FUTURE OF FASHION-TECH ALLIANCE

edited by
Daria Casciani, Chiara Colombi

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

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of good practices - Knowledge Alliances
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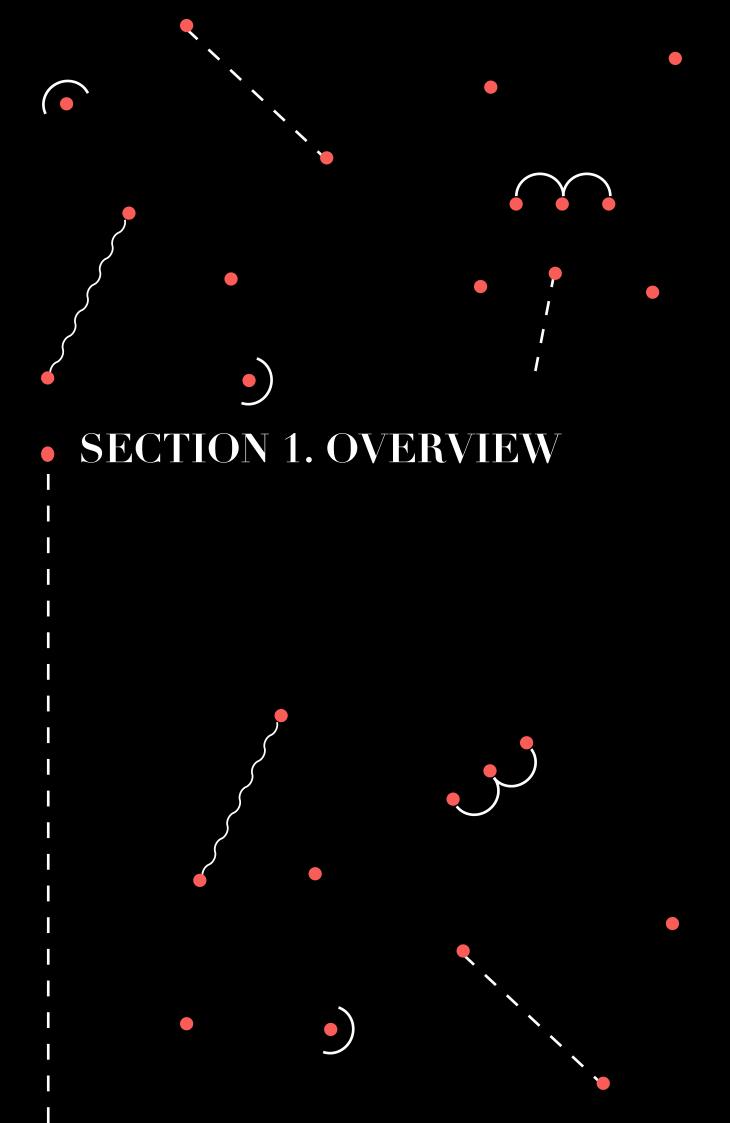
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SECTION 1. OVERVIEW

Sustainable futures of Fashion-Tech

Exploring paths of Fashion-Tech transition toward the cultural, social, economic, and environmental sustainability.

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Background

The fashion industry, being both a sociocultural and industrial system, has been affected by the potential of the "Fourth Industrial Revolution". Electronics, information and communication technologies, biotechnological materials, and digital transformation enable the creation of cyber-physical systems that blur the lines between the physical, digital, and biological worlds along the entire supply and value chain (Bertola and Teunissen, 2018). The Internet of Things (IoT), Big Data and Artificial Intelligence (AI), advanced manufacturing and digital fabrication, virtual reality (VR), augmented reality (AR), mixed reality (MR), and collaborative robotics (CR) are just a few examples of the technologies at the core of the implementation of Fashion-Tech systems that are paving their way into the fashion industry and enabling fashion brands to create intelligent and innovative strategies to completely shift fashion paradigms. Fashion-Tech has developed in this setting as a ubiquitous, fragmented, and transdisciplinary industry that includes bio-nano-info technologies and may lead to open-innovation trajectories, activating immediate opportunities and influencing long-term shifts on the industrial, economic, and professional levels. At the same time, Fashion-Tech gives the possibility to broaden the scope of the research from design and technology-oriented issues by raising ethical questions, focusing on sustainable challenges, and possibly driving unexpected outcomes. The COVID-19 pandemic has accelerated current change and reneged on prior agreements. The global fashion system is now under criticism, both in terms of production and consumption as well as focusing on its detrimental impacts at social, cultural, economic, and environmental levels.

