BLOCKCHAIN IN THE FASHION INDUSTRY: OPPORTUNITIES AND CHALLENGES

Authors:

Elisa Pautasso, Enrico Ferro, Michele Osella

TCBL 646133 – RESEARCH NOTE RELEASED AS ANNEX 1 TO D2.10 (TASK 2.5)

18th July 2019

TCBL is a project co-funded by the Horizon 2020 Framework Programme of the European Union Grant Agreement Number 646133

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1 INTRODUCTION

The present research note aims at shedding light on the opportunities generated by blockchain technology for sustainable fashion. Manifold reasons are behind the chosen theme.

First of all, acknowledging that in the first three years TCBL project has already reached the large part of its operational objectives for its four-year lifespan, the Consortium unanimously decided to re-orient Y4 activities towards the post-grant scenario with the purpose of facilitating the transition of TCBL from funded project to self-sustainable initiative. Along these lines, in Y4 TCBL market sensing activities were geared towards socio-technical innovation paradigms capable of unleashing far-reaching transformative forces in years to come. While the entire spectrum of so-called 'exponential technologies[1]' was scrutinized, the attention of the Consortium was caught by an emerging technological trajectory exhibiting – to some extent – analogies with TCBL values and principles. As members of TCBL movement proudly share the vision of establishing a more sustainable, fair, and competitive T&C industry by democratizing the access to innovative knowledge, equipment, and processes, the blockchain community intends to spark a new wave of innovation capable of reshaping the landscape of entrepreneurship. This happens by giving entrepreneurs new ways to raise funds and engage stakeholders and by providing innovators with novel channels to develop, deploy, and diffuse decentralized applications of any kind[2]. Although residing outside the comfort zone of the majority of TCBL partners and Associates, blockchain technology for sustainable fashion was thus chosen as theme for the yearly TCBL research note in view of its relevance for TCBL-related developments in the post-grant phase.

Even if the present research note takes a forward-looking perspective, it has to be said that project developments during the grant period brought to the fore the possibilities ushered-in by blockchain in a number of business model patterns tested within the scope of the project. Going beyond the wild volatility and stratospheric hype of cryptocurrencies, blockchain technology can drastically reduce the cost of trust by means of a profoundly new, decentralized approach[3]. Without any claim to be exhaustive, in TCBL blockchain can be instrumental to the implementation of the radical transparency paradigm from farm to retail[4] (e.g., TCBL Radical Transparency initiative with Leroy Merlin and Conforama[5]), can allow granular control of personal data in predicting offering platforms (e.g., My Yorkshire Wardrobe[6]) and another myriad of customer-centric business models[7], and can redesign incentive mechanisms in peer-

[1] https://su.org/concepts

[2] Chen, Y. (2018). Blockchain tokens and the potential democratization of entrepreneurship and innovation. Business Horizons, 61(4), 567-575.

[3] https://www.technologyreview.com/s/610781/in-blockchain-we-trust

[4] http://www.ismb.it/sites/default/files/Documenti/Research_Docs/S&R!_TCBL18_FINALE.PDF

[5] https://tcbl.eu/radical-transparency-announcement

[6] https://tcbl.eu/project/my-yorkshire-wardrobe

[7] http://www.ismb.it/sites/default/files/Documenti/Research_Docs/S&R!_SustainableTextileMarket_FINALE_SP.pdf

to-peer relationships and transactions taking place within TCBL ecosystem (e.g., short-runs, independents).

Not by chance, this nascent breed of opportunities has been corroborated by the advent of blockchain-based offerings that TCBL service providers make available to Associates[8]. Provenance[9], for instance, uses blockchain technology to enable secure traceability of certifications and other salient information in supply chains by means of a digital 'passport' that proves authenticity (is this product what it claims to be?) and origin (where does this product come from?) of physical products. Another TCBL service provider harnessing blockchain is Seratio[10], which issued an Ethereum-based token with the ability to capture the social value resulting from transactions involving people, products, processes, projects, and organizations.

Moreover, not to be overlooked is the relevance of the blockchain paradigm in the roadmap of TCBL Foundation. In order to promote new initiatives that are coherent with the strategic directions identified in the TCBL project, the new non-profit exploitation vehicle intends to contribute to the progress of the textile and clothing sector through research, innovation, education, and cultural promotion. In the pursuit of such a mission, a superior comprehension of opportunities and challenges posed by blockchain technology in the textiles and clothing realm is crucial to demonstrate thought leadership in the sectoral community, attract high-potential startups as well as innovative Labs and service providers into the TCBL ecosystem, and secure funding coming from donors, sponsors and agencies.

Recognizing the 'strategic fit' between blockchain technology and the TCBL movement, the present research note maps existing blockchain initiatives taking place in the fashion industry and outlines emerging application areas for the community of TCBL Associates. All in all, this document aims to provide fashion companies of any kind with actionable insights on how to adopt blockchain as a strategic lever for improving their competitiveness.

Concluding these introductory comments, the document is structured as follows. Section 2 gives an overview of the fashion sector background, identifies most critical challenges to be tackled, and presents the fundamentals of blockchain technology. Section 3 focuses on the main results of the case study analysis carried out while section 4 discusses some conclusive remarks. Finally, the Appendix provides a detailed account of case studies under the lens.

The present research note is released as Annex 1 to TCBL D2.10, which was developed within the scope of T2.5.

[8] https://tcbl.eu/business-services

[9] https://www.provenance.org

[10] https://www.seratio-coins.world

2 BACKGROUND

2.1 CHALLENGES IN THE FASHION SECTOR

As pointed out by a McKinsey's recent report[11], 2019 is the year of awakening for the fashion industry with respect to a number of long-lasting strategic and operational challenges.

Environmental issues

Firstly, the textile industry operates largely according to a linear, take-make-waste production process: tones of non-renewable resources are consumed to produce clothes that are often used for only a short time, after which they are incinerated or sent to landfills. According to a study by Ellen MacArthur Foundation[12], the **fashion industry has a large environmental impact**. In fact, it is responsible for the creation of a massive amount of waste and pollution, due both to the production processes adopted (i.e., 98 million tons of non-renewable resources are extracted per year to produce clothes) and to the emergence of practices that stimulate short-time usage of clothes (i.e., increase of waste). Total greenhouse gas emission from textiles production is 1.2 billion tons annually. Moreover, less than 1% of material used to produce clothing is recycled into new clothing, meaning loss of more than 100 billion $ worth of materials each year.

