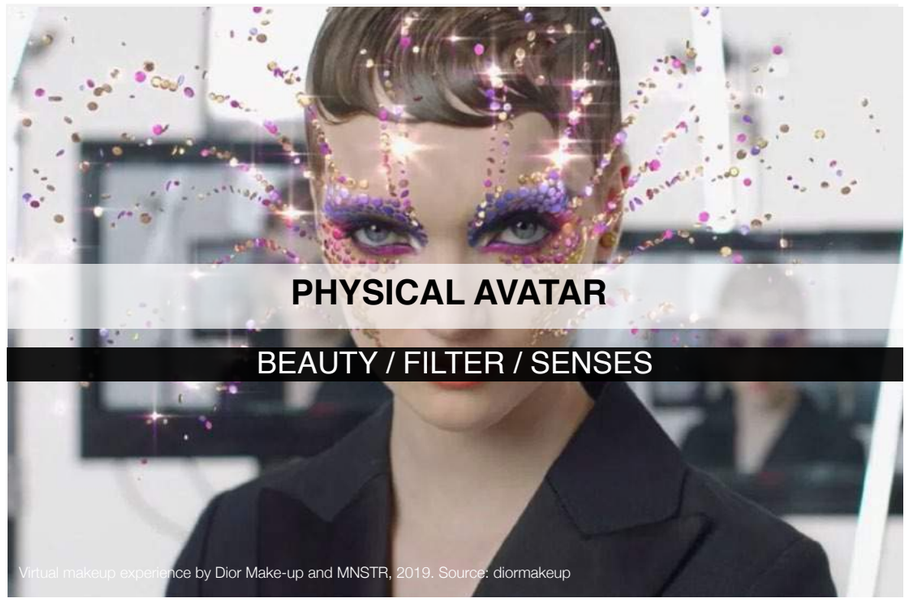
SOCIAL / BEHAVIOURAL / EMOTIONAL

Flowing Water, Standing Time by Ying Gao, 2019. Source: Ying Gao

ORNAMENTAL NEEDS

PROSTHESIS / MEDICAL / BODY ENABLER

Black Squid Jacket by Volleback (2019). Source: Volleback



PHYSICAL AVATAR

BEAUTY / FILTER / SENSES

Virtual makeup experience by Dior Make-up and MNSTR, 2019. Source: diormakeup

SCENARIO

APO CALY PTIC LIFE

Mars Garden: an Engineered Greenhouse for a Sustainable Residence on Mars, MIT media Lab, 2019. Source www.media.mit.edu

APOCALYPTIC LIFE

SURVIVAL / SHIELD / CARE

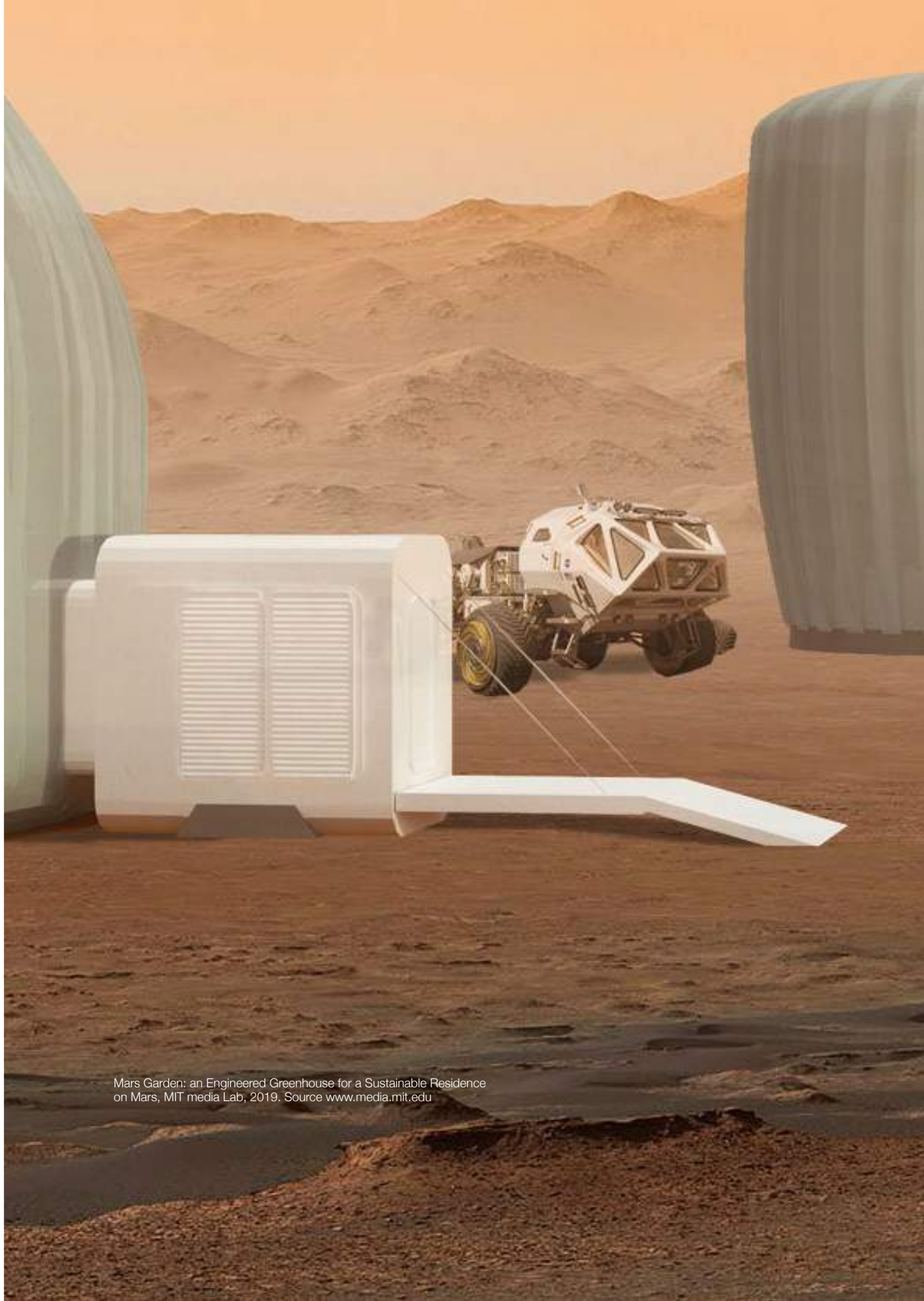
A dystopian dimension where pollution, viruses, nuclear wars, exodus to new unexplored spaces will question the survival of human beings.

Surviving in polluted environments, the dynamism of a nomadic lifestyle, the need to adapt to extreme climates, space exploration. The spaces will have to be reorganized according to the new limits imposed by the change or even will have to pass through new contingent planet, the behaviour in domestic and private life but also in public life and the interactions between people will be modified to cope with emergency and crisis situations.

On April 12, 1959 John Fitzgerald Kennedy gave a speech at the Convocation of the United Negro College Fund in which he said “When written in Chinese, the word ‘crisis’ is composed of two characters. One represents danger and the other represents opportunity.”

This double reading well summarizes the impact of the two emergencies on the contemporary landscape - pandemic and environmental crisis -: on the one hand the whole world is overwhelmed by a dramatic emergency, on the other hand creative visions are taking shape in response to the crisis.

The world of art, science and culture has perceived these changes and has given different interpretations. These have been grouped into five micro-trends.



Mars Garden: an Engineered Greenhouse for a Sustainable Residence on Mars, MIT media Lab, 2019. Source www.media.mit.edu

MICRO SCENARIO

Resurrecting the Sublime by Alexandra Daisy Ginsberg. Source: www.daisyginsberg.com

SYNTHETIC BIOLOGY

SYNTHETIC BIOLOGY is a call for investigating and crafting, through art and science collaboration, stories to "stay with the trouble" of living in an environment of global warming, pollution, and species extinction. Dark Ecology, synthetic biology, genetically-engineered creatures to cope with environmental crisis. It is based on the scientific certainty that changes in our climate will require us all to adapt, focusing on human-scale acts of innovation and contemplation.

They reveal how artists, designers and scientists explore new imaginaries and visions of a future in the making: the natural world will never be the same again and what is taken for granted could be lost forever; nature needs care to give something in return; spontaneous natural processes become artificial.

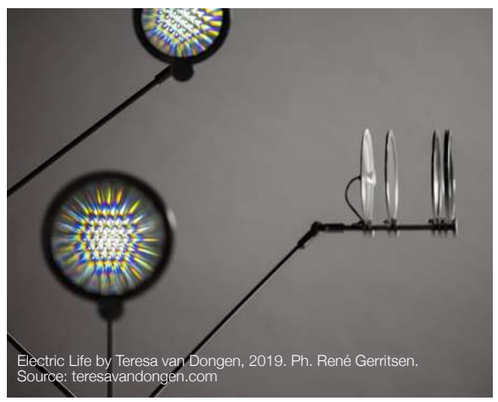
CURRENT FORWARD LOOKING PROJECTS

Mud Well by Teresa van Dongen, 2019. Ph. Alex Hamstra Photography, Source teresavandongen.com

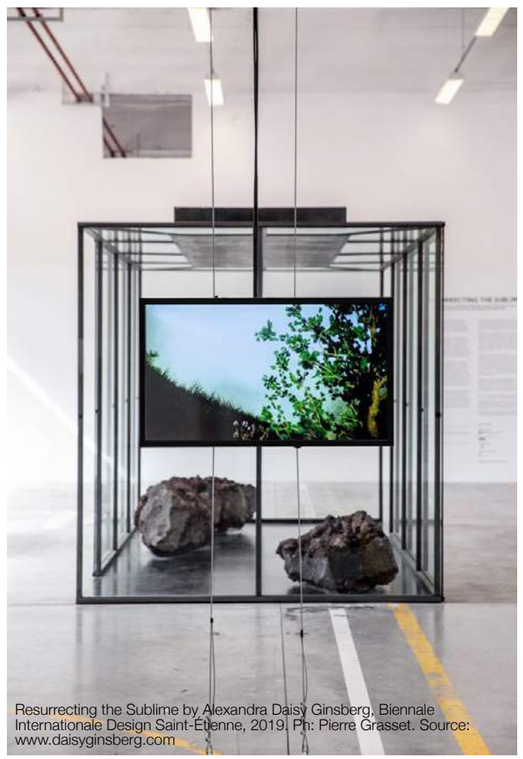
Hybrid living materials (HLMs) by The Mediated Matter Group MIT Media Lab, 2019. Source www.media.mit.edu.

Microsilk and cellulose blend fiber Tennis Dress by Bolt Threads, Stella McCartney, Adidas, 2019. Source: boltthreads.com

Transversal by Faber Futures, Cooper Hewitt Museum, 2019. Source: faberfutures.com



Electric Life by Teresa van Dongen, 2019. Ph. René Gerritsen. Source: teresavandongen.com



Resurrecting the Sublime by Alexandra Daisy Ginsberg, Biennale Internationale Design Saint-Etienne, 2019. Ph: Pierre Grasset. Source: www.daisyginsberg.com

AlgaeFabrics by Studio Tjeerd Veenhoven, 2016. Source: Studio Tjeerd Veenhoven

Algae biomass Ultra Blooms by Vivobarefoot, 2017. Source: Vivobarefoot

CURRENT FORWARD LOOKING PROJECTS

Loose to understand what you miss. The **“Resurrecting the Sublime” exhibition by Alexandra Daisy Ginsberg**, gives voice to one main question: could we ever again smell flowers driven to extinction by humans? could we ever again smell flowers driven to extinction by humans? “Resurrecting the Sublime” is an immersive exhibition resurrecting the smell of extinct flowers so that humans may again experience something they destroyed. Awesome and perhaps terrifying, it evokes the “sublime”. Biotechnology, smell, and digitally reconstructed landscapes reveal the complex interplay of species and places that no longer exist. “Resurrecting the Sublime,” asks us to contemplate our actions, and potentially change them for the future.

Alternative ecosystems to generate energy. Under our feet lies a world full of micro-organisms, most of which perform important tasks in our environment. The Geobacter is a bacteria that can purify water while continuously excreting electrons to its surrounding. **Teresa van Dongen** has been exploring these specific organisms since 2016 together with the Ghent University as a means to generate electricity for human use. For the 2019 Oerol Festival she investigated multiple places at the island Terschelling to see if she could find a new, strong ecosystem containing these energy providing microbes. Based on her findings she created **Mud Well**, a light installation that gets its energy from the bacteria in the muddy soil of an old Second World War bomb-crater. The ecosystem that she found in the so called “Bommengat” is one of the strongest she has ever encountered. The crater has turned out to be the perfect place for these microbes. One of the reasons is, that there is always an abundance of organic material and that it is quite closed off from various other influences like the sea or rivers. The water-filled crater thus functions almost like a closed cycle. Similarly, **Electric Life** (2019) is a home lighting system powered by the presence of bacteria to be nourished by tap water and a tablespoon of vinegar. Light, becoming living matter, needs care and establishes a deep human interaction. Natural processes go to artificial. Bacteria are also the main characters of the **Hybrid Living Materials** (HLMs): a method of interfacing a 3D digital design and printing platform with engineered bacteria, in such a way that we achieve programmable, replicable control of gene expression across the surface of 3D printed objects.

As for fashion, synthetic biology can be an alternative to traditional methods of producing fabrics, often highly polluting.
Some kinds of innovative and eco-friendly materials rely on the processing of waste of animal origin. Spider Silk, despite its apparent fragility and flimsiness, is in fact extremely resistant, a characteristic which has been developed by researchers with quite different backgrounds. After having developed its line of ties in 2017, **Bolt Threads** in 2019 partnered with **Stella McCartney** and **Adidas** to develop Tennis Dress, a piece made with a Microsilk and cellulose blend fiber and designed to be fully biodegradable.
Some other companies process plant-based materials. Indeed, a concrete threat to our planet is currently posed by the exponential proliferation of algae, which is largely due to the phosphorus and nitrates released into the sea by chemical waste; however, these organisms are in fact extremely versatile, and may be transformed into bioplastic material. **Ultra by Vivobarefoot** is a footwear collection made from algae-based foam, a valid vegetal alternative to the synthetic and oil-based ones; **Tjeerd Veenhoven** produces a similar fabric which is also made of the same aquatic organisms. The dyeing industry makes a huge environmental impact in terms of water use and water pollution. Faber Futures is developing an alternative dyeing method through fermentation, using bacteria such as Streptomyces coelicolor. **Transversal by Faber Futures**, commissioned by the Cooper Hewitt Museum, is a silk sculpture we designed and created in synergy with the parameters of their bacteria dye protocols. The piece explores how scale-up of biofabrication processes can be achieved both using the pigment produced per milligram through the fermentation process, as well as by emphasising the assembly of biofabricated components. They cut silk organza on a bias and then applyed the bacteria dye protocols to the material. The outcome is a malleable, breathable structure, pigmented with painterly forms of S.coelicolor.