Given this scenario, design approaches are particularly interested in facilitating a digital transition of the whole system toward a holistic view of sustainability, associated with the strenght of resilience to envision, shape and develop a better and more responsible future for the fashion system. Therefore in this publication, we aim to address a multi-dimensional perspective on sustainability, whose definition is established on four pillars: economy, environment, society and culture (Ceschin and Gaziulusoy, 2016; UNESCO, 2010; UCLG, 2010).

Fashion-tech influence on a multi-dimensional sustainability

Environmental sustainability refers to our ability to live within biosphere limits, recognising planetary boundaries and limited resources (Rockström et al., 2009). It draws on ecological principles and various practices that recognise people as part of nature and looks for ways to preserve the quality of the natural world on a long-term basis.

Fashion industry´s impact on the environment focuses in particular on design and production processes, as well as on existing materials, their qualities, and their respective environmental footprints.

Economic sustainability aims to ensure a healthy relationship between investment, productivity, employment and economic status and to guarantee that citizens enjoy living conditions that are within agreed boundaries in terms of wage levels relative to costs of living. Fashion industry's should introduce more sustainable and circular business models to support sustainable entrepreneurship and alignment with relevant actions that align with the responsability of the brand. Social sustainability refers to the ability of a community to interact and collaborate in ways that create and exemplify social cohesion, by considering places, communities and organisations, resources, opportunities and challenges. Ethics, wellbeing and quality of life, social inclusion, human beings, child labour laws, and gender equality are the core of the social sustainability scopes. Cultural sustainability aims to recognise and cultivate diversity, to reflect a range of communities, locations, cultural resources and belief systems, safeguarding their integrity. The cultural dimensions of sustainability means to comprehend fashion industry's impact on culture and cultural systems in order to explore how they can be employed in the fields of textile, apparel, and fashion. The fourth pillar of sustainability is aimed at Identifying a recognisable and meaningful relationship between culture and heritage in order to sustain, discover, learn values and knowledge to encode deeper meanings which can be reconfigured into new universal narratives (Martin and Vacca, 2019; Brown and Vacca, 2022).

Aim and structure of the publication

This publication aims to collect, describe and return three different perspectives that approach the sustainable futures of Fashion-Tech alliances among academic researchers and teaching staff, professional designers, researchers, and technicians from Fashion-Tech companies and students, exploring paths of the Fashion-Tech transition toward the cultural, social, economic, and environmental sustainability. The publication reports on these different perspectives in the structure of four sections that cover both emerging topics in the Fashion-Tech scenario and also the results of collaboration among the different stakeholders of the sector. Section 1 provides an overview of the publication providing a precis of topics and opportunities for collaboration among HEIs, Companies, and undergraduate students. Section 2 presents four interesting research works in form of invited academic papers that showcase the most promising research tracks conducted at the HEIs partners of the FTalliance, in particular Politecnico di Milano, Design Department and ESTIA Institute of Technology. Section 3 presents the digest of students' activities and achieved results of 13 Fashion-Tech Residencies, a piloted model of collaboration between HEIs and Fashion-Tech Companies allowing to boost the innovation potential of Companies meanwhile enhancing the professional opportunities

and skills of students working on real-world projects to exploit knowledge, materials, and laboratories from both Academia and the professional fields. The 13 projects has been selected as prototype to be exhibited during the the Biarritz Good Fashion 2022   event (October 2022). Finally, section 4 provides an overview of innovative French Fashion-Tech start-ups working with technologies integration into design-driven processes toward sustainability. These companies have been selected to pitch their business ideas during the Biarritz Good Fashion 2022 event (October 2022).