Ethical issues

From the social point of view, the fashion industry faces relevant challenges too. The extensive recourse to outsourcing to low-wage countries results in poor working conditions offered to overworked, underpaid, and underage employees in developing economies. The Rana Plaza tragedy in Bangladesh in 2013 well exemplifies the possible terrible risks associated to these unethical practices[13].

Globalization & fast-fashion

Like many other industrial sectors, the fashion industry has grown to a global scale. Large luxury brands and multinational companies operate worldwide: global supply chains link developing countries to international markets and large retailers' networks gain a widespread diffusion in all the continents. As a consequence, companies need to control all actors involved in their supply chains in order to avoid the aforementioned ethical and environmental issues. The influence of globalization on the fashion industry is represented also by the well-known phenomenon of **fast-fashion**, through which fashion trends can become more readily available to consumers all over the world. If, on the one hand, globalization and fast-fashion increase production speed to match the rapid appearance of new trends while simultaneously lowering prices, on the other hand, they lure customers to purchase more and more products, thus enabling the fast-fashion industry to grow even larger. This might translate

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[11] McKinsey, "The State of Fashion 2019", 2019. Available on-line: https://www.mckinsey.com/industries/retail/our-insights/the-state-of-fashion-2019-a-year-of-awakening

[12] Ellen Mac Arthur Foundation, "A New Textiles Economy: Redesigning Fashion's Future", 2017. Available on-line: https://www.ellenmacarthurfoundation.org/assets/downloads/publications/A-New-Textiles-Economy_Full-Report.pdf

[13] http://www.europarl.europa.eu/EPRS/140841REV1-Workers-conditions-in-the-textile-and-clothing-sector-just-an-Asian-affair-FINAL.pdf

into short-term savings for consumers, but the long-term social and environmental damages could be disastrous.

Counterfeiting

In this context, the notion of **radical transparency** has assumed an increasing importance not only as a means for controlling supply chains and showing sustainability-driven practices, but also for fighting against **counterfeiting**. Counterfeiting issues, in fact, are identified by Business of Fashion[14] as one of the biggest threats to the global fashion industry: for example, according to the Global Brand Counterfeiting Report 2018[15], luxury brands lost $30.3 billion in 2017 due to on-line counterfeiting.

Traditional vs "challenger" SMEs

Despite the presence of large and well-known brands that contribute significantly to the total turnover of the sector, the fashion industry is constituted by many small companies that strive to remain in the black due to the fierce industry competition. In this regard, Eurostat data[16] shows that in the traditional manufacture-textile sectors (i.e., NACE C13, C14, C15), 86% of the companies have less than 10 employees (i.e., micro-enterprises) and only 0.4% of them have more than 250 employees. Nevertheless, larger companies represent ⅓ of the total turnover of the considered NACE sectors. In recent years, amid this plethora of small "traditional" enterprises, a new guard of small "**challenger" companies**[17] has grown up: they are accustomed to technologies, e-commerce practices and frequently use social networks as marketing channels to engage new customers. Furthermore, they are often inclined to address needs of conscious customers who demand sustainability and integrity on large scale.

Customer shifts

The importance to cope with ethical and environmental sustainability has been recognized by many brands that want to incorporate more sustainable practices into their existing businesses in an attempt to adapt to times, trends, consumers, and needs. The Nielsen Global Responsibility Report[18] reveals that in 2015 66% of **customers were willing to pay more for sustainable brands**. This percentage reaches the value of 73% for millennials. Moreover, according to a report from Rank and Style[19], Google searches for the term "sustainable fashion brands" increased by 25% from 2017 to 2018, and by 61% since 2016. In addition, from 2016 to 2018 there had been a 450% increase in sales at sustainability-driven companies[20]. On the whole, consumer shifts point towards a **more transparent, caring, and sustainable industry**. If, on the one side, transparency is a customer need that facilitates remediation of human rights

[14] https://www.businessoffashion.com/

[15] https://www.researchandmarkets.com/reports/4438394/global-brand-counterfeiting-report-2018

[16] https://ec.europa.eu/eurostat/data/database

[17] Defined by McKinsey "The State of Fashion 2019". See footnote 11.

[18] Nielsen, "Global Responsibility Report", 2015. Available on-line: https://www.nielsen.com/us/en/about-us/global-responsibility-and-sustainability.html

[19] https://www.rankandstyle.com/

[20] https://fashionista.com/2019/02/sustainable-fashion-brands-end-to-end-retail-economy

and environmental violations and a tool used by workers in cases of conflicts, on the other side, it can help companies to embed better practices internally[21].

Digitization

As previously stated, the role of customers has shifted from passive observance to increased interaction and influence on the brands from which they buy. The exponential growth in the use of digital technologies has empowered customers, and fashion companies are adapting their businesses accordingly. By using digital technologies, fashion companies have become able to strengthen their competitiveness, offer personalized services, and address users' needs in innovative ways. Moreover, technologies help to tackle the identified issues and to revitalize the sector[22]. Despite these prominent benefits, **many fashion companies have still to discover, understand and, finally, incorporate such new technological trends** into their processes.

2.2 Blockchain Relevance

The research note at hand focuses on the transformative potential of blockchain, an emerging technology that, according to the famous Gartner Hype Curve[23] (2018), just passed the peak of the inflated expectation phase (Figure 1). More precisely, Gartner identifies blockchain as a core and relevant technology that characterized one of the five technological emerging trends in 2018 ("Digitalized ecosystems").