MICRO SCENARIO

PARALLEL UNIVERSE

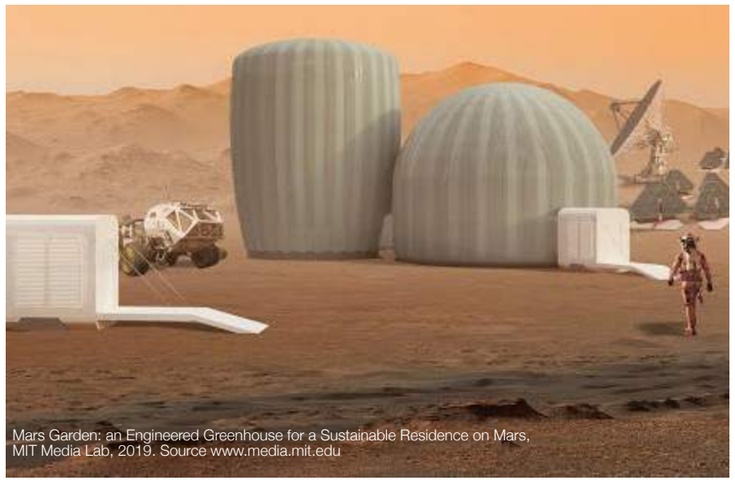
PARALLEL UNIVERSE is the search of new places to conquer, to explore and to populate.
Unless there are breakthroughs in quantum computing, Earth won't be able to produce enough energy to power the world's computers by 2040, according to a report from the Semiconductor Industry Association. The raw materials for solar panels and wind turbines could also dry up as our supplies of rare earth metals dwindles (Farah, 2019).
Earth is not enough. New territories must be explored. A company to develop state-of-the-art space manufacturing technology to support exploration, national security, and sustainable space settlement is an answer.

Vulcan by Made in Space. Source: madeinspace.us

CURRENT FORWARD LOOKING PROJECTS

Vulcan by Made in Space. Source: madeinspace.us

Spacesuits by Virgin Galactic and Under Armor, 2019. Source: virgingalactic.com



Mars Garden: an Engineered Greenhouse for a Sustainable Residence on Mars, MIT Media Lab, 2019. Source www.media.mit.edu

SpaceHuman: A Soft Robotic Prosthetic for Space Exploration, MIT Media Lab, 2020. Source: Valentina Sumini, www.media.mit.edu

The Deep Sleep Cocoon by Vollebak, 2019. Source: www.vollebak.com

Skyscrape. Yarn expansion respect to the temperature, 2019. Source: skyscrape.us

CURRENT FORWARD LOOKING PROJECTS

As interest in space exploration increases, it is necessary to seek new housing solutions to achieve a safer stay in space. Reducing dependence on terrestrial resources and energy used, while improving conditions for astronauts.

In 2019, **Made In Space** won a NASA contract to build a robotic space manufacturing system called **Vulcan** that will build “precisely-machined metal parts” using over 30 different materials including stainless steel, titanium, aluminium and thermoplastic composites. The company hopes their system will be able to make anything crewed missions may need — for example, housings for life support systems on a lunar-orbit space station.

To respond to this same requirement, **Responsive Environments Group at MIT Media LAB**, proposes **Marsboreal Greenhouse**, a new design for a greenhouse module that can provide 100% of the food necessary for a crew of four astronauts on an extended mission to Mars. Maximizing the exploitation of space, thanks to a spiral system inside an inflatable cylindrical shell designed to protect astronauts from harmful radiation. The plants grow in modular hydroponic trays that descend from the top floor of the module along six spiral tracks. The lighting, temperature, nutrient supply, track length and vertical separation of each spiral are adapted to the models and growth needs of the plants, thus maximizing the volume for growth, optimizing growth conditions and providing isolation in case of illness.

Protection has traditionally been one of clothing’s primary material functions. While in the past items of clothing were essentially devoted to protecting humans from the cold, the complexity of modern life has given rise to a plethora of new variables. Scientists and designers have consequently developed over the years innovative solutions and materials aimed at improving clothing’s performative characteristics depending on the area and range of use.

Experimental projects concern themselves with the study of high-performance materials and technologies which may protect the human body from extreme temperatures.

SkyScrape produces responsive clothing that can naturally adapt to the temperature of the wearer and the surrounding environment. The active yarns with which the fabrics of the garments are made change their shape, expand and contract, becoming thicker and more insulating when temperatures drop. The temperature-responsive apparel is thought to preserve the human body from hostile climates: the fabric itself acts as a thermometer, with the thickness and insulation increasing in the cold.

From hostile earthly environments to space exploration. Nowadays, space travel has evolved from an inspiring utopia into a veritable creative opportunity also for the fashion industry. As we enter the second space age, we are being introduced to space garments and accessories which are created for the space exploration of the future. Sleeping in orbit can be difficult. Just think of astronauts on board the International Space Station who live 16 sunrises every day and in order to rest they need various aids. Vollebak designed a sweatshirt that can help astronauts sleep while moving around the cosmos in a cramped spacecraft. The project is based on the basic concept of creating an autonomous microhabitat around the wearer’s head through a space helmet hood. **Deep Sleep Cocoon by Vollebak** is designed to help space travellers cope not only with lack of sleep but also with high pressure situations. Five segments inspired by insects’ shells completely enclose the wearer’s head, preventing light from filtering through.

Virgin Galactic in collaboration with Under Armor designed a space clothing system for private astronauts. Unlike NASA suits, born around the concept of utilitarian functionality to allow astronauts to carry out their work and keep them alive, new suits primarily concern the experience. In fact, the astronauts to whom Virgin Galactic is targeting are consumers looking for a unique experience, dedicated to adventure and leisure. A pioneering human space flight for individuals and researchers, the collaboratively designed space clothing system designed by Virgin Galactic and Under Armor combines comfort and attention to the customer experience, and could be what tourists will

CURRENT FORWARD LOOKING PROJECTS

wear in space.
Also **SpaceHuman**, a project developed by the **MIT Media Lab**, aims to support the human body during space exploration. The project consists of a soft robotic prosthesis to support space operations. In particular, the prosthesis is aimed at improving and enhancing the floating experience, while allowing man to adapt in microgravity environments. The underwater world, and in particular the structure of the seahorse's tail, inspired the design of an extension of the body capable of integrating the interiors of zero gravity habitats. In fact, the structure of the tail allows for movement, grip and protection while floating. SpaceHuman is therefore an additive prosthesis that can move around the body to grab objects, protecting the wearer from injuries that could occur while floating in a cramped habitat, while providing a cinematically stable base.

MICRO SCENARIO

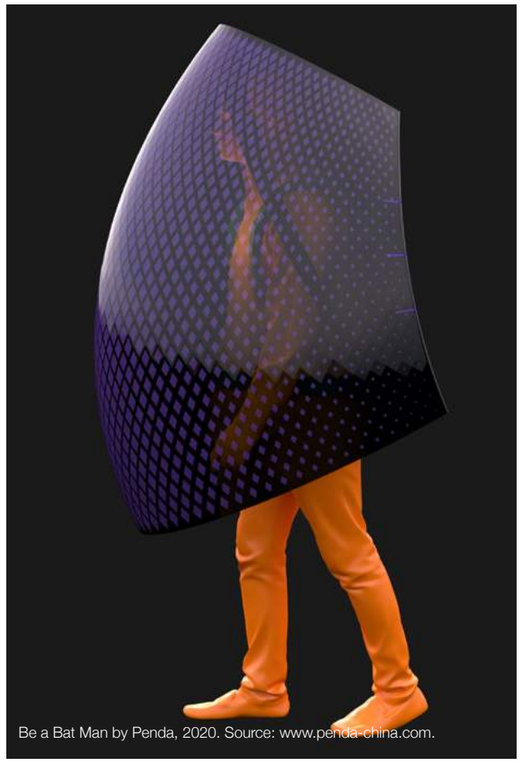
SOCIAL DISTANCING

An airborne virus has extended across the globe creating a pandemic, changing the way people perform their everyday tasks across the world. Social distancing measures have been introduced by the authorities as a way of slowing down the spread of the disease. However – beyond the obvious benefits of this action – there are certain drawbacks that make it only viable for a limited period of time, like its toll on mental health or its impact on the economy.
The theme of social distancing is explored in very different ways.

Here Comes the Sun Picnic blanket, open-source design by Paul Cocksedge, Source: www.dezeen.com

CURRENT FORWARD LOOKING PROJECTS

Don't forget to breathe installation by Doug Aitken, 2019, Ph. Stefan Altenburger Photography Zürich. Source: Hasselblad H5D



Be a Bat Man by Penda, 2020. Source: www.penda-china.com.

Proxxy by Halo, 2020. Source: www.proxxi.co

Do-it-yourself social-distance crown by Burger King Germany, 2020. Source: www.businessinsider.com

Here Comes the Sun Picnic blanket, open-source design by Paul Cocksedge. Source: www.dezeen.com

Proximity Dress 2.0 by Anouk Wipprecht, 2020. Ph Jeff Cacossa. Source: www.anoukwipprecht.nl

CURRENT FORWARD LOOKING PROJECTS

On one hand, a poetic and contemporary reflection comes from **Doug Aitken**. Doug Aitken explores the juxtaposition of the physical landscape with our ever-changing technological world, capturing intimate interpretations of the installation, '**don't forget to breathe**'. as light and colour synchronize through the sculptural bodies sited within an abandoned storefront in Los Angeles, they create a continuously changing contradiction between isolation and connectivity.

On the other hand **Burger King and Paul Cocksedge** with **Here Comes The Sun** work on products to facilitate the organization of spaces with social distancing. The fast food giant adopted the social distance crowns concept for a test run. On May 22, Burger King Germany posted on socials that some restaurants are handing out the crowns (folded and users have to make them themselves). 'We wanted to re-enforce the rules of high safety and hygiene standards that the BK restaurants are following,' a Burger King representative told. 'The do-it-yourself social distance crown was a fun and playful way to remind our guests to practice social distancing while they are enjoying food in the restaurants.' Here Comes The Sun can help people to socialize safely and confidently once restrictions have been eased. The typical English blanket, a symbol of convivial pleasures during Sunday brunches or picnics in the park, has been reinterpreted and redesigned to help people keep the right distance. Inspired by the sun and consistent with Cocksedge's style, based on simplicity, joy and wonder in everyday life, Here Comes The Sun is an open-source project available for download, to encourage people to make, craft and pattern-cut during lockdown.

Fashion builds shelters for the human body whose structures are no longer distinguished by the solidity and heaviness of the masonry, but rather take on the dynamism, fluidity and lightness typical of textiles (Testa, 2019).
Dayong Sun, founder of **Penda**, developed **Be a Batman**, a project based on a wearable shield concept, which could potentially be distributed during pandemics. Be a Batman is a light system, similar to the wings that allow bats to fly. Users wear a carbon fibre skeleton frame backpack. They hold a PVC film, which wraps around them like a jet cockpit, or personal bubble, creating a physical barrier with the virus. For added protection, UV lights also sterilize the plastic surface.
Proxxi, designed by **Halo**, is a bracelet with integrated technology that vibrates to alert wearers that another equal device is 2 meters away, reminding them of the need to keep social distance. The device could be widely distributed to ensure that an adequate and safe physical distance is maintained.
Also **Anouk Wipprecht**'s project starts from the concept of proximity and alertness. Her creation, the **Proximity Dress** was born as a response to the Covid-19 pandemic that has imposed new rules in terms of social distancing. The Dress generate a physical barrier when another person is detected in the surroundings of the wearer. It responds based on proximity and thermal sensors and identifies strangers within the intimate, personal, social and public space around the wearer. Each dress extends itself using an embedded robotic 3D printed mechanism.

MICRO SCENARIO

PURIFICATION

PURIFICATION is defence against the invisible viruses that silently graft onto everything around us.
Another response to the virus - in addition to social distancing - is hygenisation. Everything is meticulously purified, from the parts of the body to the objects we use daily to the spaces.

The Fountain of Hygiene by Bompas & Parr, 2020. Source: Bompas & Parr.

CURRENT FORWARD LOOKING PROJECTS


Micrashell by Production Club, 2020. Source: Production Club

Notebook Sanitizing by Studio Shikai, 2020. Source: shikai.tw.


Pura-Case by CRA-Carlo Ratti Associati, 2020. Source: carloratti.com


The Fountain of Hygiene by Bompas & Parr, 2020. Source: Bompas & Parr


Sterilising Lamp by Frank Chou, 2020. Source: frankchou.com

Time-Changing Hand Sanitizer by Pino Wang and Frank Chou, 2020. Source: frankchou.com


Atmosphère by Seymourpowell, 2019. Source: Seymourpowell


EarthTones by Hybridbody Lab, Cornell University, 2017. Source: Hybridbody Lab


Air's Atmos by Ao Air, 2020. Source: Ao Air

CURRENT FORWARD LOOKING PROJECTS

The Fountain of Hygiene by London-based design **studio Bompas & Parr** initiative challenges designers to explore new forms and functions to improve behavioural norms when it comes to the simple act of handwashing through a new product.

While with the same aim the **Time-Changing Hand Sanitizer by Pino Wang and Frank Chou**—the liquid changes colour as the user rubs it into their hands, as a visual representation of the length of time spent on washing.

Not only hands but also objects.

February 2020 Frank Chou initiated the Create Cures project, inviting designers to "promote the development of public health in a designer's way." Concepts from Create Cures include the **Sterilizing Lamp by Frank Chou**, which uses ultraviolet light to disinfect objects such as the user's keys, mobile phone and wallet in 60 seconds.

Notebook Sanitizing: considering the current rate of remote work, **Studio Shikai** redesigns a notebook stand which integrates a 270-280nm UV light, allowing users to easily sanitize their laptop keyboard, away from diseases.

Also many projects are born around the purification of garments. Two of them are Micrashell and Pura-Case. **Micrashell** was born as a socially responsible solution to safely allow people to interact in close proximity. Specifically designed to satisfy the needs of nightlife, live events and entertainment industries, Micrashell is a virus-shielded, easy to control, fun to wear, disinfectable, fast to deploy personal protective equipment (PPE) that allows socializing without distancing. **Pura-Case**, a portable wardrobe purifier that uses ozone to remove most micro-organisms, bacteria, and viruses from clothes and fabric, is designed by **CRA-Carlo Ratti Associati**. Once a piece of garment is hung inside the case, an air purification system by ozone treatment cleans and deodorizes the fabrics.

Research in the field of fashion is aimed at identifying ways to help protecting man from pollutants or virus and bacteria.

The most immediate solution is the one of masks, which act as filters and help prevent health issues such as asthma and other diseases. Air filtering masks have been already popular in specific areas of the world, where for example the air is particularly polluted, or in some places where the "courtesy masks" - masks worn to prevent their germs from infecting others - are consider a polite practice to wear if you are sick. The reasons of using masks are many and might unfortunately drastically increase in the future. The forest fires that occur in Australia and the growing concern about climate change could make the fire seasons longer and more frequent: the air full of pollutants caused by smoking is dangerous and can exacerbate asthma and other respiratory conditions that lead to stroke, heart disease and even cancer. Added to this is the COVID 19 pandemic.

Against bad air quality is also **AO air**, a wearable device presented at CES 2020. It is a transparent mask that crosses the face, covering the mouth and nose, inside which an incorporated system of fans adapts to the breath of the wearer and cleans the air that passes through the mask.