To this extend, the publication also includes the deliverable D5.3 of the FTalliance project, by providing excerpts of the event "Future Fashion-Tech Alliance" a roundtable about the FTalliance project that took place the 20 October 2022 in Biarritz during the aforementioned event.

Unveiling Fashion-Tech sustainable futures

The publication stems from an open call for paper launched in July 2022 striving to collect original and recent research studies, along with emerging and straightforward findings that explore Fashion-Tech future perspectives with a holistic sustainable impact. As a pervasive, fragmented and transdisciplinary sector, Fashion-tech has shown to expand in multiple directions, due to the complexity and transversality of the field (Casciani and Colombi, 2022). Scientific, academic and industry based research (Bertola & Teunissen, 2018; Noris et al., 2021; Nobile, 2021; CB Insights, 2022; ETP, 2016) has attempted to frame the borders, correlations, and future trends of the research topic of the sector, highlighting limits and opportunities. In addition, through the FTalliance project, we have been investigating how the transformation of the Fashion-Tech sector are changing the skills required by future professional, thus impacting and progressing new educational models (Colombi and Casciani, 2021; Casciani, Colombi, Jansen & Chae, 2021; Teunissen, Miller, Colombi & Casciani, 2021).

According to these previous studies, the following five research directions were presented in the call:

- Fashion Virtual Dimension, focusing on the organizational and sustainability dimensions of digital and virtual fashion systemic transformation
- Sustainable Fashion 4.0, focusing on innovation, sustainability, and digital transformation of fashion manufacturing processes
- Bio-tech Fashion Materials, focusing on circularity and recyclability.
- Eco-phygital retail, focusing on digital and technological acceleration of consumption patterns, and retail experiences.
- Reshaping fashion-tech education, focusing on the sociocultural and pedagogical dimension of fashion-tech education and its transformation towards sustainability.

The invited academic papers under this publication provide a focus specifically on three topics among the suggested ones, giving a instantaneous picture that the future implementation of the Fashion-Tech sector will be extremely interested in:
- the biotech and growing materials for the fashion sector supporting sustainability

in terms of circularity and recyclability, through zero-waste and cradle-to-cradle approaches;

• human-centred applications of Industry 5.0 in the fashion field enabling the collaboration among craftspeople and robots in manufacturing activities toward productivity and enhanced working conditions.

• Fashion-tech education evolution in light of emerging new methodologies and pedagogical practices, but also driven from research findings and insights to shape learning objectives and expected outcomes of the learning experiences.

In particular, around the first topic, the article from D'Itria focuses on circular models based on the design and fabrication of bio-based materials and fibers to achieve the sustainable transition of the fashion system against natural resource depletion and the limitation of production of residual waste. In the same context but focusing specifically on bacterial cellulose, the paper of Bolzan and Regaglia investigates the possibilities of integration and contamination between technology and bacterial cellulose by mapping the opportunities arising from the application in the production phase as in the final product outputs.

The second topic is investigated by Bernar, Prevot, Legardeur and Chanal focusing on the collaboration between humans and collaborative robotics within a clothing workshop where it is assessed the improvement in productivity and also the good practices for human management in a human-robotic interaction application.

The third topic is investigated by Rohsig Lopez and Legardeur exploring a design methodology for teaching circular economy concepts to engineering students in a French higher institution and focusing on disassembly solutions to use the material for recycling or repair strategies. This paper includes reflections on materials, circular economy, and educational strategies that allow students to achieve more competencies and skills when dealing with complex matters.