[21] Fashion Revolution, "Fashion Transparency index – 2019 edition", 2019. Available on-line: https://issuu.com/fashionrevolution/docs/fashion_transparency_index_2019?e=25766662/69342298

[22] https://www.businessoffashion.com/articles/voices/how-can-new-technologies-help-make-fashion-more-sustainable ; https://www.nytimes.com/2016/04/02/technology/using-tech-to-revive-the-textile-industry.html

[23] https://www.gartner.com/smarterwithgartner/5-trends-emerge-in-gartner-hype-cycle-for-emerging-technologies-2018/

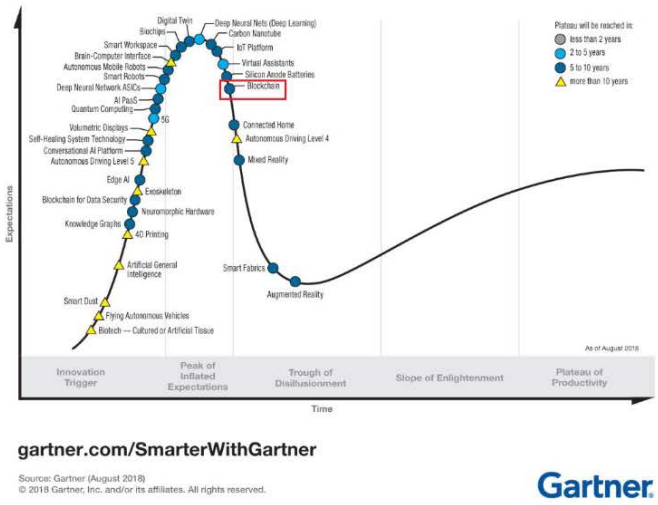

Figure 1 – Gartner Hype Curve Emerging Technologies, 2018 (source: Gartner, 2018)

What is blockchain? – Blockchain represents a distributed ledger and a consensus algorithm leveraging cryptography to run trustless systems that – without the need of a centralized authority allowing the exchange of value – eliminate the double spending problem. The infrastructure underlying Bitcoin probably represents the most well-known example of blockchain.

> *"Bitcoin is only one application of this great innovation in computer science. The blockchain can hold any legal document, from deeds and marriage licenses to educational degrees and birth certificates. It enables smart contracts, decentralized autonomous organizations, decentralized government services, and transactions among things"*[24].

In summary, blockchain enables transparent and decentralized transactions and has many possible applications: currencies (the most popular); digital content (rights management); patents (protecting innovators while incentivizing innovation); e-voting (electoral system); smart contracts; transparency and accountability in the supply chains; rethinking public services; decentralized autonomous organizations[25]. Against this backdrop, themes like smart contracts, patents and rights management, decentralized organization management and, above all, transparency and accountability in the supply chains are certainly relevant for the fashion sector.

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[24] Tapscott, D., & Tapscott, A. (2016). Blockchain revolution: how the technology behind bitcoin is changing money, business, and the world. Penguin.

[25] European Parliamentary Research Centre "How blockchain technology could change our lives", 2017. Available online: http://www.europarl.europa.eu/RegData/etudes/IDAN/2017/581948/EPRS_IDA(2017)581948_EN.pdf

The European Commission (EC) has been paying close attention to this technology and to its implication for businesses, governments, and individuals with intent to work towards the development of a common approach to blockchain for the entire European Union[26]. The main actions on blockchain that the EC launched so far are:

- European Blockchain Partnership[27] (Apr 2018)
- EU Blockchain Observatory and Forum[28] (Feb 2018)
- International Association for Trusted Blockchain Applications (INATBA)[29] (Mar 2019)
- Horizon Prize on Blockchain for Social Good[30] (i.e., 5M€)
- Financing blockchain and distributed ledger technologies research and innovation projects (i.e., 340M € is the budget to be invested by the end of 2020[31]).

Finally, the relevance of blockchain can be summarized as follows:

1) The significance of financial resources flowing into DLT-based innovation.

Data on blockchain-related investments by venture capitalists and Initial Coin Offerings (ICOs) reveal a huge market interest in this technology in the last years: according to a CoinDesk report[32], blockchain fundraising from ICOs and venture capitalists from 2017 to 2018 (Q3) settled at a total of $25 billion, of which 86% from ICOs. Moreover, IDC[33] estimates that the worldwide spending on blockchain solutions is forecast to be nearly $2.9 billion in 2019, with an increase of 88.7% from 2018. IDC experts forecast a five-year compound annual growth rate (CAGR) of 76.0%, so that total spending could reach $12.4 billion in 2022.

2) A global effort and an exponential pace of change.

Unlike what happened during the late nineties (i.e., the dot-com bubble), blockchain started as a global phenomenon to which all continents are contributing to. As a consequence, the pace of change at which this technological trajectory is evolving is extremely fast, in line with the principles of 'exponential technologies' as defined by Singularity University[34]. A patter in this vein, which significantly shortens the lead time from lab to market as well as the diffusion process of blockchain-based services, makes blockchain a leading candidate for accelerating and shaping major industries[35]. Concerning the global footprint of the phenomenon, IDC proposes a forecast of the blockchain spending by regions. Even if the

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[26] https://ec.europa.eu/digital-single-market/en/blockchain-technologies

[27] https://ec.europa.eu/digital-single-market/en/news/european-countries-join-blockchain-partnership

[28] https://www.eublockchainforum.eu/

[29] https://inatba.org/

[30] https://ec.europa.eu/research/eic/index.cfm?pg=prizes_blockchains

[31] http://europa.eu/rapid/press-release_IP-18-521_en.htm

[32] CoinDesk, "State of Blockchains Q3 2018", 2018. Available on-line: https://www.coindesk.com/research/state-of-blockchains-q3-2018

[33] IDC, "Worldwide Semiannual Blockchain Spending Guide", 2019. Available on-line: https://www.idc.com/tracker/showproductinfo.jsp?prod_id=1842; https://www.idc.com/getdoc.jsp?containerId=prUS44898819

[34] https://su.org/concepts

[35] https://su.org/blog/exponential-technology-trends-defined-2019

United States will be the geographic region that will see the largest blockchain spending in 2019 ($1.1 billion), also other regions will reach high values, namely $674 million in Western Europe and $319 million in China. In any case, all the regions covered by the IDC study will see phenomenal spending growth over the 2018-2022 forecast period: Japan and Canada, in particular, are expected to grow at five-year CAGRs of 110% and 90%, respectively.