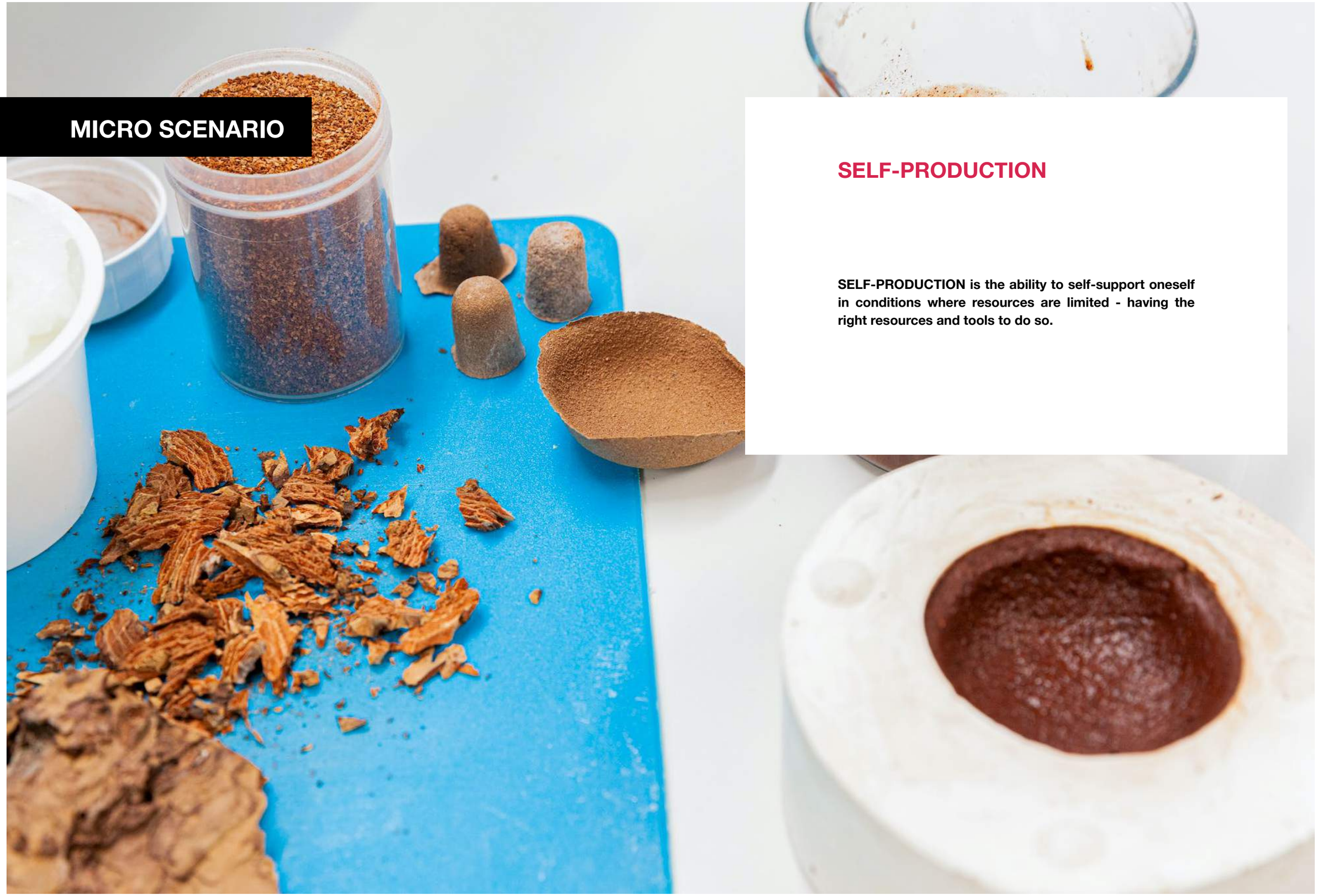
Atmosphère by Seymourpowell is a wearable device that combines protection against pollutants present in the environment with personalized beauty treatments on-the-go. The protective wearable device is equipped with artificial intelligence that maps the user's position and allows to respond in relation to the environment, also taking into account the user's personal data (from the type of skin to the needs of the body). It uses this information to obtain optimal environmental protection, while also trying to contribute to body homeostasis and to replace the skin care ritual by supplying beauty products in the form of steam.

EarthTones by Hybridbody Lab is a wearable chemical display that comes in the form of cosmetic powders. EarthTones is able to detect environmental pollution, generating colour shifts to display dangerous levels. Three different types of powder are able to detect respectively carbon monoxide, ultraviolet and ozone. For example, in the case of a ultraviolet sensitive powder, when exposed to UV rays a yellow to dark red colour transition occurs.

MICRO SCENARIO

SELF-PRODUCTION

SELF-PRODUCTION is the ability to self-support oneself in conditions where resources are limited - having the right resources and tools to do so.



Chemarts Cookbook by Aalto University - ARTS, 2020. Source: chemarts.aalto.fi.

CURRENT FORWARD LOOKING PROJECTS

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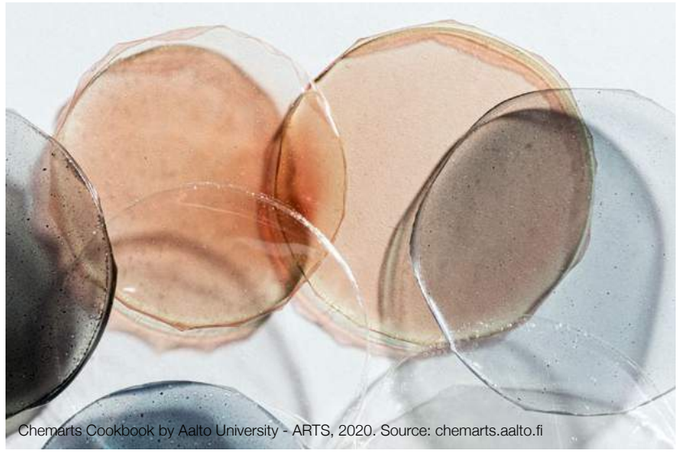
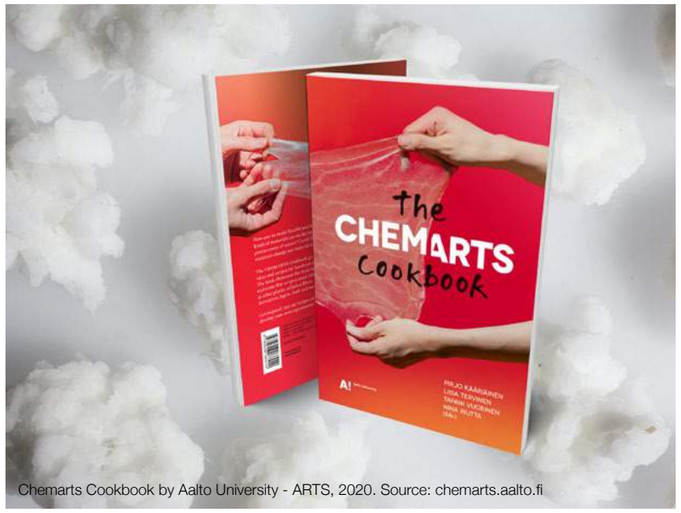


Chemarts Cookbook by Aalto University - ARTS, 2020. Source: chemarts.aalto.fi



Chemarts Cookbook by Aalto University - ARTS, 2020. Source: chemarts.aalto.fi

Xylinum Mask by Sum Studio, 2020. Source: sum design

Xylinum Mask by Sum Studio, 2020. Source: sum design

Xylinum Mask by Sum Studio, 2020. Source: sum design

CURRENT FORWARD LOOKING PROJECTS

The **Chemarts Cookbook** offers both simple and more advanced ideas and recipes for hands-on experiments with wood-based materials. The book showcases interesting results, focusing on raw materials that are processed either chemically or mechanically from trees or other plants: cellulose fibres, micro- or nano-structured fibrils, cellulose derivatives, lignin, bark, and wood extractives.

Xylinum Mask by Sum Studio starts from the need for the material with which the masks are made to fight Covid-19 and the possibility of growing the material could in local municipalities, in people's homes, or even within the very hospitals that need them. N95 masks are made from melt blown non-woven plastic fabric at the perfect precision in order to filter particles containing pathogens. These materials are paramount in our fight to stop the spread of COVID-19, yet our essential workers are lacking supply of them. This is due to the machining and precision required to make the fabric. The machines that create melt blown fabrics are expensive, complex, and take months to build. Despite ramped up production and factories prepared to transition their time toward PPE fabrication, the supply chain of N95 Masks has bottlenecked severely. Sum Studio declares "As bio-designers, we often look at moments where synthetic chemistry hits a wall and ask ourselves if this bottleneck would have occurred in a world more invested in bio manufacturing. To follow our question, we grew our own bacterial cellulose face mask in our home quarantine kitchen while ideating some possible ways that this prototype could be grown to function just like the melt-blown N95 fabric that is in short supply."

APO CALY PTIC FASH ION

The ability of fashion and design is to understand and investigate the changes of its own time, offering solutions as a result of exploring new areas, contexts, technologies or materials.
Fashion's quest for innovation will include radical projects focussed on a world which is constantly evolving. These experimentations will envisage the human body as immersed in environments and spaces which are complex, extreme, an ever-changing reality which may be continuously remodelled and reshaped (Sbordone, 2012). Fashion interacts with the body like a second skin layer and by adding new functions determines unusual behaviours and meanings.
Tackling successfully all the complex scenarios mentioned above will be made possible thanks to a new generation of high-performance clothing. These items will be devoted to a wide range of uses, from shielding to filtering, from curing to nourishing the body, and they may even act as a kind of second skin to ensure protection and preserve the existence of humankind.

SCENARIO

EXTRA HUMANS

‘I Want To Believe’ photobook by David Vintiner and Gemma Fletcher, 2020. Ph: David Vintiner. Source: David Vintiner Photographer

EXTRA-HUMANS

PROSTHESIS / MEDICAL / BODY ENABLER

The adventures of superheroes have populated comic books for children all over the world, and their supernatural powers have informed humanity's collective imagery for more than a century. What seemed only a fairy tale and a fantastic childhood dream is closer and closer to the real world.

Superhumanity becomes reality thanks to technology. The theme of technology as an extension of the body is not new and various thinkers have reflected on the relation between technology and the human body.

The first to approach this subject was Eric Kapp in 1877 with Grundlinien einer Philosophie der Technik, claiming that technological products are nothing but a "projection" of the physical and functional features of biological organs. To illustrate this concept he uses the example of the shape of the hook that recalls the drawing of a folded finger, the bowl that has a similar shape to that of the cupped hand to hold liquids, the rake that simulates the human arm and hand, the telegraph cables that take their inspiration from the nervous system and so on (Tenuta, L. 2020).

McLuhan is the first using the term "extension" and he writes that «all technologies are extensions of our physical and nervous system to increase power and speed. Again, unless there were such increases of power and speed, new extensions of ourselves would not occur or would be discarded» (M. McLuhan, Understanding Media, the extension of Men, McGraw–Hill, 1964, p. 91.). McLuhan has the merit of dividing technologies that are extensions of the body into physical and cognitive. The first mechanise a task usually performed by the human body, the second on the other hand help in the processing of data — the media for example. These are, as psychologist Donald Norman has called them, cognitive artefacts able to represent, keep, retrieve and manipulate information. Thirty years later, in Hand's End, David Rothenberg continues McLuhan's line of investigation and similarly divides technologies into two big categories: faculties of action and faculties of thought for perception, abstraction and memory. His main contribution to debate lies in his intuition that these intentions are already present in human beings and the technologies are simply their carriers, facilitators of the intentions innate in human beings. Today technologies are used to enhance the human body 360 degrees.

Tech pioneers like Elon Musk and Mark Zuckerberg are now pursuing brain implants that aren't purely for treatment but could let us do things like communicate telepathically or type with our minds. Others claim we'll soon have neuroprostheses to enhance our attention and memory or allow us to integrate our brains with the Internet and control our smart homes with our minds.

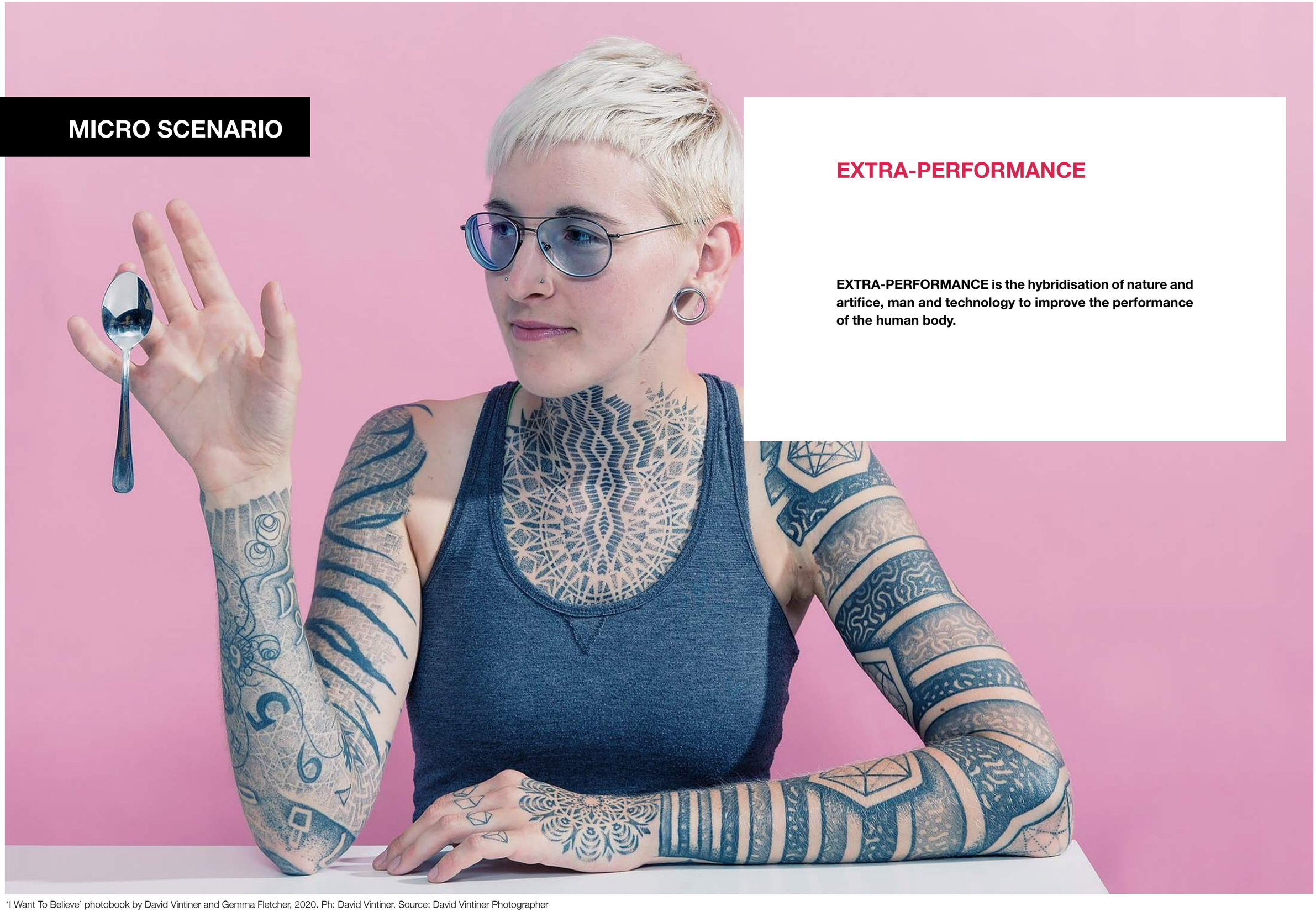
Cullen and graduate student Dayo Adewole setting up an experiment with light-sensitive living electrodes. Cullen uses tissue engineering to grow tiny, three-dimensional threads of brain cells that he calls "living electrodes." Grown from stem cells and then packed into biodegradable gel tubes, these natural electrodes could be gentler in the brain, merging and connecting with living tissue rather than injuring it. He hopes they could solve some of the problems with implants used in DBS and BCIs and potentially make these treatments available to more patients (Mullin, 2018).