The third section of the publication encompasses short reports of students that have participated in the Fashion-Tech Residencies during the FTalliance project (2019-2022). Fashion-Tech residency aimed to select students through a contest and to generate innovation through a multidisciplinary exchange between young international talents and Companies. During the 2021-2022, 18 Fashion-Tech Residencies has been launched within 4 HEIs and 8 Fashion-Tech Compaines. In this publication, the digest of the 13 Residencies describes the experiences of the students by providing (i) an introduction that states the issue/problem referencing the relevant background of theory and practice; (ii) residency objectives as a short summary of the aim and the contents of the Residency project; (iii) a residency timeline providing information about actors involved in the activities, achieved milestones, and results both intermediate and final; (iv) residency activities by highlighting the exchange process with the Company, the tools, and used resources. (v) project description as a focus on the developed product/service/research highlighting originality, innovation, and relevance; (vi) residency results conceived as the learning outcomes, the knowledge exchange, and the acquired new skills.

The Fashion-Tech Residency experiences have been structured in:
(i) physical prototypes, focusing on zero-waste prototyping techniques for reducing waste materials and using natural bio-based materials and pigments and including sensors for monitoring users' performance and wellbeing:

- Natural dyeing on bio-based material - Zero-waste plants-dyed and biodegradable garments
- Garmentity (noun) - The process of giving a garment an identity
- Hyperfunction - Functional clothing for modern urbanites
- Sensorized twin-set for sportswear - A bio-data monitoring system
- Biomimicry wearable - Smart textile wristband

(ii) Ux and UI prototypes, offering an omnichannel Customer Journey for purchasing better and more comfortable experiences, and offering data related to the company's ecological footprint for more responsible purchase choices:

- Eiréne - Omnichannel Customer Journey for Mass Market brands targeting Gen-Z users
- Optimising impacts - byborre's Online Plaform Create ™

(iii) virtual prototypes, used for reducing samples and materials during the prototyping stage and aiming to achieve the best results in terms of materials aesthetical and performative simulations:

- Modular design and system for disassembly - A Multipurpose Parka
- Digitally empowered fashion design - How digital technologies support the fashion design process

and (iv) models and frameworks, investigating the state of traceability that can enhance sorting and recycling of textiles, the clothing rental business models and the influence of digital platforms and technology on clothing rental, the opinions and discussions spread on the social media platform Twitter relating to fashion rental, and circular economy solutions to achieve a sustained competitive advantage:

- Bridging infrastructural holes - Traceability for circularity in textiles
- Collaborative fashion consumption - Business Model analysis of clothing rental digital platforms
- Developing kpi framework for circular fashion management. A study on circularity initiatives of fashion brands with EU taxonomy
- Discussion topics on fashion rental - An application of Topic Modelling with LDA and Sentiment

The fourth section of this publication is presenting the perspective of young companies in the fashion-tech sector approaching the recyclability and circularity of the fashion, textile and apparel sector by focusing on environmental sustainability at the level of shoes,

materials for collants and threads. The Fashion-Tech Company testimonials have been presented during the pitch session of the BiarritzGood Fashion event held the 20 October 2022.

Three companies have been selected to present their solutions to contribute to the societal, environmental, and economic transition of the fashion industry.

Here, Alex Marquoin presents the project Reshoes developed at CETIA around the topic of automated sorting and dismantling of end-of-life or unsold textile and footwear items thanks to to automation, robotics, and artificial intelligence. Agathe Rouzaud from Ecollant presents the environmental values of the company allowing the recycling processes of tights in a circular loop focusing on the technological aspect and, at the same time, organizing the collection of the raw material, thus implementing bottom-up approaches and customer-based initiative that help the change of behaviours of consumers. Finally, Sonya Manolova presents EcoCycle. a new thread that retains its durability during the life of the garment but dissolves for disassembly when washed in an industrial machine at 95°C, thus allowing a better disassembly of garments and so impacting recyclability and circularity.