3) The role of the blockchain in the transition from the Internet of information to the Internet of value.

The first generation of Internet, a.k.a. the 'Internet of information' has contributed to transform a large portion of our private and business lives by establishing a convergence between computing and communication technologies. Nevertheless, blockchain – hailed as the flagship disruptive technology of the second age of the Internet, a.k.a. the 'Internet of value' – is expected to have a massive economic impact that, in hindsight, may dwarf the one the Internet had over the past few decades. Acting as the 'trust technology', blockchain is redefining the way transactions work, disintermediating middlemen and kick-starting an era of radical decentralization. Looking at the direct impact on the process of value exchange, 'smart contracts' may be one of the most transformative blockchain applications at the moment in view of their game-changing role in automating payments as well as the transfer of currency or other assets as negotiated conditions are met[36].

[36] Iansiti, M., & Lakhani, K. R. (2017). The truth about blockchain. Harvard Business Review, 95(1), 118-127.

3 BLOCKCHAIN APPLICATIONS AND OPPORTUNITIES FOR THE FASHION INDUSTRY

The aim of this section is to explain how the blockchain technology can be fruitfully applied to the fashion industry. In order to fulfill this objective, a case study analysis has been carried out by LINKS analysts. The research methodology adopted is visualized in Figure 2.

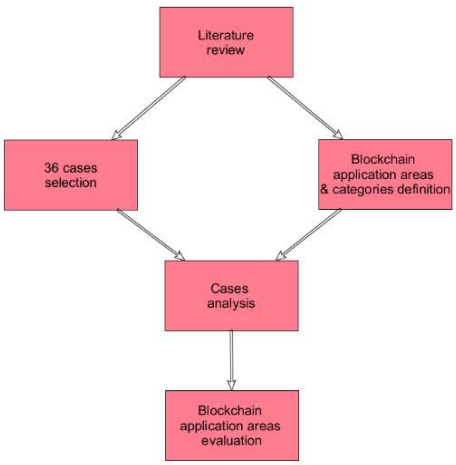

Figure 2 – Research methodology

Firstly, an in-depth examination of existing studies and relevant materials available on-line (e.g., white papers, articles, reports, blog posts, thematic websites, grey literature) allowed to define the list of cases to be analyzed. In addition, this was instrumental to determine the blockchain application areas and related categories to which each case can be associated. Afterwards, the case analysis has been performed. More specifically, each case has been analyzed in terms of typology of company and phase of product development[37], and subsequently associated to one or more application areas and related categories. The final step consisted in the overall evaluation of each application area by considering the number of existing cases found within each category.

[37] Each case has been evaluated in terms of phase of product development according to the following scale: (2) fully operative; (1) concept / test; (0) announcement.

Following such an approach, 36 use cases were identified[38]. Moreover, three main application areas of blockchain in the fashion industry were defined as follows:

Value chain management

Blockchain can be applied to guarantee traceability and transparency along the entire value chain[39], as defined by the Global Fashion Agenda's and The Boston Consulting Group's report "Pulse of the Fashion Industry"[40]. In this case, the main value driver of the technology is related to security and trust.

Access to the market

Blockchain can facilitate interactions and commercial exchanges among companies (B2B) and between companies and their customers (B2C). It favors disintermediation while it allows to verify the trustworthiness of all involved actors and to simplify reputation management and marketing/advertising procedures. Trust/security, disintermediation and decentralized management represent the main value drivers.

User engagement

Blockchain can be adopted as a tool that incentivizes users to adopt specific behaviors at community level and to participate in company governance and operational processes. In this case, the main value drivers are represented by the possibility to leverage collective intelligence through crowdsourcing as well as to align the incentives of shareholders, employees and clients towards the success of a given business venture.

Furthermore, some categories reflecting specific application objectives were defined for each area.

In addition, the case analysis helped to highlight different maturity levels for each category. Table 1 explains how such maturity levels were operationalized.

Table 1 – Categories' maturity levels

Code	Category maturity level	Definition
3	Currently applied in the fashion industry	Several operative cases[41] taking place in the fashion industry
2	Potentially relevant for the fashion industry	Few operative cases (mainly cross-sectorial)
1	Emerging area of application	Paucity of operative cases (mainly cross-sectorial)

The following three tables (Table 2, Table 3, Table 4) focus on each blockchain application area and show:

- the area breakdown in categories;
- each category description in terms of rationale for blockchain usage;

[38] Identified cases are already taking place in the sector, transferable from other sectors, or cross-sectorial.

[39] Value chain stages: design and development; raw materials; processing; manufacturing; transportation; retail; use; end of use.

[40] Global Fashion Agenda & The Boston Consulting Group, "the Pulse of the Fashion Industry", 2017. Available on-line: https://www.globalfashionagenda.com/wp-content/uploads/2017/05/Pulse-of-the-Fashion-Industry_2017.pdf

[41] Phase of product development = operative. See footnote 37.

- some examples of relevant operative[41] cases for each category;
- each category's maturity level.

Table 2 – Blockchain for value chain management

Category	Short description	Relevant cases	Maturity level
Anti - counterfeiting	Certification of products authenticity (brand protection).	VeChain & BabyGhost; Brandzledger	3
Traceability	Provision of complete information about all the actors and sources involved in production and commercialization of a fashion product. Increased awareness of the customers about the environmental and social impacts of their purchases.	Provenance & Martine Jarlgaard; Chronicled	3
Lean administration and control	Possibility for companies to control and monitor all the actors involved in their supply chains. This practice aims to ensure the best use of global resources, reduce costs by optimizing transport routes, and minimize the risks to companies through forecasting and better planning.	Faizod; Block Verify	3
IPR protection	Protection and ownership certification of original designs and concepts. Possibility to have an unalterable proof of creation in case of a dispute.	Bernstein	1