The recent documentary I AM HUMAN sets the stage for jaw-dropping revelations to come: Bill, a wheel-chair bound tetraplegic, stares intently at a simulated arm on a computer screen. Two tentacle-like cables protrude from his skull and hook into a nearby computer, which sends messages to electrodes implanted in his arm and hand with his brain signals. Bill is one of many first-wave pioneers ushering in a biotechnological revolution–presently, more than 200,000 people in the world have digital chip technology implanted in their brains (Greczyn, 2020). Man and technology come together to enhance the body or personalize it.

MICRO SCENARIO

EXTRA-PERFORMANCE

EXTRA-PERFORMANCE is the hybridisation of nature and artifice, man and technology to improve the performance of the human body.



‘I Want To Believe’ photobook by David Vintiner and Gemma Fletcher, 2020. Ph: David Vintiner. Source: David Vintiner Photographer

CURRENT FORWARD LOOKING PROJECTS

Human skin 'yarn', 2020. Source: New York Post

Wearable Lab on Body by Fluid Interface Lab, 2019. Source: Fluid Interfaces, MIT Media Lab

Black Squid Jacket by Volleback (2019). Source: Volleback

G+ Graphene Aero Jersey by Oakley, Bioracer, Directa Plus (2018). Source: Bioracer

G-SERIES shoes by Inov-8 and University of Manchester, 2018. Source: www.manchester.ac.uk

CashCuff by DressCode and DIGISEQ (2019). Ph: Keith Heppell. Source: www.cambridgeindependent.co.uk

Fulu Haptic Finger Nail for Augmented Reality, 2019. Ph: Deo Suveera. Source: Fulu

'I Want To Believe' photobook by David Vintiner and Gemma Fletcher, 2020. Ph: David Vintiner. Source: David Vintiner Photographer

Les Hybrides by Vanessa Lorenzo, 2020. Source: Utopiana

CURRENT FORWARD LOOKING PROJECTS

Vanessa Lorenzo investigated this theme with a residency in Utopiana on the understanding of hybrids, behaviour of bodies and affectivity between species through ornaments and prostheses. Vanessa Lorenzo's project focuses on hybrids, intra-species attachment and the ecology of new media in the era of ecological and digital change. Her project is inspired by a pre-Christian architectural ornament called «Green Man», a leafy head carved on many European churches, which recognizes the pagan worship of a nature valuing our vulnerability. The project is also influenced by an animistic approach to metamorphic and indefinite beings that proliferate in times of crisis. During this residency, Vanessa Lorenzo will question the desire, the fear and the vulnerable effects between the human, the human and the technologies that link them. The human body is also the tool to strengthen and 'repair' the human body itself.

Can you imagine a textile made of human skin cells? Sounds a bit science fiction, but a team of **researchers from France, Columbia and the U.S.** have made it happen (Magnan et al, 2020). They have developed a yarn that can be woven into human textiles- a material that can be used to heal skin and even replace parts of damaged organs. It is a known fact that some patients' immune system can reject foreign agents, so it is great news to read that the scientists have found a way to create textiles that the human body will most likely accept. They did this by producing a type of textiles out of human fibroblasts—cells that generally assist with the production of collagen and other fibres. The body will not reject them because they are natural human cells.

The human body then seems to overcome the limits of space thanks to the strengthening of objects that are able to replicate the sensations of the human body. **Fulu** is designed to introduce the sense of touch to audio-visual interactions such as video calls and online gaming, which the studio says "neglect" the human senses. The Wearable technology can connect to mobile devices via Bluetooth, and recreates sensations that range from stroking the fur of your dog, to touching the hand of a loved one from anywhere in the world.

Finally, external tools potentiate the body to control it. **Wearable Lab on Body** (Pataranutaporn at al, 2019)- a project is developed by the **Fluid Interface Lab** and supported by **NASA through Translational Research Institute for Space Health (TRISH) and MIT Media Lab Space Exploration Initiative** - is a platform for active continuous monitoring of human biomarkers from the biological fluid containing both digital sensors such as IMU for activity recognition, as well as an automated system for continuous sampling of biomarkers from saliva. The main advantage of such a bio-digital wearable platform is that it enables the continuous monitoring of behaviour and wellbeing of the individual in real-world settings. The information from both the biochemical and digital sensors can contextualize one another, and provide insights on the effects of an individual's behaviour, which in turn can be used to develop healthier lifestyles. With the closed-loop system, the platform could also provide real-time feedback to the individual when recognizing unhealthy behaviour. Hybridisation opens up interesting scenarios when pushing the boundaries between the human body and body equipment, questioning the relationship between prosthesis and ornament and the generation of new aesthetic canons.

The work of the photographer **David Vintiner** explores the concept of transhumanism, of how human experience can be redefined through technology. The book, entitled **"I Want to Believe - An Exploration of Transhumanism"**, created in collaboration with the artistic director and critic Gem Fletcher, tells about the theme of body modification, presenting a variety of people who identify themselves, to some extent, as "transhuman": man with bionic ears who perceives changes in atmospheric pressure, a woman who can "feel" earthquakes that occur all over the world and technicians who have developed laboratory organs. According to Vintiner, the impact of science on the human understanding of aesthetics is one of the most fascinating aspects of transhumanism, on the concept of beauty standards of posthuman perfection.

Today research has made possible the creation of products for the body which favour and facilitate performances in direct proportion to the amount of

CURRENT FORWARD LOOKING PROJECTS

physical effort made. Hyper-performing garments have been especially welcome in those sectors of human activity which require specialised technical clothing; one of these is the field of sports, which demands continuous experimentation on materials and fabrics to enhance the future performance of the bodies wearing them. It is very important for athletic shoes to have a firm grip, as this feature does not only boost the athletes' performance, but also helps prevent accidents. In view of this consideration the **Inov-8 firm and the University of Manchester** developed a kind of rubber which is graphene-based. Graphene derives from graphite, and because of its very high level of strength and flexibility it makes shoe soles twice as robust, elastic and wear resistant, and indeed ensures a firmer grip. The same material has also been used by **Oakley and Bioracer** to develop their **G+Graphene Aero Jersey**, a high-tech, high-performance garment for cyclists: graphene's properties dissipate heat from the rider's body, and enable them to use less energy to adjust their body temperature (TechnicalTextile, 2018).

But, ever more often today, the athletic gestures comes out of the stadiums and inspires daily life.

Volleback's Black Squid Jacket is made up of a completely waterproof and windproof external coating that mimics the adaptive camouflage of squids. Volleback replicated elements of this biological survival mechanism using lasers, resin and over 2 billion microscopic glass spheres. The result is an amazing ski and snowboard jacket. In opaque light conditions it has a metal or petrol colour, but when exposed to bright lights it instantly reflects every colour in the visible spectrum, a particularly useful feature if you want to be seen on the ski slopes but also while commuting at night.

To simplify everyday activities, **DressCode**, the fashion-tech start-up from Cambridge, designed together with **DIGISEQ**, **CashCuff**, a tailored and smart shirt, which allows users to pay for the goods using the shirt cuff.

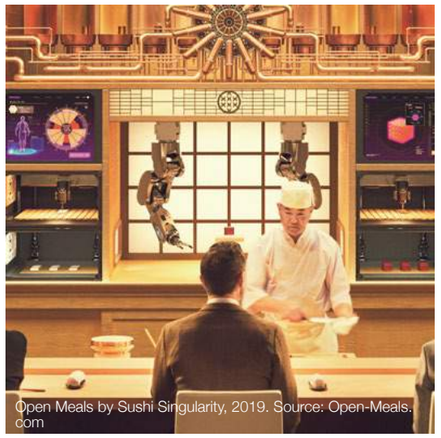
MICRO SCENARIO

BIODATA SERVICES AND HYPER-PERSONALIZATION

In 2020 consumers primed by constantly evolving digital services and smart physical spaces – and accustomed to the ultra-convenience of 'everything as a service' – will increasingly expect relevance as a service, too. That means services and experiences that constantly adapt around the changing needs of the user. Facial recognition, sensors and smart objects are turning the world into a landscape that shifts and changes around consumers. The result is ever-heightening expectations for responsive personalization. No wonder 39% of global businesses say they have started to deliver personalized experiences in real-time (Adobe and Econsultancy, February 2019). New technologies – think affordable DNA testing, blood testing and more – are making new innovations that shift and change around the changing human body possible for the first time. More than 26 million people have taken an at-home ancestry test. High-end services are turning to genetic analysis to take hyper-personalization to new heights. Over the past few years, at-home DNA testing kits have exploded in popularity. By February 2019, over 26 million consumers had added their DNA to four leading commercial ancestry and health databases, according to an MIT Technology Review report. As advances in speedy, sophisticated DNA analysis make genetic testing easier than ever, it's paving the way for lifestyle experiences that elevate the hyper-personalized offerings already saturating the luxury space. Daniel del Olmo, founding partner of The Passionality Group, has called this the next era of dining. "We believe hyper-personalization will become commonplace in the future." (Regaladoa, 2019).

Open Meals by Sushi Singularity, 2019. Source: Open-Meals.com

CURRENT FORWARD LOOKING PROJECTS

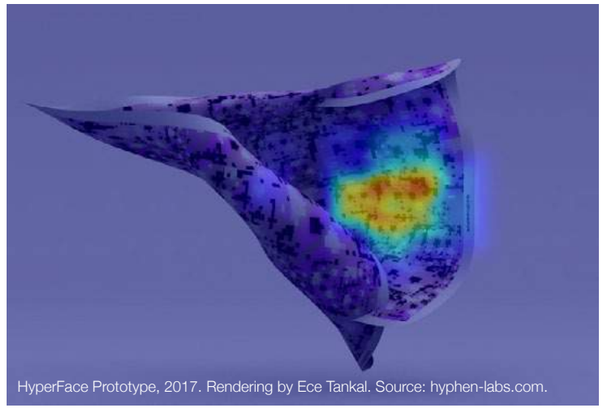


Open Meals by Sushi Singularity, 2019. Source: Open-Meals.com

Open Meals by Sushi Singularity, 2019. Source: Open-Meals.com

HyperFace Prototype, 2017. Rendering by Ece Tankal. Source: hyphen-labs.com.

Exclusion of Surveillance by Jip van Leeuwenstein, 2019. Source: HKU Design/Jip van Leeuwenstein



HyperFace Prototype, 2017. Rendering by Ece Tankal. Source: hyphen-labs.com.

Yo! Dinner, Yo! Way by Yo! Sushi, 2019. Source: yosu

Optune by Shiseido, 2019. Source: FashionNetwork.com.

CURRENT FORWARD LOOKING PROJECTS

But how this customization is applied today?

Sushi Singularity will use genetic analysis to create bespoke meals for each individual. New restaurants and services are turning to biodata to redefine the fine dining experience. Set to open in Tokyo later this year, the restaurant will collect bio samples from diners a week before their reservation to create unique, 3D-printed sushi tailored to diners' nutritional needs.

Another sushi dining experience assesses a person's DNA information to curate a menu suited to their specific nutritional needs. **London's Yo! Sushi** partnered with at-home genetic testing company **DNAFit** in February 2019 for the **Yo! Dinner, Yo! Way** scheme and offered free personalized meals to a select number of customers who mailed in a saliva sample. Baze has developed a closed-loop personalised nutrition model that uses blood micronutrient analysis and app data to deliver tailored supplements to the doorstep of its consumers.

Also fashion and beauty re evolving into that direction, with products and services customised according to the single user.

Optune, Shiseido's first subscription service, to which users can sign up via website, is an IoT skin care system that offers 80,000 personalized skin care models that match the body conditions, user habits and environments they frequent. A dedicated application uses an algorithm to analyse data on skin conditions, environmental data - such as temperature and humidity - and sleep information to detect the interruption of the biological rhythm. The data is sent to a dedicated machine that provides optimal skin care by adapting the one's current conditions.

Hyper personalisation brings along tools such as facial recognition which are highily controversial because of privacy reasons. Facial recognition technology is widespread and is becoming increasingly pervasive. Against this dynamic, Wearable accessories and clothes have been designed to contrast facial recognition technology.

Already in 2004, the researcher and artist **Adam Harvey** invented a clutch decorated with L.E.D. lights: when a camera flash went off, the bag would respond with a counter-flash, washing out the photo and making it unreadable. More recently, he worked on a textile print, **HyperFace**, which can be used as clothing that interferes with recognition by adding visual noise around the face. It is the case of the **Exclusion of Surveillance** mask designed by **Jip van Leeuwenstein**. The facial recognition software takes place by means of artificial intelligence capable of detecting human faces in real time. Body equipment can mislead the software with forms that prevent artificial intelligence from detecting the object. Other designs confuse artificial intelligence with images of decoy faces, preventing it from making proper identification.

ORN AME NTAL NE EDS

Heightened senses, speed, and the ability to fly effortlessly: garments and accessories will become functional as well as ornamental prostheses capable not only of overcoming physical impairment but also of enhancing body performance by bestowing almost supernatural characteristics on it. Among the challenges posed by this dimension are those concerning the relationship with the body modification and the definition of a new concept of beauty.

Although the subject of body modification has long been discussed in fields such as anthropology, technology and science, it has only recently been approached by design. Design and fashion have started to pay more attention to the potential of the human body as a place of project intervention. Engineers and scientists have oriented their research mainly towards an improvement in terms of quantifiable performance, data and mathematical results, intending to constantly push humanity beyond its limits. Contemporary society is markedly based on performance, on breaking records, on crossing borders, in the incessant pursuit of the superhuman myth. The fantasy that feeds the common imagination is that technologies applied to the body and clothing can become functional prostheses capable of improving human performance and therefore, as a direct consequence, it's quality of life. But is it really so?

Designers now have a new area to work on: the body. In this territory, the definition of the prosthesis is questioned. Design and fashion will have the task, or at least the possibility, of bringing the results of the most daring scientific progress closer to a human being and tolerable dimension.