Conclusions

This publication provides an overview, on one side of the future Fashion-Tech topics that spontaneously reiterated in academic research, student prototyping activities, and companies' businesses. On the other side, it strives to highlight the importance HEIs and Companies' collaboration for innovation, entrepreneurship, and impact on a scientific, economic, environmental, social, and cultural level. It covers wider scopes of introducing strategies and plans for future research topics and collaboration among different stakeholders of the Fashion-tech system, suggesting that the expertise of different domains of fashion, technology and business management should be combined in alliances working on both theoretical and practical research and development levels in order to develop synergistic changes expected for a more sustainable future.

At the level of Fashion-Tech thematical focus and therefore skills necessary to future fashion-tech professionals, this overview allows expanding of the Fashion-Tech subject-specific skills resulting from the focus groups and learning experiences that were implemented during the FTalliance project (Colombi & Casciani, 2021).

In particular, the focus on eco-material and natural dyes harvested from nature requires the integration of design and engineering with biology and chemistry disciplines toward circularity and recyclability of tech-based fashion products/services and systems. The entanglement of bio-nano-info technologies on garments addresses social sustainability when talking about social acceptance, the influence on human behaviours, and the ethical implications, thus requiring knowledge and expertise from humanistic sciences to predict impacts with a critical attitude and further expand the research questions. In addition to this, the complex architecture of fashion products integrating technologies requires a focus on social, natural, and environmental sciences to understand how to tackle environmental and economic sustainability toward a real change in terms of circularity and recyclability. New business models associated to circular fashion management, fashion reuse, and consumption are of growing interest as service-based fashion activities that

allow the real uptake of circular practices. Collaborative approaches between human and machines, specifically robots are also driving research interests both for companies and HEIs in the manufacturing processes to enhance human work ecosystems and upskill the workforce via non-standard fabrication approaches, thus requiring knowledge on Human-Robot Interaction and a compination of humanistic and engineering disciplines. The virtualization of fashion design and how this is influencing the design practices, the manufacturing and selling processes along with the new business models is also another topic of growing interest, where technological innovation should not give way to a critical reflection of the social, cultural, environmental and economic implications (Casciani, Chkanikova & Pal, 2022).
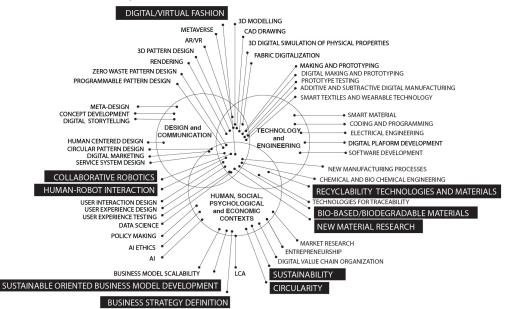

Fig.1 Overview of the subject-specific skills more recurrent in the contributions of this publication, compared to the ones emerged from the three focus groups developed and integrated into the three pilot learning experiences of the FTalliance (Colombi & Casciani, 2021; Colombi & Casciani, 2022)

Given the convergence of different disciplinary domains to navigate the complex field of Fashion-Tech, new hybrid pedagogical approaches based on multidisciplinary, interdisciplinary, and transdisciplinary collaborative practices are required to shape future professionals equipped with both soft skills to understand divergent disciplinary glossaries and the specificity of each field through the enhancement of subject-specific skills (Figure 1). All the contributions included in this publication show that the collaboration among HEIs and companies allows achieving excellent results in terms of HEIs scientific impacts, the establishments of new businesses with the development of original and meaningful products, services and systems, along with the enhancement of entrepreneurship of young talents, academic teaching staff, researchers and professionals. Shared vision, relational closeness, collaboration on the same research topics, and knowledge transfer among HEIs and Companies are all very important aspects toward the sustainability and long-lasting future of Fashion-Tech.

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