Table 3 – Blockchain for accessing the market

Category	Short description	Relevant cases	Maturity level
Decentralized on-line marketplaces	Creation of a new typology of on-line marketplace based on a peer-to-peer network that directly connects buyers and sellers. This new typology of marketplace allows to avoid intermediaries and platforms while guaranteeing faster transaction times and enhanced security. Within this category, also second-hand market initiatives are considered.	Openbazaar; Listia marketplace & Ink protocol	2
Decentralized reputation management	Facilitation of the exchanges between buyers and sellers inside existing marketplaces. Subjects that want to sell or buy a product can verify the trustworthiness of counterparties.	Monetha	2
Decentralized influencers marketplace	Possibility to promote influencer-marketing campaigns through a decentralized network that directly connects companies with influencers, thus obtaining benefits in terms of cost reduction (payments automation and check) and higher access to influencers worldwide. This solution is ideal for small companies with little budget and resources available.	SocialMedia.Market; Patron	2
Decentralized digital advertising	Possibility to promote digital advertising campaigns through a decentralized network that allows the digital advertising supply chain to coordinate in a scalable, trustworthy and secure way.	AdChain	1
Loyalty programs management	Management of loyalty programs: blockchain can help to keep track of multiple loyalty programs and to redeem points before they expire. End-users can access a unique platform for sharing/using fidelity points gained in different programs.	Qiibee	1

Table 4 – Blockchain for user engagement

Category	Short description	Relevant cases	Maturity level
User involvement in product development	Direct participation of the user in the product development process (e.g., expression of preferences, proposition of personal ideas, crowd design), from concept creation to commercialization.	Socios	1
User data sharing	Data sharing between users and fashion companies. Currently the main applications in this vein are related to textile products and devices integrated with the blockchain through digital identification and IoT sensors. A potential future application consists in the use of blockchain for better managing data provided by users (e.g., personal clothing size) in on-line marketplaces and fashion brand websites; should that be the case, users' involvement can be incentivized and rewarded with tokens.	Loomia; 1 TrueID & Alessandro Gherardi	2
Consumers becoming "prosumers"	Users' involvement in company's fundraising. Thanks to token generation, everyone is in the position of buying company's equity in the form of tokens and potentially being rewarded (e.g., profit sharing, benefit sharing).	Neufund; AmaZix & timeless Luxury Group	1

Previous tables show that – currently – the main opportunities of leveraging blockchain for the fashion industry are related to the value chain management area. Applications related to access to the market and user engagement areas (often non-fashion specific) need to be further explored but seem to be promising for the industry.

The next image (Figure 3) provides a synoptic view of all the categories identified for each macro-area, differentiating them by maturity level (sizes of the cubes) and highlighting the main value driver of blockchain.

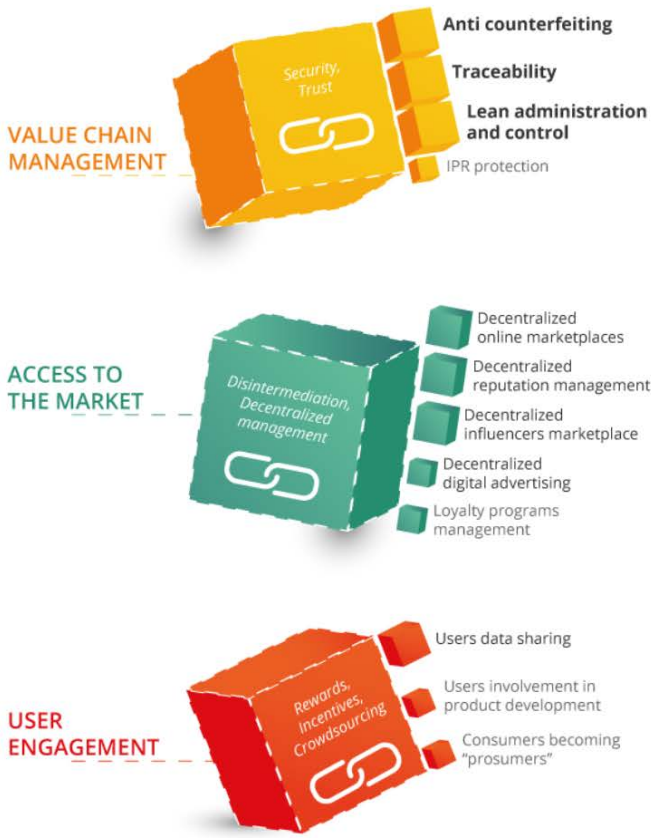

Figure 3 – Blockchain applications for fashion industry ('big picture')

Finally, the case analysis suggested that fashion companies tend to be more interested in some blockchain applications than others, depending on their characteristics (e.g., size and quality of the product) and their position along the value chain (Figure 4). In more detail, blockchain can represent a particular opportunity for the following categories of companies:

Large "historical" luxury or premium brands: multinational companies present worldwide, which offer high quality fashion products at high prices.

Fast-fashion companies: multinational companies present worldwide, which offer large quantities of clothes at low prices while changing models very frequently.

These first two groups of companies cover the entire value chain.

SMEs "challenger": smaller brands, often with a local territorial coverage, which offer products and services more aligned with new customers' needs and expectations, especially in terms of sustainability and service personalization. They very frequently operate as retailers.

Note that all the "super winners" brands (i.e., the top 20 players in the fashion industry for economic profit) listed by the McKinsey global fashion index[42] are included in the first two categories, while the third category is aligned with the "challenger" companies defined by McKynsey in "The state of the fashion report, 2019"[43].

The first category of companies (i.e., large "historical" luxury or premium brands) can take advantage of many opportunities offered by blockchain, especially with respect to the value chain management area: blockchain can be considered as a useful tool for brand and original ideas protection, but also for having a complete view and control over the global supply chains and for protecting against the counterfeiting phenomenon. Moreover, they can leverage some opportunities offered by the technology in terms of user engagement (e.g., user involvement in product development and user data sharing), allowing them to better align their offering with users' expectations.

Fast-fashion companies, for their part, could reap the benefits of blockchain solutions for controlling all the actors operating along their supply chain and for reducing bureaucracy (i.e., value chain management area – traceability and lean administration and control). In addition, they could take advantage of blockchain for managing in a trustworthy manner customers' shared data collected on their website (i.e., user engagement area – user data sharing).