SCENARIO

AI FEELS

Dormio by Fluid Interfaces, MIT Media Lab, 2018. Source: Fluid Interfaces Group, MIT Media Lab

AI FEELS

SOCIAL / BEHAVIOURAL / EMOTIONAL

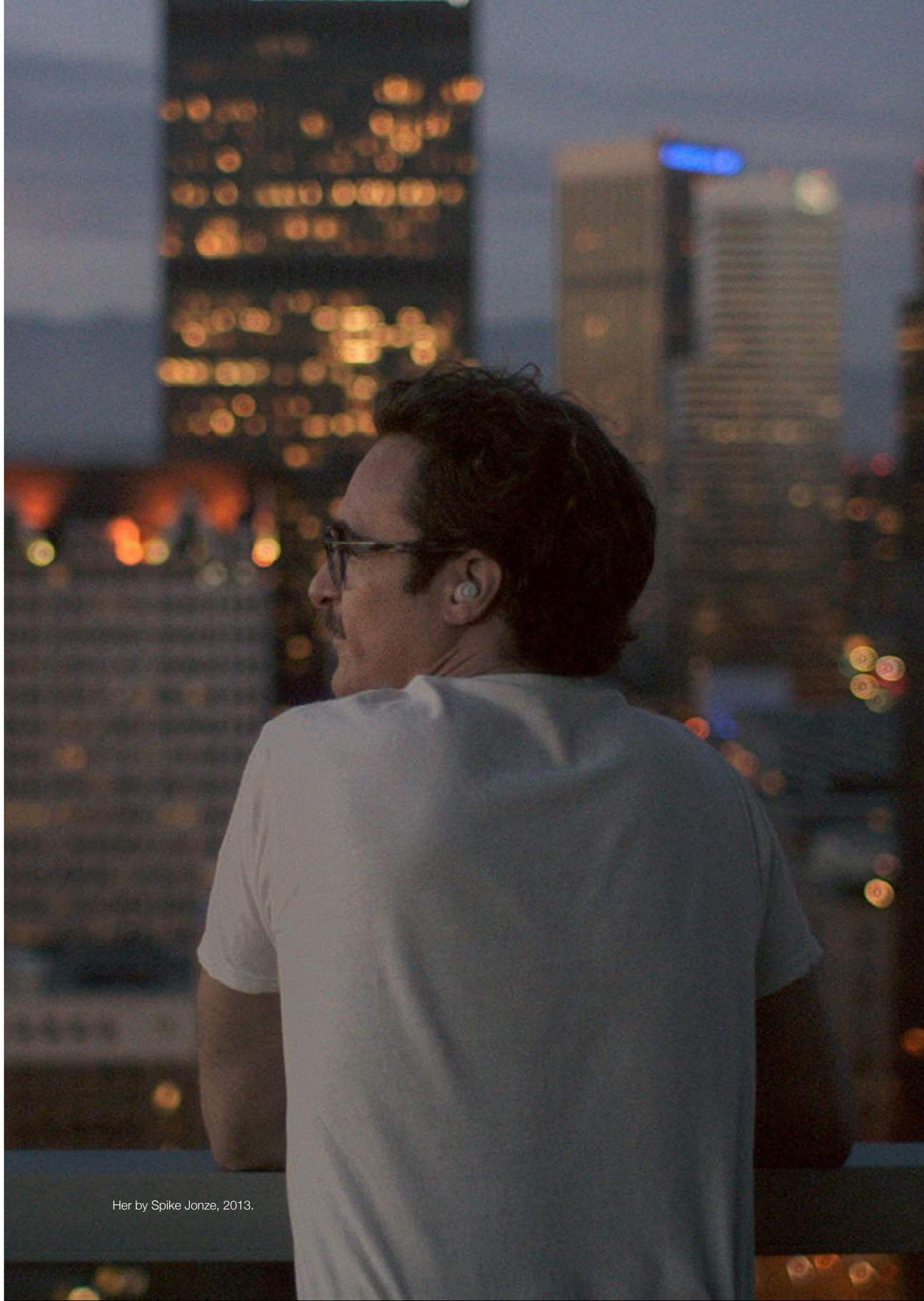
Theodore Twombly: ‘I’ve never loved anyone the way I loved you.’
Samantha: ‘Me too. Now we know how.’

A completely normal dialogue, if it wasn’t for the fact that it involved a man and a machine. This happens in Her, the movie written by Spike Jonze.

No field in computing is as hot or heavily hyped right now as artificial intelligence. Once a science fiction dream, AI is now a big part of our everyday lives; whether it’s commonplace tech like fraud prevention systems, online recommendations, or the speech recognition tools driving smart assistants — all the way through to innovative new technologies like self-driving cars and autonomous delivery robots.

In computer science, Artificial Intelligence (AI), sometimes called machine intelligence, is intelligence demonstrated by machines, unlike the natural intelligence displayed by humans and animals. Colloquially, the term “artificial intelligence” is often used to describe machines (or computers) that mimic “cognitive” functions that humans associate with the human mind, such as “learning” and “problem-solving”. (Russell & Norvig 2009, p. 2.) Modern machine capabilities generally classified as AI include successfully understanding human speech, (Russell & Norvig 2009.) competing at the highest level in strategic game systems, autonomously operating cars, intelligent routing in content delivery networks, and military simulations. (Allen, Gregory, 2020).

A more elaborate definition characterizes AI as “a system’s ability to correctly interpret external data, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation.”(Kaplan et Haenlein, 2019). “Siri, Siri, in my hand: Who’s the fairest in the land? On the interpretations, illustrations, and implications of artificial intelligence”. Business Horizons. 62 (1): 15–25.) But what is changing is that artificial intelligence is taking on human features and is not only a functional tool but also brings with it emotions, feelings and experience. Just like a human being.



Her by Spike Jonze, 2013.

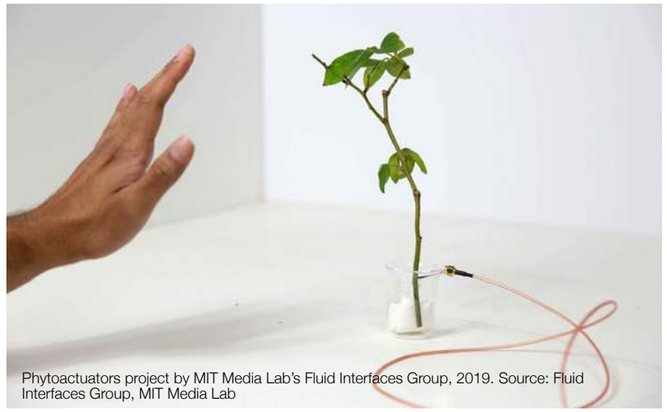
MICRO SCENARIO

INDUCED BEHAVIOURS

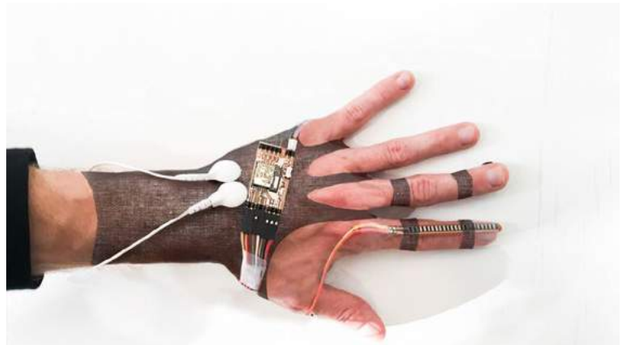
INDUCED BEHAVIOURS describes new behaviours that are generated through the use of technology in particular in relation to nature or objects. These objects behave, communicate through their gestures and create a relationship with the user or the system around them.

Phytoactuators project by MIT Media Lab's Fluid Interfaces Group, 2019. Source: Fluid Interfaces Group, MIT Media Lab

CURRENT FORWARD LOOKING PROJECTS

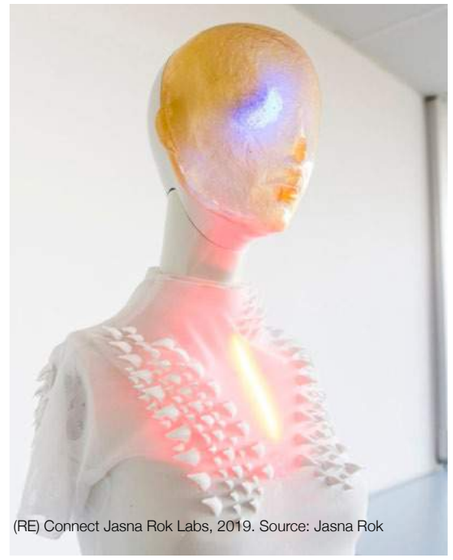


Phytoactuators project by MIT Media Lab's Fluid Interfaces Group, 2019. Source: Fluid Interfaces Group, MIT Media Lab



Dormio by Fluid Interfaces, MIT Media Lab, 2018. Source: Fluid Interfaces Group, MIT Media Lab

Flowing Water, Standing Time by Ying Gao, 2019. Source: Ying Gao



(RE) Connect Jasna Rok Labs, 2019. Source: Jasna Rok

Project Oasis by Harpreet Sarren, 2018. Source: harpreetsareen.com

Elowan by MIT Media Lab' Fluid Interfaces Group, 2018. Source: Fluid Interfaces Group, MIT Media Lab

Mercedes-Benz Vision AVTR, 2019. Source: Mercedes-Benz.it

Flowing Water, Standing Time by Ying Gao, 2019. Source: Ying Gao

CURRENT FORWARD LOOKING PROJECTS

These first projects describe a world based on hybrid electronics that includes natural, biological and artificial elements to communicate the digital and natural world through computing.

The **Phytoactuators project by MIT Media Lab's Fluid Interfaces Group**, for example, has developed a way to transmit an electronic signal and then convey a message through plants. Plants act as natural interface devices for all soft notifications to lessen cognitive overload by communicating to the user that something has changed but it is not critical to focus on it (Sareen & Maes, 2019; Sareen, Zheng & Maes, 2019). Another example is **Elowan**, a cybernetic lifeform, a plant in direct dialogue with a machine. The plant is interfaced through its own internal signals with a robotic extension that drives it automatically towards the light.

Harpreet Sarren also explores nature focusing on how the medium of our conversation with nature is so visual and multi-modal, in contrast to what we do with do with technology today. Weather on phones or computers doesn't invoke the same senses as literally seeing or feeling the weather. **Project Oasis** is a Voice Terrarium you can talk to. It's a self-sufficient closed ecosystem that mimics outside weather but inside a box. You can ask the terrarium about 'Weather in Seattle' as a response to which it might start pouring inside the box. The terrarium can also generate clouds, mist or change the lighting to represent other weather conditions. This experiment expands our conversation with technology and the natural world. We live in-between nature and technology and traditionally look at them as two very different worlds. Oasis is an ecological conversation but naturally - neither programmed nor chaotic.

In this micro-scenario also objects become alive: from cars to accessories. **Mercedes-Benz Vision AVTR** is an avatar-inspired concept car that is meant to feel more like a living creature than an automobile. Mercedes-Benz chief design officer Gordon Wagener said of the Vision AVTR concept in a keynote speech at CES 2020, "we wanted to create something like a living organism." The vehicle as an immersive experience space. Human being and machine linked with biometric data. Although it is an electric and autonomous vehicle, user can still take control, even if traditional commands are absent. Through a surface in the centre console the driver can position his/her hand and connect to the vehicle, so to provide the vehicle with the biometric data. By moving the hand, holographic menus can be displayed to control other vehicle functions, while the curved dashboard display and large glass surfaces create continuity with the outside world. This creates a real relationship between the car and the user.

About accessories, **Dormio** is a Wearable device designed by the **Fluid Interface Group of MIT** to hack your dreams. And, they hope, help change them for the better. The user wears a gloved device, a little bit like one of those old Nintendo Power Gloves from the 1980s, that collects biosignals which track changes in sleep stages. These signals are tracked via the hand using data related to a wearers' finger muscle tone, heart rate, and skin conductance. While we may not realize it, all of these are things that change when a person is asleep. When the biosignals appear to signal the end of a sleep transitional state, the device triggers an audio cue to be played, waking the user slightly, but not enough to jolt them back into a state of full wakefulness. They enter the dreams as new content, making it possible to alter the course of a person's dream. The system then quietens down until biosignals appear to signal another transition into a deeper sleep.

Technology unites, technology divides.

Some projects applying technology and science to fashion, to explore new dimensions of human interactions and build Wearable objects that could help us to better understand ourselves and others.

Jasna Rok Labs developed **(RE) Connect**, a piece of smart Fashion-Technology which helps not to lose the emotional contact of people around us. The project focuses on emotion technology, a new field that is creating new business models and applications based on human emotion. (RE) Connect is an emotion identifier which is emotionally enhancing humans by creating new levels of empathic communication. The reactive emotional fashion piece can

CURRENT FORWARD LOOKING PROJECTS

identify and track feelings by speech and provide real-time visual and haptic feedback to the wearer and the wearer's environment.

Montreal stylist **Ying Gao** created robotic clothes, **Flowing Water**, **Standing Time**, which respond to colours in their immediate vicinity, wrinkling, expanding and contracting as if they were alive. The pieces evolve between two states and show perpetual metamorphosis as they react to the colour spectrum. The reactive garments use colour and light sensors, as well as micro cameras connected to a raspberry PI computer, to gather information about their environment. These data then activate actuators and magnets interlaced with silicone to generate undulations and tissue movements.

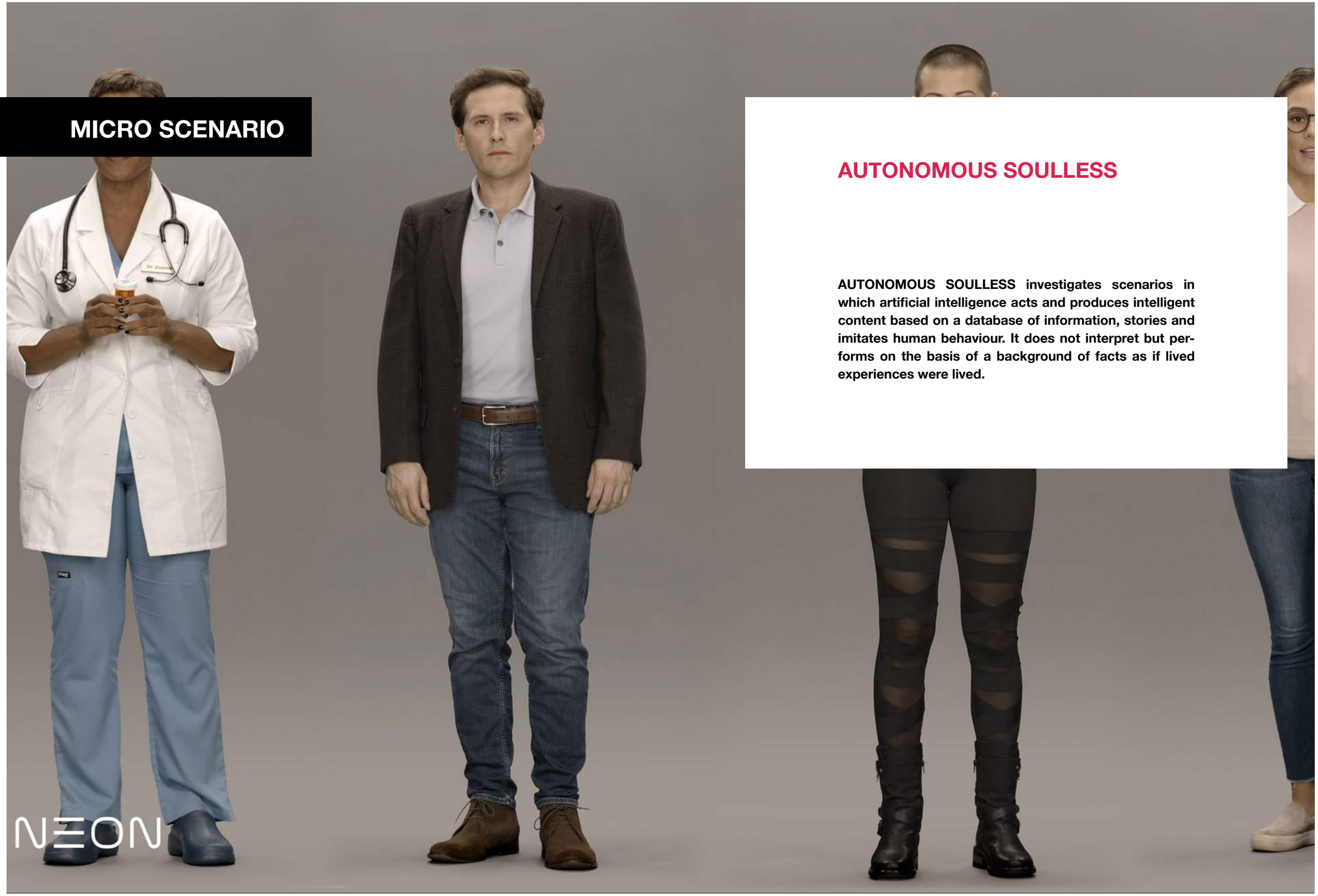
Some projects then use artificial intelligence to generate interactions.

This is the case of the experimental project developed by some researchers from **King Saud University in collaboration with Heilongjiang University**. Mental health has become a serious problem that significantly affects people's quality of life. With the development of science and technology, a completely new direction has emerged for the improvement of mental health by using the interaction between robots and people. The project consists of an autonomous emotion-sensitive system that integrates a personal robot, intelligent clothing and a cloud terminal. It is a "people-centred" emotional interaction mode: personal robots and intelligent clothing complement each other seamlessly and interact jointly with users. Artificial intelligence technology are used to design the perception of emotions and interaction algorithms including intelligent recommendations, recognition of relationships, recognition of emotional expressions.

MICRO SCENARIO

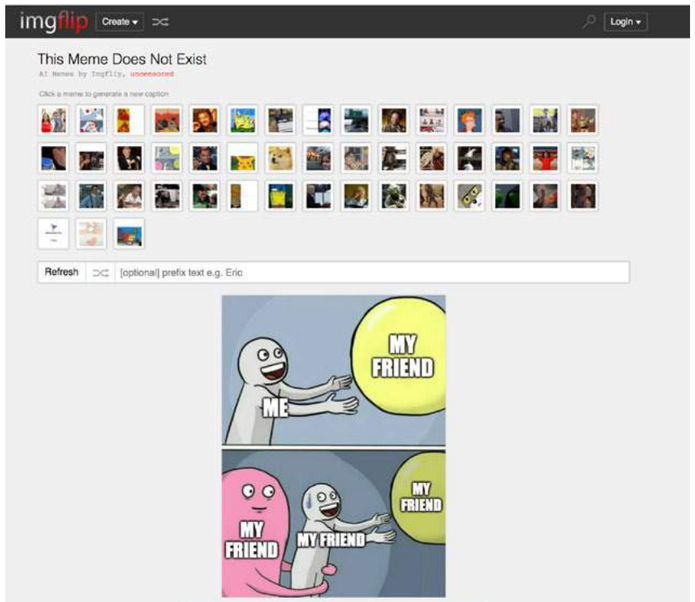
AUTONOMOUS SOULLESS

AUTONOMOUS SOULLESS investigates scenarios in which artificial intelligence acts and produces intelligent content based on a database of information, stories and imitates human behaviour. It does not interpret but performs on the basis of a background of facts as if lived experiences were lived.



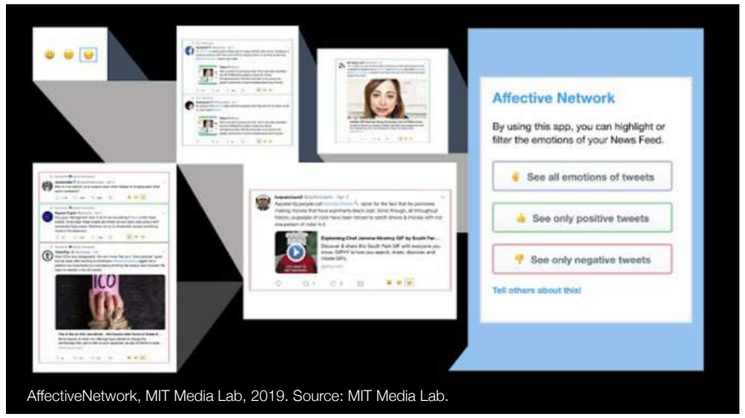
Neon by Samsung STAR Labs, 2019. Source: Samsung

CURRENT FORWARD LOOKING PROJECTS



This Meme Does Not Exist, 2020.Source: https://imgflip.com/ai-meme.

Neon by Samsung STAR Labs, 2019. Source: SamsungA



AffectiveNetwork, MIT Media Lab, 2019. Source: MIT Media Lab.

Everybody Dance Now by UC Berkeley (CHAN et al), 2018. SCREENGRAB: YOUTUBE

SK-II, Affectiva, Unruly, 2017. Source: www.thedrum.com

CURRENT FORWARD LOOKING PROJECTS

Let's start with 'light' applications. Memes are one of the things that make us human. They are, by design, massively shareable images based on some universal (or at least semi-universal) lived experience that draws on some aspect of popular culture, but seeds it with additional meaning. Titled **This Meme Does Not Exist**, after the plethora of other similar A.I.-generated projects, this new online tool (we use that term loosely) lets you select a popular meme image and then generates a new funny caption to go alongside it. Users have the option of saving and sharing particularly absurd ones or simply continuing to click to see what insane idea the computer will come up with next. About leisures' applications, in a paper posted to the arXiv preprint server, researchers at **University of California Berkeley** demonstrate how they designed AI that, given a video of an expert dancer and an amateur, can transfer the moves from one to the other and create a convincing video of the amateur pulling off some seriously impressive rug-cutting. But that's not all. The paper is called **Everybody Dance Now**, which is charming because it conjures ideas like recreating the entire "Evolution of Dance" viral video with algorithms and minimal physical effort. But it also represents the latest step forward in creating a highly realistic video that can put people in situations that they were never really in.

But there are also more functional and useful application, the ones of the medical field. Researchers from the **University of California, San Francisco**, have developed a brain implant which uses deep-learning artificial intelligence to transform thoughts into complete sentences. The technology could one day be used to help restore speech in patients who are unable to speak due to paralysis.

Last but not least, the fake-humans by **Samsung**. Samsung's future factory **STAR Labs** has developed **Neon**, AI-powered virtual beings that look and behave like real humans. Unlike artificially intelligent (AI) assistants like Siri or Alexa, STAR Labs' computationally created beings aren't programmed to be "know-it-all bots" or an interface to answer users' questions and demands. Instead, the avatars are designed to converse and sympathise "like real people" in order to act as hyper lifelike companions.

Emotional contagion in online social networks has been of great interest over the past years. **Affective Network**, by the **Laboratory for Social Machines and the Affective Computing group at the MIT Media Lab**, aims to help users better understand which emotions they experience on this social network. It is a Google Chrome extension, powered by machine learning algorithms, that enables Twitter users to filter and make explicit - through coloured visual marks - the emotional content in their news feed.

Artificial intelligence is not only able to measure and analyse facial expressions, gestures, voice, sweat and heart rate, buy new "affective" information technologies allow digital devices to track and respond to human emotions, with strong implications for marketing, sales and assistance and for product development.

Emotions and feelings largely influence the perception of the brand and guide consumers' behaviours, especially for the fashion and luxury sector where impulse buying is very frequent.

The artificial intelligence company **Affectiva** has developed an emotion recognition technology capable of analysing facial expressions and emotions through cameras. In Hong Kong and Taiwan, the premium skincare brand **SK-II** uses Affectiva technology through a partnership with video advertising technology company **Unruly Media** that analyses the audience's emotional responses to SK-II video ads. This emotional targeting ability allows SK-II to focus its content on the audience who are more likely to be interested in its products to create an emotional connection.

TANGIBLE EMOTIONS

INCEPTION ON FASHION-TECH SOLUTIONS

Artificial intelligence, autonomy and feelings will shape the fashion system from design to retail, automatically adapting strategies in response to customers' emotional reactions.

In this scenario body equipment is not only a medium enabling different types of interactions, but it also behaves autonomously, amplifying the emotions, touching the intimate dimension of the wearer. Fashion products feel and reveals the feeling.

The scenario challenges companies, designers and consumers to confront crucial technological, ethical and social issues.

SCENARIO

Trashy Muse fashion show, Paris SS20 fashion week, 2019. Source: Trashy Muse

PHY GIT AL SE LF

PHYGITAL SELF

BEAUTY / FILTER / SENSES

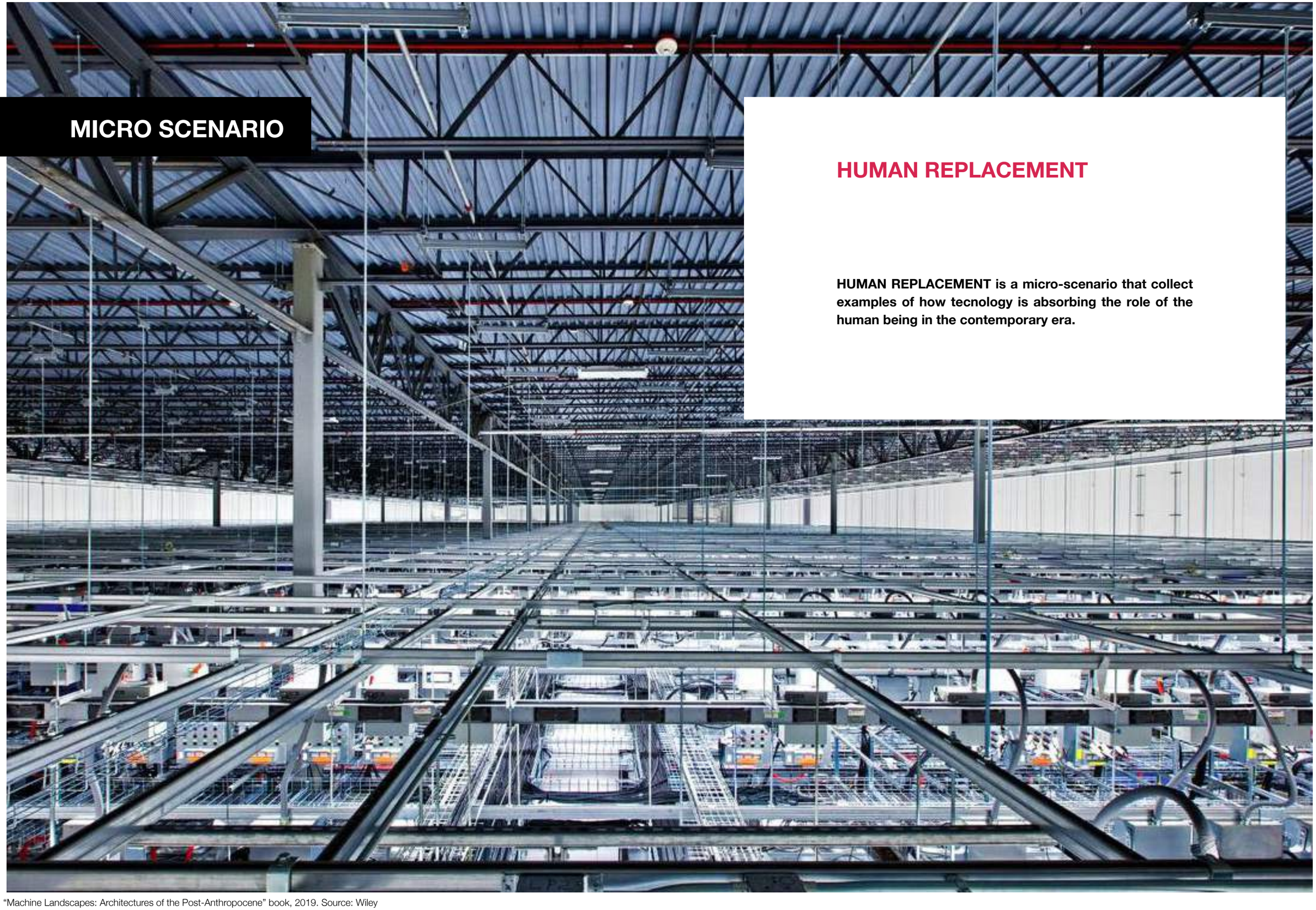
Living in a connected world - where people are 24/7 online - the borders between reality and on-line presence become more and more liquid.

This forms a hybridization of digital and physical life, where transitioning dynamically from one world formed by pixels to the other and back to reality becomes normality. To experience these new dimensions people create digital avatars of themselves, for which creativity and freedom of self-expression have no boundaries. Also, products lose their physical essence to become virtual. “Nosedive” is the first episode in the third series of the British science fiction anthology series Black Mirror. The episode is set in a world where people can rate each other from one to five stars for every interaction they have, which can impact their socioeconomic status. Lacie is a young woman overly obsessed with her ratings; she finds an opportunity to elevate her ratings greatly and move into a more luxurious residence after being chosen by her popular childhood friend as the maid of honour for her wedding. Her obsession leads to several mishaps on her journey to the wedding that culminates in a rapid reduction in her ratings. This episode traces in an interesting way the importance that digital worlds have assumed today, equal if not superior to what the real world has. In addition, what happens in the digital world has an impact on the real world. Just think about misinformation. A 2019 study published by the Pew Research Center found that more than half of U.S. adults get news from social media often or sometimes (55%), up from 47% in 2018, and despite 88% reporting that these same companies have at least some control over the content that they see. Add to that tools like AI, which can now be leveraged to automatically generate, post and even comment on a steady stream of nonsense from made-up stories to entirely made-up people, and the plot literally thickens, albeit with a totally different brand of intrigue. The two worlds, apparently separate, are in continuous dialogue or whatever happens in one of the two has an impact on the other. In particular, technologies are producing physical and digital avatars which, in the first case, totally cancel the role of the human being and create new spaces and new architectures to live in; in the second case, instead, they dematerialize objects, habits, behaviours and bodies to replicate them in the virtual world.

MICRO SCENARIO

HUMAN REPLACEMENT

HUMAN REPLACEMENT is a micro-scenario that collect examples of how tecnology is absorbing the role of the human being in the contemporary era.