Moreover, looking at the "access to the market" area, larger brands (both luxury / premium and fast-fashion) could take into consideration blockchain mainly for loyalty programs management (e.g., enhanced security and trust, reduced frauds, possibility to analyze the performance of loyalty systems in real-time).

The other categories that are comprised within "access to the market" application area are more suitable for smaller companies. In fact, these companies need to come to grips with new ways to emerge in a very competitive market by obtaining cost savings, avoiding intermediaries, and reaching more easily their target customers. Smaller "challenger" brands may be interested also in blockchain applications aimed to protect their brands (i.e., anti-counterfeiting) and to ensure traceability (e.g., to demonstrate commitment in ethical and environmental issues). Last but not least, the applications aimed to enhance user engagement could be explored by this category of enterprises, either to tap into collective intelligence (e.g., crowd design) or to experiment with new fundraising avenues (e.g., crowdfunding).

[42] Included in the report: "The state of the fashion, 2019". See footnote 11

[43] See footnote 1

Figure 4 – Relevant blockchain categories for different types of fashion companies

4 CONCLUDING REMARKS

Even though blockchain is still in an initial stage and its full potential has to be further explored, this technological trajectory can represent a one-of-a-kind opportunity for giving the fashion industry a makeover. As a matter of fact, the industry is facing relevant interdependent challenges that blockchain can help tackling.

Firstly, the garment industry as a whole has been under a microscope in recent years due to **ethical and environmental issues** that are becoming increasingly acute for both customers and companies. On a parallel track, many brands are working to combat the proliferation of **counterfeit goods** by ensuring product authenticity from its point of origin to the hands of the customer. The analysis carried out showed that the vast majority of blockchain applications already at an operational stage (associated to the "value chain management" area) are the answer to these needs.

Secondly, the study shone a light on **potential avenues for blockchain adoption** that, even if in an embryonic stage, can be particularly promising in the near future, especially when it comes to the "access to the market" and "user engagement" areas. They are particularly compelling for **emerging smaller ("challenger") brands**, including the ones that are known in the TCBL jargon with the moniker of 'independents'. They can tap into blockchain to satisfy new customers' expectations (e.g., penchant for eco-friendly and ethical products becoming more and more popular) and digital attitudes (e.g., growing tribe of avid users of second-hand on-line marketplaces, mass customization platforms, and predictive offering services).

Finally, it is important to remind that the proposed classification can provide useful insights to any fashion company falling within the TCBL business model library[44]. In this regard, Table 5 shows the alignment between some business model archetypes identified[44] and the blockchain application areas discussed so far. Following this approach, each company associated to a specific business model archetype can get a flavor of how and for which purpose blockchain can be applied in its specific context.

Table 5 – Alignment between TCBL business model archetypes and blockchain application areas

TCBL business model archetype[45]	Blockchain application area[46] and category
[SUSTAINABILITY] - Absolute green	[VALUE CHAIN MANAGEMENT] - Traceability
[SUSTAINABILITY] - Closet sharing	[ACCESS TO THE MARKET] - Decentralized on-line marketplace
[SUSTAINABILITY] - From waste to value	
[DATA] - Mass customization	[USER ENGAGEMENT] - Users data sharing
[DATA] - Predictive offering	
[OPENNESS] - Crowd-design	[USER ENGAGEMENT] - Users involvement in product development

[44] See "Business Model Dynamics enabled by TCBL" primer, available on-line: http://www.ismb.it/sites/default/files/Documenti/Research_Docs/WP4_Primer.pdf

[45] In brackets the TCBL innovation dimensions.

[46] In brackets the blockchain application areas.

DOCUMENT INFORMATION

REVISION HISTORY

This document is Annex 1 to TCBL Deliverable 2.10, “Achievements And Perspectives In Knowledge Exchange (With Special Focus On Market Sensing), Version 3”.

This Annex is written by Elisa Pautasso, Enrico Ferro and Michele Osella.

STATEMENT OF ORIGINALITY

This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation or both.

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ACKNOWLEDGEMENTS

The TCBL project has received funding from the European Union's Horizon 2020 Programme for research, technology development, and innovation under Grant Agreement n.646133.

APPENDIX – CASES ANALYZED

The following tables (Table 6, Table 7, Table 8) report all cases that were analyzed as part of this study. For each blockchain application area, the list of related cases is provided. Each case is described through the following fields:

- Case: case name
- Sector:
  - F = case applied to the fashion sector
  - O = case applied in another sector
  - C = cross-sectorial case
- Description
- Link
- Phase of product development
  - 2 = Fully operative
  - 1 = Concept / test
  - 0 = Announcement
- Area categories
  - Anti - counterfeiting
  - Traceability
  - Lean administration and control
  - IPR protection
  - Marketplaces = Decentralized on-line marketplaces
  - Reputation = Decentralized reputation management
  - Influencers = Decentralized influencers marketplace
  - Advertising = Decentralized digital advertising
  - Loyalty = Loyalty programs management
  - Users involvement = Users involvement in product development
  - Users data sharing
  - Consumers becoming "prosumers"

Table 6 – Blockchain for value chain management (cases)

Case	Sector	Description	Link	Phase of product development	Anti - counterfeiting	Traceability	Lean administration and control	IPR protection
Provenance & Martine Jarlgaard	F	**Martine Jarlgaard**, in collaboration with the blockchain company **Provenance**, produced the first garments with "smart labels". In this way, the consumer could scan to see every step of the production process, from raw material to finished product, complete with time stamps and location mapping for every step.	https://www.provenance.org/	2		x		
1trueid	C	**1trueid** is a distributed and secure system that allows to create and verify items' identity. It facilitates the management of: (a) track & trace of the product, including design, production, logistics, distribution and delivery; (b) anti-counterfeiting, working as a tool to verify product authenticity.	https://www.1trueid.net/	2	x	x		
Devery	C	**Devery** is a decentralized protocol for developers to integrate blockchain verification technology. It allows to prove provenance and prevent counterfeiting.	https://devery.io/	2	x	x		
VeChain & Babyghost	F	**VeChain** is a cloud product management solution integrated with blockchain technology that puts unique IDs on the blockchain and can verify if an item is genuine or not. It teamed with the fashion label **Babyghost**, thus allowing a clothing collection to be verified on the blockchain.	https://www.vechain.com/	2	x	x		
FAIZOD	C	**Faizod** created the Global Supply Chain, which uses blockchain technology to allow supply chain actors to seamlessly interact with each other and provide complete transparency over how products are made, moved and paid for.	https://faizod.com/blockchain-solutions/logistics-industry/further-research/global-supply-blockchain/	2	x		x	
Blockchain Tech Ltd	C	**Blockchain Tech Ltd** offers a secure registry that helps customers to track the entire production process from creation of the product to the moment it gets to the counter.	http://btl.co/	2	x	x		

Case	Sector	Description	Link	Phase of product development	Anti - counterfeiting	Traceability	Lean administration and control	IPR protection
Everledger	C	**Everledger** allows to track, with the help of blockchain, all stages of production and distribution. Everledger offers solutions to industries where transparency, trust and provenance matter most (e.g., diamonds, gemstones, minerals, wine, luxury, art).	https://www.everledger.io/	2	x			
BONAFI	C	**BONAFI** is a blockchain company which has the mission to defend all brands and retailers and protect consumers from counterfeiting by implementing a fail-safe authentication system using blockchain technology.	https://www.bonafi.io/	2	x			
UCOT	C	**UCOT** wants to stop criminals selling counterfeit products by tracking every step of the supply chain. This is done by embedding a unique digital identification microchip and sensor into the product's packaging, thus adding an extra layer of transparency and accountability into the supply chain process.	https://www.ucot.world/	2	x		x	
Brandzledger	F	**Brandzledger** implements blockchain technology to establish trust in any transaction along the whole product lifecycle, from the beginning to the end. Every transaction is recorded permanently on a secure and immutable blockchain ledger.	http://brandzledger.com/	2	x	x	x	
Block verify	C	**Block Verify** is a blockchain startup that operates in such diverse areas as pharmaceuticals, luxury items, diamonds and electronics for identifying counterfeit products, track diverted goods, stolen merchandise and fraudulent transactions.	http://www.blockverify.io/	2	x		x	
Seal	C	The **Seal** proprietary technology utilizes NFC-compatible Seal chips that can be effectively, securely and discretely incorporated with any physically manufactured product. Upon integration of the Seal chip, the product is paired with the digital counterpart on the blockchain. Verification of authenticity is instantaneous with a simple tap or scan with any smart device.	https://seal.network/	2	x	x		

Case	Sector	Description	Link	Phase of product development	Anti - counterfeiting	Traceability	Lean administration and control	IPR protection
Chronicled	C	**Chronicled** offers blockchain-based solutions to improve supply chain management, maximize supply chain transparency and ensure goods are authentic and verified. In 2015, Chronicled launched its first product identity and anti-counterfeit application in the limited edition sneaker market in collaborations with dozens of sneaker retailers. Today their solution is applied in many industries.	https://www.chronicled.com/	2	x	x	x	
Wave	C	**Wave** addresses global supply chain related challenges from the side of documents import. The service connects all the participants of the chain by means of one decentralized ledger where they can directly exchange documents, thus simplifying the shipping process.	http://wavebl.com/	2			x	
Marine Transport International	C	**Marine Transport International** offers a blockchain solution in the global shipping industry, which enables interoperability between multiple legacy systems. Interoperability of these legacy systems creates cost savings through the automation of data flows between supply chain actors.	https://www.marinetransportint.com/	2			x	
Bernstein	C	**Bernstein** allows companies to create a digital trail of records of their innovation processes using blockchain technology. Inventions, designs, and proofs of use can be quickly registered to obtain blockchain certificates that prove ownership, existence and integrity of any IP asset. Most importantly, all notarized information remain perfectly private thanks to a unique cryptographic layer. It considers “fashion and design” within its use cases.	https://www.bernstein.io/	2				x

Case	Sector	Description	Link	Phase of product development	Anti - counterfeiting	Traceability	Lean administration and control	IPR protection
SOMA	C	**SOMA** provides a social marketplace for consumers to buy authenticated goods whose provenance is tracked and stored on the blockchain. Members can monetize social capital, build a personal brand, and trade in a decentralized fashion with other trusted users.	https://soma.co	1	x	x		
Microsoft & Louis Vitton	F	**Luis Vitton**, in collaboration with **Microsoft**, intends to begin tracking all its goods from the source of origin as raw materials to their sales shelves, including on secondary markets.	https://bitcoinnews.com/louis-vuitton-microsoft-to-build-proof-of-authenticity-blockchain/?utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3A+Bitcoinnewscom+%28BitcoinNews.com%29	1	x			
IBM & Maersk	C	**A.P. Moller-Maersk** and **IBM** have announced the creation of TradeLens, a global trade platform using blockchain technology for improving the cost of transportation, lack of visibility and inefficiencies with paper-based processes.	https://www.ibm.com/blogs/blockchain/2018/01/digitizing-global-trade-maersk-ibm/	1			x	

Table 7 – Blockchain for accessing the market (cases)

Case	Sector	Description	Link	Phase of product development	Marketplace	Reputation	Influencers	Advertising	Loyalty
Openbazaar	C	**OpenBazaar** is an open source project developing a protocol for e-commerce transactions in a fully decentralized marketplace. OpenBazaar is a peer-to-peer ecommerce platform with no fees or restrictions.	https://openbazaar.org/	2	x				
Listia marketplace & Ink protocol	C	**Ink Protocol** is the new reputation and payment system within the **Listia marketplace**. It is possible to buy and sell anything on Listia using XNK, like clothing, collectibles, electronics, toys, gadgets, jewelry, and much more.	https://paywithink.com/	2	x	x			
ModulTrade	C	**ModulTrade** connects small enterprises to global trade via four main components: blockchain based smart contract platform, trade-related service platform, trade & reputation network, marketplaces. ModulTrade addresses the needs of small enterprises by eliminating the traditional barriers to entry in the global trade like lack of trust, high entry costs, and complexity of trade related operations.	https://about.modultrade.com/	2	x	x			
Monetha	C	**Monetha** is a decentralized reputation platform aiming to increase the confidence and probability of success for any interaction between parties.	https://www.monetha.io	2		x			
SocialMedia.Market	C	**SocialMedia.Market** creates a global marketplace for advertisers and opinion leaders within all major social networks, providing convenient and transparent tools for interaction between participants.	https://socialmedia.market/	2			x		
PATRON	C	**Patron**'s blockchain technology connects brands, influencers, and fans in a sharing economy.	https://patron-influencers.com/	2			x		