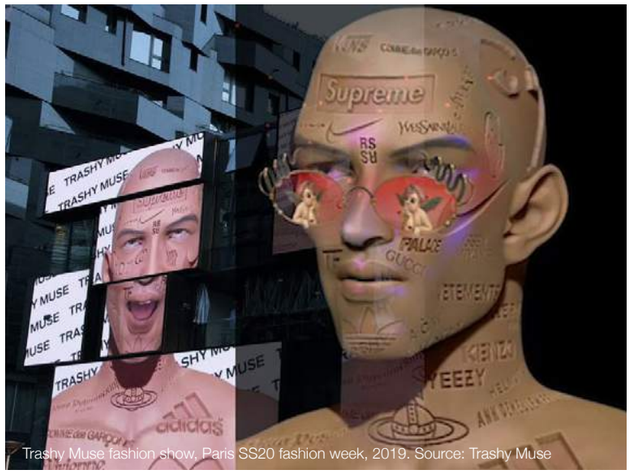
“Machine Landscapes: Architectures of the Post-Anthropocene” book, 2019. Source: Wiley

CURRENT FORWARD LOOKING PROJECTS

"Machine Landscapes: Architectures of the Post-Anthropocene" book, 2019. Source: Wiley

Trashy Muse fashion show, Paris SS20 fashion week, 2019. Source: Trashy Muse

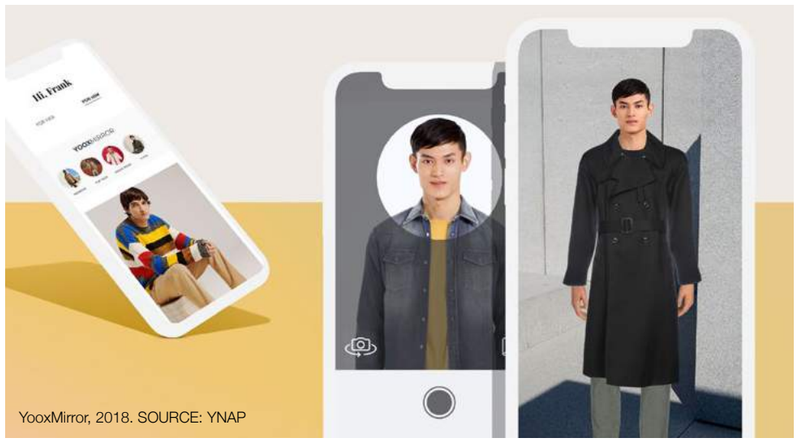
Avatar robots attend graduation in place of students in Tokyo amid coronavirus concern, 2020. Source: BBT University



Trashy Muse fashion show, Paris SS20 fashion week, 2019. Source: Trashy Muse

FXMirror True Fit, 2018. Source: FX Mirror

Spot by Boston Dynamics, 2019. Source: Boston Dynamics



YooxMirror, 2018. SOURCE: YNAP

CURRENT FORWARD LOOKING PROJECTS

"**Machine Landscapes: Architectures of the Post-Anthropocene**" by (Young, 2019) is a book that explores the new typology of the post-human and shows how technology and artificial intelligence are now computing, conditioning, and constructing our world. The most significant architectural spaces in the world are entirely empty of people. The data centres, telecommunications networks, distribution warehouses are occupied by server stacks and hard drives, logistics bots and mobile shelving units, autonomous cranes and container ships, robot vacuum cleaners. These sites, architectures and infrastructures are not built for us, but whose form, materiality and purpose is configured to anticipate the patterns of machine vision and habitation rather than our own. They describe a period where it is the technology and artificial intelligence that now computes, conditions and constructs our world. Marking the end of human-centred design, the issue turns its attention to the new typologies of the post-human, architecture without people and our endless expanse of Machine Landscapes.

Machines have taken man's place in various roles. Let's think about the **Spot by Boston Dynamics**: a nimble robot that climbs stairs and traverses rough terrain with unprecedented ease, yet is small enough to use indoors. Built to be a rugged and customizable platform, since the beginning of March 2020, Boston Dynamics has been testing how their spot robot can help the fight against COVID-19. The dog bot has been on trial at the Brigham and Women's Hospital in Massachusetts, where it has been used as a mobile telemedicine platform. It has assisted in ad-hoc environments, such as to remotely triage patients in tents and parking lots.

With different purposes but always to deal with the problems that emerged with the Covid-19 remote-controlled robots, they replaced the students in the graduation **ceremony at the Business Breakthrough University in Tokyo**. Students called into the ceremony using a video-conferencing tool zoom to display their faces on the mobile devices. The newme telepresence robots were designed by **ANA group** and work as remotely controlled, customizable avatars.

Digital world is increasingly creeping into fashion, 'replacing' some of the actors involved, from customers to models, from stylists to designers.

FXGear's FXMirror is a virtual adaptation solution that uses Mixed Reality. It is a virtual fitting device that measures the user's body. The customer stands in front of a display showing 3D clothing pieces, generated from photos, which are layered on the user's reflection on the display. The latest released version, with physics-based fitting simulation, provides users with suggestions of suitable sizes for clothes. FXMirror creates a 3D avatar starting from the customer measurements. As the user checks the appearance of each size on the body, it displays how tight or lose the size will be from the smaller to the larger ones by determining how much pressure is applied by the clothes to each body part. FXMirror suggests the most suitable size based on the analysis of the user's body measurements.

Ora again, **YOOXMIRROR** is a function that allows consumers to develop their own digitized version and have fun creating their own clothes, combining clothes and accessories and sharing their favourite looks on social media.

Ruti, founded by Israeli-born designer and former tech executive Ruti Zisser, is a fashion business which developed a technology platform that assists in the design process and supports its in-store stylists by providing customers with a hyper-personalised, high-touch experience. The system keeps building customers' profiles, having tracks of past purchases and tried on items. Also, customer feedback gathered on the database influences inventory and design process for upcoming collections. Ruti's proprietary platform uses Artificial Intelligence, customised CRM, and facial recognition that are personalised recommendations based on each shopper's fashion preferences.

Substituting designers: artificial intelligence can also be used in the design phase.

Glitch is a fashion brand that designs black sheath dresses, exploiting the potential of a type of artificial intelligence called Generative Adversarial Network, which involves two opposing neural networks to create realistic examples of something - in this case, clothes - to the point that the neural network cannot

CURRENT FORWARD LOOKING PROJECTS

distinguish them from man-made designs.

Trashy Muse in 2019 launched a virtual avatar and **augmented reality fashion** show at EP7 gallery in Paris during the SS20 fashion week. With a cast of mostly digitally rendered avatars, including the a digital model Shudu, virtual superhuman Dagny and Trashy Muse's influencer, Branded Boi, the one-day show saw Instagram's AR designers collaborate to design bespoke virtual garments and accessories designed for and worn by avatars. The fashion show was a collective effort, with the work by many creators across Trashy Muse's network, consisting of 3D artists like Anthony Rosati, creative studio NDA Paris and the brains behind virtual shopping experience RELMS. These artists are part of a dedicated pocket of Instagram pushing the boundaries of augmented and virtual design into the mainstream by creating hyperreal Wearable pieces that exist only in the virtual realm.

MICRO SCENARIO

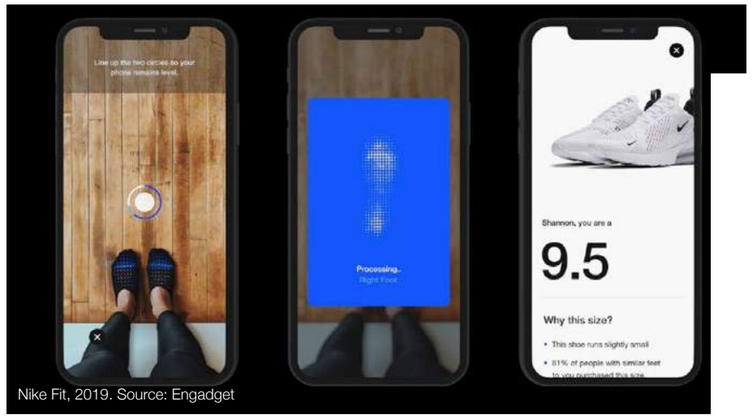
DEMATERIALIZATION

The benefits of digital transformation include simplifying processes and eliminating some of the errors, benefiting from efficiency, operation, and cost reduction. While automation has led to greater efficiency, dematerialization of information leads to a different interaction between the various actors in the scenario.

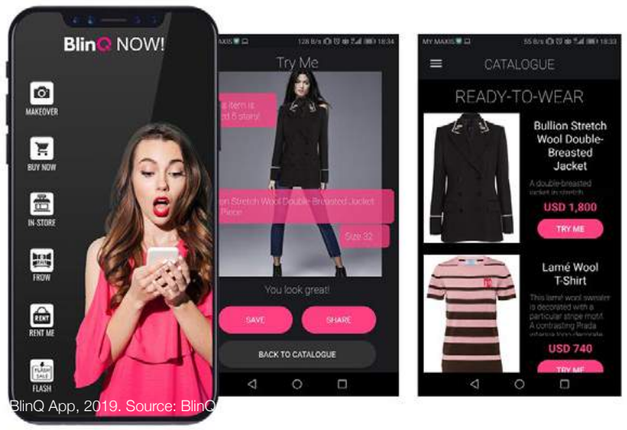
FORME Life, 2018. Source: Forme Life

CURRENT FORWARD LOOKING PROJECTS

HBO Max documentary series Happily Ever Avatar, 2020. Source: HBO

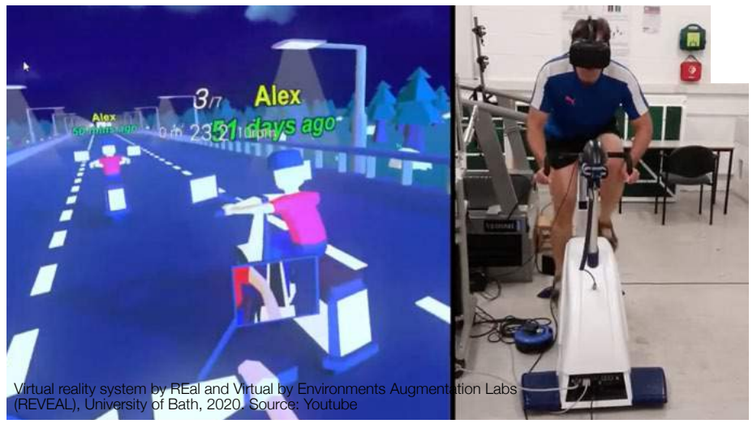


Nike Fit, 2019. Source: Engadget



BlinQ App, 2019. Source: BlinQ


FORME Life, 2018. Source: Forme LifeA



Virtual reality system by REal and Virtual by Environments Augmentation Labs (REVEAL), University of Bath, 2020. Source: Youtube


adidas GMR, 2020. Source: atap.google.com


Virtual makeup experience by Dior Make-up and MNSTR, 2019. Source: diormakeup

Digital Product Identities (IDs) by Ralph Lauren Corporation (NYSE: RL), 2019. Source: evrythng.com

CURRENT FORWARD LOOKING PROJECTS

This has an impact in different and unexpected fields. As the one of relationships. The new **HBO** Max documentary series **Happily Ever Avatar**, for examples, follows three couples whose relationships began in the games they love, only to make the leap to the real world. The 12-part series explores the way gaming brought them together and shapes the way they approach life, love, and their potential futures together.

In addition to feelings in the virtual world, real values, however intangible, such as the desire to improve and learn can exist and be tested. The members of the **REal and Virtual Environments Augmentation Labs (REVEAL)** in the **U.K. University of Bath** have developed a virtual reality system that allows people exercising in a sport using a virtual reality headset in the gym and compete against a ghostly version of themselves. “Athletes really enjoy competing against others,” says Christof Lutteroth, senior lecturer in computer science and head of the projcet, “For them, the racing experience is really exciting. It can be euphoric, exhilarating, with this cocktail of really powerful emotions. This is not really accessible to the average person — especially to people who are not motivated to exercise or maybe not very fit to begin with. It’s really difficult for them to find enjoyment in racing against another person.”

But not only people are dematerialized but also places or objects. **FORME Life**, as an example, set out to innovate both where and how personal fitness is done. What at first appears to be a six-foot, full-length mirror transforms, in an instant, into an all-in-one gym portal, bringing an array of physical and mental wellness classes right to home. When the machine is turned on, interactive instructors appear within the mirror to guide users through each motion and motivate their success. Its weight-simulating accessories and adjustable arms remove the intimidation and limited functionality of traditional resistance devices, and also track users’ progress in-app and across FORME’S own social community. In this way, the FORME Life system combines the best of conventional and boutique fitness in a single experience, mixing the convenience of home workouts with the liveliness and stimulation of one-on-one and group sessions.

AR technology is transforming the fashion industry with the aim of creating a more effective user experience. In the past, different fashion projects have revolved around the topic of digitalization, but recently some projects have revolutionized the dynamics of product use, dematerializing the experience in the retail space (Tenuta, L., Abitare 2020).

BlinQ allows consumers to virtually try on clothes before making the purchase, thanks to Augmented Reality. The cameras take photos of users to transform them into digital models on which to try and see clothes and measure their body parameters to suggest the most suitable sizes.

Size suggestions are also **Nike Fit**’s solutions to optimize the shoe buying process and reduce the number of incorrect orders. To know the correct size of the shoe, consumers only need to scan their feet with the smartphone camera. This practice not only offers a tailor-made service, but has a significant impact on the quantity of product returns. Extending interactions physical to digital and viceversa, to enhance the user experience.

In its exploration of a new form of beauty, Dior is moving beyond physical makeup. In December 2019 **Dior Make-up** in collaboration with **MNSTR** launched a virtual makeup experience for “Dior Makeup Holiday 2020”: an Instagram filter in augmented reality, co-created by Peter Philips, Creative and Image Director at Dior Makeup, and Inès Alpha, 3D Make-up artist.

Designed to create an enhanced experience for players, three world’s leading brands in sportswear, gaming and technology, **Adidas, EA SPORTS FIFA Mobile** and **Jacquard by Google** created a product that connects physical and virtual. The Jacquard tag is a small computer that connects to the Jacquard app and translates the user’s interactions into commands that Jacquard app can execute. Jacquard Tag can be embedded seamlessly into the design of the clothing items, becoming part of it.

The concept of dematerialisation also concerns product identity, shifting from physical to virtual. To give consumers the power to authenticate, **Ralph Lauren Corporation** has infused digital identities to each product of their Polo products.

PHY SIC AL AVA TAR

Fashion has always acted as an immediate interface with the surrounding environment by constantly communicating and conveying emotions, experiences and meanings; by the same token, body equipment becomes a channel through which to communicate the multiple meanings they take on, and ultimately act as a mediator between individual human beings and the rest of the world. Clothing behaves like a second skin generating and transmitting data on individual identities.

In this scenario the role of fashion is amplified: beyond make-up, filters overlap reality and create multiple layers altering the sensory perception. Avatars wearing virtual products, clothes or accessories made or adapted to the body or according to the preferences of artificial tailors, boutiques that cross the house.

Imagining and deceiving, revealing and concealing by switching on and off.

INCEPTION ON FASHION-TECH SOLUTIONS

05.

HIGHER EDUCATION INSTITUTIONS' TRANSNATIONAL PARTNERSHIP

Chiara Colombi, Jose Teunissen, Ann Vellesalu

05. HIGHER EDUCATION INSTITUTIONS' TRANSNATIONAL PARTNERSHIP

C. Colombi, J. Teunissen, A. Vellesalu

More and more companies are building close relationships with HEIs. They are no longer only interested in placements or recruitment of graduated talents, they want to develop relations with students while they study, to be close to the talent pool. Another motivation is to facilitate collaboration with students and HEIs on major challenges the industry is facing to find answers to bridge the gap between traditional design and new technologies that help to make the industry more sustainable, forward-thinking and effective.

To facilitate the exchange, flow of knowledge and co-creation within the Fashion-Tech sector industries to boost students' employability and innovation potential is the main aim today. The E4FT project was mainly focused on Higher Education Institution, the next step is the one to create a connection with the industry to test and implement the professional figures educated with the methodology developed during the E4FT project.