Case	Sector	Description	Link	Phase of product development	Marketplace	Reputation	Influencers	Advertising	Loyalty
AdChain	C	**AdChain** emerged as a result of the cooperation between such companies as MetaX and ConsenSys. MetaX develops and implements open platforms for digital advertising. ConsenSys is a venture-based studio that produces decentralized applications. AdChain is used to supply advertising traffic to MetaX services.	https://www.adchain.com/	2				x	
QIIBEE	C	**QIIBEE** allows companies to create their own branded loyalty tokens and analyze the performance of those loyalty systems in real-time. It also allows customers to store their loyalty tokens in one place and send or receive loyalty tokens with friends.	https://qiibee.com/	2					x
AQER	C	**AQER** is a platform that uses blockchain technology and AI to allow content creators and content seekers to find each other. It has the goal of making the influencer marketing ecosystem more transparent and secure through the blockchain.	https://www.engage.it/blog/blockchain-advertising-digitale#yyj8WQcr0lkCwl1m.97	2			x		
SOMA	C	**SOMA** provides a social marketplace for consumers to buy authenticated goods whose provenance is tracked and stored on the blockchain. Members can monetize social capital, build a personal brand, and trade in a decentralized fashion with other trusted users.	https://soma.co	1	x				
LUKSO	F	**LUKSO** is an open blockchain ecosystem specifically created for the fashion and lifestyle industry, providing a decentralized innovation and trust infrastructure for fashion brands, startups and customers. It offers the foundation for new forms of automated economic interactions and sustainable ownership management.	https://www.lukso.network/	1	x		x		x

Case	Sector	Description	Link	Phase of product development	Marketplace	Reputation	Influencers	Advertising	Loyalty
LOYELA	C	**Loyela** is a reward and loyalty protocol that empowers brands and merchants to engage and excite their users, promoting increased spending and higher sales. Using the Loyela platform, merchants can configure rewards for a variety of social activities promoting the brand. Powerful AI analytics also provides brands with insights to create meaningful and ultra-personalized campaigns. Users earn tokens from multiple merchants, and can exchange them peer-to-peer.	https://medium.com/loyela/introducing-loyela-the-worlds-first-blockchain-based-smart-loyalty-protocol-ae720ad752b7	1					x
Lablaco	F	**Lablaco** is a global platform committed to make fashion circular. They created the first social-commerce platform where users can give away the clothes that do not wear anymore, gain Lablacoin and redeem them as a discount. Lablaco is not blockchain-based but showed interest in this technology and in its potential for decentralizing the fashion industry.	https://www.lablaco.com/	0	x				

Table 8 – Blockchain for user engagement (cases)

Case	Sector	Description	Link	Phase of product development	Users involvement	Users data sharing	Consumers becoming "prosumers"
Socios	O	**Socios** developed an open, gamified 'fan token' economy. This platform connects fans with their favorite club. The users who own fan tokens can express their opinion on club matters through polls.	https://www.socios.com/	2	x		
Loomia	F	**Loomia** is working on solutions to collect consumer data directly from the textiles themselves and register that data on the blockchain. Loomia designs and manufactures soft, flexible circuitry that can heat, light, sense and track data, while seamlessly integrating into soft goods.	https://www.loomia.com/	2		x	
Neufund	C	**Neufund** is building a blockchain-based and investor-directed platform that bridges the world of cryptocurrency and equity. It brings ownership back to the people, making it more efficient, transparent and accessible.	https://neufund.org/	2			x
AmaZix & Timeless Luxury Group	O	Swiss company **Timeless Luxury Group**, which specializes in luxury holiday villas, resorts and lifestyle products, has partnered up with **AmaZix**, a blockchain advisory firm that has worked on over 120 ICOs, to introduce a new Digital Security Offering (DSO). The DSO give holders of the token a 40% cut of the profits of the Timeless Hideaways and Timeless Resorts. Additionally, investors receive 10% of all revenues of the other three divisions of the company (i.e., Timeless Yachts, Timeless Selection, and a planned global franchise concept). As a bonus, holders of the tokens also receive a discount of 20% on bookings of Timeless Hideaways or Timeless Resorts.	https://cryptonewsreview.com/amazix-partners-with-timeless-luxury-group-on-its-security-token-offering-for-high-end-properties-and-resorts/	2			x

Case	Sector	Description	Link	Phase of product development	Users involvement	Users data sharing	Consumers becoming "prosumers"
1trueid & Alessandro Gherardi	F	**Alessandro Gherardi** presented his own "Su Misura Smart" thanks to the expertise of over 45 years of history in the production of classic men's shirts, together with the brand's exclusive **1TrueID**® NFC technology. Thanks to smartphones and tablets, the Alessandro Gherardi's electronic identification of the shirts allows each retailer to access the order history of each customer, the technical data and any other useful details to then reprogram the subsequent reorganization in a completely digitized manner.	https://it.fashionnetwork.com/news/Alessandro-Gherardi-rafforza-il-network-globale-e-lancia-Su-Misura-Smart-,892777.html#.XL7_eegzaUk	2		x	
Fashion coin	F	**Fashion Coin** is a purely peer-to-peer version of electronic cash for Generation Z. Based on creativity, game theory, steganography and cryptography, Fashion Coin provides seamless and effortless on-line payments with maximum speed and limitless scale. Built upon blockchain, in this re-imagining of the ecosystem a customer can connect directly with designers, stylists, models, photographers, influencers, and other members involved in garment production. Those customers can then play a role in the creation process, promotion, pricing and even invest in early designs of a product, all while being incentivized via a specially-built token.	https://coin.fashion/	0	x		x