ENVISIONING FUTURE SCENARIOS FOR TRANSNATIONAL PARTNERSHIPS IN HIGHER EDUCATION WITHIN FASHION-TECH FIELD: FTALLIANCE

That is why another European Project was activated, FTalliance: Weaving Universities and Companies to Co-create Fashion-Tech Future Talents and the consortium comprises 13 partners (12 full + 1 associate) among which are higher education institutions, research organisations and small, medium and large enterprises. The European dimension of the consortium reflects the complexity and the international character of the Fashion supply chain. FTalliance ambition clearly requires a major collaborative effort by pooling and sharing know-how and resources. A European wide university-business cooperation is needed to enhance the fashion and textile designers' skills and capabilities to compete at international level. To enhance industrial, research or educational institution cooperation on a European scale, multidisciplinary skills and resources are necessary to carry out innovative educational models when engaging a holistic business value chain. In particular, the combination of specialised knowledge in fashion design, engineering, material science, manufacturing, and business modelling is needed to develop Fashion-Tech savvy professionals. Within the consortium each partner has a unique complimentary speciality embedded in a regional cluster (Lombardy, London, Nouvelle-Aquitaine, Holland and Västra Götaland). FTalliance is an International Industry-Academia educational Alliance designed to enable mutual learning from different research, training and industry experiences, to exchange know-how and build an open-innovation model to foster cooperation and nurture the competitive growth of the Fashion-Tech market. The FTalliance project starts with a series of knowledge exchange activities aimed at fine-tuning a multidisciplinary Fashion-Tech curriculum integrating fashion, design and engineering with industry-relevant challenges through open innovation and project-based learning methodologies. Secondly, the project is aimed at designing and piloting innovative mentoring formats for students. Workshops will be launched in the form of challenging based design activities to boost creative encounters within the framework of a number of industry briefs, allowing beneficial and reciprocal exchanges between the student participants and companies. Lastly, the project explores the development of a Fashion-Tech Residency and cocreation opportunities to foster innovative concept development and products prototypes. The residentcies have the objective of generating a hands-on pedagogical model embedding students in company innovation activities. The selected students will have the opportunity to develop their projects through coaching opportunities provided by the host company. At the end of the Residency period, FTalliance will deliver a portfolio of developed projects. The purpose behind the project is to ensure the ongoing innovation in the European Fashion-Tech sector by providing emerging talent with relevant competencies and know-how to enter the jobs market. We will do this by building strong and committed partnerships between higher education institutions, fashion enterprises and their socio-economic supply chains. Fashion-Tech means new products, process- es, tools and professional figures that come about as a result of cross-disciplinary approach- es. To keep up with this emerging field, there is an increasing urgency for universities and companies to adapt to and advance collaborative practices, to find ways to integrate new technologies into fashion and design to boost competitiveness.mAs previously seen, according to the most recent reports the Fashion-Tech area is not anymore, a future direction but it is a tangible reality. The new research report published by MarketsandMarkets™ proves that the Wearable Materials Market size is projected to grow from USD 1.5 billion in 2018 to USD 2.9 billion by 2023, at a compound annual growth rate (CAGR) of 15.0% between 2018 and 2023.The global smart fabrics market, on the other hand, was valued at USD 1.72 billion in 2017 and is expected to reach USD 4.08 billion by 2023, at a CAGR of 19.01% over the forecast period (2018-2023) (Mordor Intelligence). Also, regarding production, new technologies such as robotics and 3D printing are maturing and overcoming some of their early limitations and may enable companies to deal with these time pressures and offer customers greater personalisation at the same time. However, to support the competitive growth of the emerging EU Fashion-Tech sector we need to ensure that fashion and textile, design and engineer graduates are equipped with necessary Fashion-Tech skills. Fashion-Tech Master's courses are emerging along with existing modules to train students in the design and development of products that embed technologies in the process or in the product itself. These courses must ensure they are in dialogue with fashion and technology companies to ensure they are responding to industry needs.

The challenge is to co-create shared experiential models among fashion, design, engineering HEIs and fashion, apparel and accessories enterprises including:

- knowledge exchange activities aimed at fine

tuning a multidisciplinary Fashion-Tech curriculum and integrating within it industrial relevant activities through open innovation methodologies, project and challenge based learning; educational experiences aimed to satisfy the expected level of competence according to the field-oriented approach in Fashion-Tech. Delivering a new curriculum and innovative delivery models making the knowledge triangle work by linking fashion, textile and design higher education, research and Fashion-Tech businesses for excellence and regional development. This is expected to contribute to the EU 2020 goal of raising graduate numbers and to support the implementation of the Bologna Process improving HEIs European Qualifications Framework (EQF) and using the ECTS systems to assure the recognition of the skills acquired;

• learning experience with students and companies in the form of contests to boost creative encounters within the framework of a challenge rich in innovations allowing beneficial and reciprocal exchanges between the participants and companies;

• development of a Fashion-Tech Residency and co-creation opportunities to generate innovation and to propose a model through a multidisciplinary exchange between the creativity of young international talents and the know-how, expertise, tools and channels of the host company; this educational model aims to improve the entrepreneurial attitude of students.

Generally, the companies will get the following benefits:

• Having students through Fashion-Tech residencies with the goal of producing connected fashion (Innovate processes and products form ideation to implementation);

• Co-create examples of how connected fashion can create new revenue models for fashion companies;

• Inspire and accelerate radical Digital Fashion innovations and their uptake;

• Being influential on the next cursus for Fashion-Tech;

• Using resources on Fashion-Tech topics matching industry needs.

The project is designed to support technological developments and global competition creating new opportunities for people in higher education. The project contributes to achieve into the EU Education policy objectives as it promotes sharing knowledge from one another across national

borders and to work together on joint projects to develop good learning and teaching and teaching models, undertake excellent research and promote innovation in the field of Fashion Design and Engineering.

Starting from the conviction that today it is necessary to share as much as possible one's knowledge and results, all training materials and results produced by the Alliance will be made openly available to the public as open educational resources (OERs) via the project website, the partners' websites and their own institutional platforms and repositories as well as through the E+ Dissemination Platform. To favour a wider diffusion of the results, the IP framework will be based on Creative Commons licences. Course material, edited lectures and other content harvested from the teaching and learning activities will be collated, re-formatted and presented to allow future engagement with this material by a European-wide fashion and textile HEI community. Additionally, each partner will share with teachers and students the training resources through their own institutional learning platform; POLIMI's Open Knowledge platform; UAL LCF's Moodle; ESTIA's Moodle; TUD's Brightspace collaborative and learning environment.

Open Educational Resources: the teaching/learning resources and content produced by the project will be made available under Creative Commons-Share Alike 4.0. This to boost content use and reuse. Learning resources will be also shared in other open sources educational content repositories and in formats suitable to guarantee interoperability with state-of-the-art open learning management systems.

Open Access: publications in peer-reviewed journals through academic dissemination will occur and which will be of value to the research, teaching and industrial community. The partners plan to publish findings about the training and learning experience in peer reviewed journals. To attain a wide dissemination of the knowledge the partnership will follow a self-archiving strategy (Green Road to Open Access). Electronic copies of the peer-reviewed accepted manuscripts will be stored in on-line repositories which allow papers to be publicly accessible in full-text together with complete metadata such as UAL Research Online, OpenAire, Zenodo.org, ResearchGate. Green Open Access will also provide access to other types of content such as conference presentations and training materials.

Open Data: data obtained from the educational activities will be made available as open data through the website, or as supplementary materials in publications and mirrored in other suitable repositories selected e.g. or http://

ABOUT

FTalliance

Specifically, FTalliance shows an innovative approach according to the following points:

• Supporting innovation and creativity through partnerships and inter- and transdisciplinary approaches

The partners are committed to drive the collaboration between higher education and companies to ensure a graduate profile that is relevant to the growing Fashion-Tech market.
Through this design-led partnership, there is the opportunity for knowledge exchange, training approaches and sharing best practice to create curricula that directly respond to the trends of the European Fashion-Tech market. With these creative and innovative approaches to develop education in the field of Fashion-Tech, the role of higher-education will be strengthened through its positioning within the field of practice as well as its links to the industry who will be engaged in the project as stakeholders.

• Enhancing the quality and relevance of students' knowledge and skills

The partners see the need and the opportunity for developing specific knowledge and skills of students looking for a successful career in the contemporary Fashion-Tech market. The collaboration among the HEI partners and companies will combine heterogeneous and complementary skills and approaches to Fashion-Tech to:
- design an innovative and relevant curriculum for the sector;
- design a multidisciplinary and intersectoral learning experience for the Fashion-Tech sector;
- create a Fashion-Tech Residency model of integration/multidisciplinarity.
The innovation concerns deepening knowledge on the state-of-the-art of digital technologies for fashion design and manufacturing and the acquisition of new design methods focused on emerging product segments. To enhance the quality, innovative pedagogies will be tested, together with companies. This would lead to develop training models that are more collaborative, learner-centred, experimental and experiential, open to co-creation and peer-learning, supporting entrepreneurial and intrapreneurial skills that are essential for innovation management in fashion industries.

• Open and innovative practices in a digital era

Open and agile collaborations are crucial to respond with speed and to enhance competitiveness in the fast-changing Fashion-Tech sector. To this end, the project is aimed at testing innovative and open innovation practices through the organisation of a series of co-creation Labs organised so that through collaboration, peer- and challenge-based learning, students will be able to face current and future challenges and to convert knowledge and ideas into products and services for economic and social benefit.

databib.org. The aim is to achieve a wide use and re-use of the data produced in the project to support further educational and pedagogic research in fashion and design but also to support companies innovation. All data will be identified using a standardised file naming protocol agreed by the partners which will include relevant metadata to ensure their accessibility and findability.

IDEAS FOR IMPLEMENTATION

All the experiences carried out during the three years of the European project have let the EFU4FT partners to identify tools and recommendations in the contemporary panorama, that can serve to implement the teaching and learning activities related to Fashion-Tech and which are reported below.

Learning from Distance

The last few years, and specifically early 2020 because of the Coviud-19 emergency, have seen massive changes in how undergraduate and postgraduate courses are delivered. It is now expected that much, or perhaps all, of the course content will be made available online. This change to online forms of delivery would seem to provide the ideal circumstances for non-traditional methods of teaching and learning to be re-examined.
Online collaborative and cooperative learning techniques are not widely practised, despite their many widely recognized advantages – see for example Panitz (2000). However, interest in such techniques is increasing, as evidenced by the biennial Computer-Supported Collaborative Learning (CSCL) conferences and recent books on the topic by Barkley, Cross, & Major (2003) and Roberts (2003, 2004).
In online collaborative learning, students and teachers learn primarily by communicating amongst themselves via the Internet. In online cooperative learning, students are allocated to, and learn in small groups, and communicate within those groups via the Internet.
Given the increasing importance of distance learning, we have identified two case studies that directly involve two partner universities in the E4FT project and which are described below.

Shared Campus
Seven art and design higher education institutions (University of the Arts London, Zurich University of the Arts, Cit University Of Hong Kong, Hong Kong Baptist University, Kyoto Seika University, Japan, Lasalle College Of The Arts, Singapore, Taipei National University of the Arts, Taiwan) bringing together London, Zurich, Singapore, Taipei, Kyoto and Hong Kong have launched Shared Campus; a united university concept to collaborate on creative education, research and knowledge production across multiple countries. Spearheading an ecologically sustainable, cross-cultural digital university model, Shared Campus partners will build

up collective knowledge by connecting their shared interests, competencies, resources and infrastructures to form a virtual campus.
Based on borderless creative knowledge and values, the project marks the beginning of an education model of worldwide day to day collaboration on global issues.
With a two-year inception phase - December 2019 -, the partners will co-develop activities and tools in support of progressive teaching and learning approaches, addressing cross-disciplinary themes of international relevance. In the longer term, students at the individual institutions will be able to access innovative student mobility and learning experiences, including joint study projects, co-teaching events, digital exchange and online classrooms.

Mooc
MOOC (Massive Open Online Courses) are courses designed for distance learning involving a large number of users.
Participants in the courses, coming from different geographical areas, access the contents only via the network; since the courses are open, access does not require the payment of a registration fee and allows them to use the materials distributed by them.
At Politecnico di Milano, for example, in 2014 the POK, Polimi Open Knowledge, was launched: it is the portal of MOOC (Massive Online Open Courses) of Politecnico di Milano.
POK's slogan is "MOOCs to bridge the gaps": it, therefore, expresses the strategy adopted by the Politecnico di Milano for:
- support students in the various stages of their career;
- promote educational innovation for teachers;
- promote awareness of citizenship.

Advanced Tools

To support collaborative learnings, tools such as AR, VR for a digital design space, to utilise the competence and resources from external HEIs can be a valid support.
As suggested by Susan Smith Nash, a blogger, educator and early ed-tech adopter, five technologies are making a major impact in the higher education classroom:

1. Google Docs and Slack Grant Flexibility in the Higher Ed Classroom
Flexible and able to ensure real-time collaboration with students and teachers, cloud tools like Google Docs adapt to students' needs. Also, formatting is never lost, an advantage of Google's new workflows that makes it easier for educators to build models.

2. Augmented and Virtual Reality Facilitates Hands-On Learning
Virtual reality in the higher education classroom provides a lot of potentials for immersive learning. Educators can enhance teaching of certain techniques by bringing in VR to assist with visualisation. VR also has huge potential in getting students to think outside of the classroom.

3. Adaptive Learning Boosts Student Success
By merging data with elements of artificial intelligence, adaptive learning helps to organize classroom work according to students' abilities. This could represent a breakthrough in academic education.

4. Mondopad and Microsoft Surface Hubs Boost Collaboration
Displays are a mainstay of technology tools in the classroom, whether in the form of one large screen or several small ones. Interactive displays, in particular, foster collaboration.

5. Videoconferencing Technology Expands Higher Education's Reach
Classrooms equipped with video cameras and high-definition displays have generated new possibilities: distance learning teachers, different learning opportunities, the participation of students who were not able to physically take part in the lessons and ultimately greater access to class resources.

Finding a shared Definition of Fashion-Tech

T
The previous research carried out in 2017 and presented in the Benchmarking Report has emerged as main keyword integration, intended not only as an integration of technologies in products but also as an integration of processes, languages and professional figure and this is nothing else but the learning of the masters of the design that is that designing doesn't mean inventing new shapes but creating new behaviours.
In the contemporary, from the case studies analysed throughout the essay, from the results emerged during the applied research and from the future directions of the Fashion-Tech scenarios it is clear that integration is already in place. Heterogeneous worlds, disciplines and professionals have already activated a dialogue that needs a fluid reading of the contents.
If at that time it was considered important to collect all the information in precise areas, today

an approach that takes into account contamination and hybridization that involves the actors of the Fashion-Tech sector is necessary. It is enough to look at the learning units presented in chapter 3 to realize how essential flexibility is in the management and organization of contents according to the expected output, or look at the case studies that involve apparently distant worlds - from medicine to wellbeing, from fashion to clubbing.

If before the Benchmarking Report proposed a definition of Fashion-Tech according to three categories (Wearables, Smart textiles and Digital manufacturing), today this is no longer possible and we suggest a more open definition, more fluid, that can involve all those areas and disciplines that intersect with fashion, design and technology in the development of products, processes and services related to Fashion-Tech.

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