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(Article begins on next page)

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Enhancing fashion sustainability through a data systemic approach

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Keywords: fashion industry, big data, sustainability, systemic innovation design

Abstract

Today everyday life is characterized by the interaction with an ever-increasing flow of digital data. The research aims to analyze the fashion industry as a data-driven enterprise in which the correlation of data characterized by greater information power and higher quality gives the chance to make a more informed decision making that lead to undertaking better and more sustainable actions in all the value chain.
Data, in this focus, could have the power of increasing the efficiency of the system and reducing its impact at the same time, creating a new model that is not only able to improve environmental, economic and social sustainability but also communicative, enabling a more human-centered products and services designing.
This research highlights the importance of giving an integrated and holistic perspective through a data systemic approach to deal with a complex and fragmented sustainable problem, proposing an information flow strategy that makes accessible information improving transparency and traceability.
This paper presents several case studies that show how data-oriented projects can contribute some benefits to a fashion system that has environmental sustainability as its priority, but also that the lack of correlation of all these strategies is not yet able to generate and lead to a systemic change.

Introduction

Today everyday life is characterised by the interaction with an ever-increasing flow of digital data.
The fashion system is not new at all to the use of these assets to increase, sales, customer segmentation and consequently its environmental impact.
Harmful to the customer, detrimental to the worker, corrupting to society, polluting to the environment, fashion today embodies one of the most significant failures of the industrial age in term of sustainability. However, the fashion industry is also

characterised by complexity, intricate interdependence and a high fragmented supply chain while the current sustainability strategies lack a systemic and integrated vision.

The increase in population, the demand and the consequent increase in consumption have led to the inevitable involvement in this sector of the technological component in every aspect of the supply chain with the final goal of accelerating production processes and offering unified garments for the mass market (Fletcher, 2008). This addition has inevitably caused repercussions and considerable impacts on tailoring production, with the consequent subtraction of the quality of materials and of the product itself.

The current processes of digitalisation of the fashion system include, still not wholly, datafication processes capable of going beyond what is commercialised, allowing to explore patterns of consumer behaviour and unexplored sustainability practices.

Starting from data analysis and exploration, from a design-oriented perspective, this contribution shows how in industries, brands, territories and consumers, a big data-oriented culture can be useful to design new products, services and process throwing the bases for an innovative and sustainable fashion industry (Viktor MS. and Kenneth C. 2013).

The research aims to analyse the fashion industry as a data-driven enterprise in which the correlation of data characterised by greater information power and higher quality gives the chance to make a more informed decision making that lead to undertaking better and more sustainable actions in all the value chain.

Data, in this focus, could have the power of increasing the efficiency of the system and reducing its impact at the same time, creating a new model that is not only able to improve environmental, economic and social sustainability but also communicative, enabling a more human-centred products and services designing.

In this, the focus is to understand complex industrial systems and identify the opportunities to transform them into circular systems, where information in outputs become the inputs for a more conscious consumer and brand decision (Bistagnino, 2011).

The objective of this research work is to explore convergence and divergence between the current fashion data model and a systemic one, able to enhance a sustainable development for fashion industry.

Because fashion generates annual revenues of $1 trillion, provides jobs for half a billion people and dresses us every day, we need to redefine the industry based on severe values. Develop real, structural and systemic solutions for the responsible use of resources and promote a better way of life for all so that we can make the difference between destruction and conservation of the planet. (Bistagnino, 2017)

In order to generate a sustainable fashion system, the goal is to integrate all the information about consumer, product, and company usually not related and connected to each other, aware of each other with the surrounding environment. Data, in this regard, might provide to business the opportunities for designing the right product, in a relationship with the right system, to the right person.

The goal is to show that by integrating systems thinking and its methods, the systemic design brings human-centred design to complex, multi-stakeholder service systems.
This research highlights the importance of giving an integrated and holistic perspective through a data systemic approach to deal with complex and fragmented sustainable problem, proposing an information flow strategy that make accessible information improving transparency and traceability.
This paper presents several case studies that show how data oriented projects can contribute some benefits to a fashion system that has environmental sustainability as its priority, but also that the lack of correlation of all these strategies can not lead to a systemic change.

Case Study: Current trend in fashion data

The fashion industry is experiencing today unprecedented change: from one side is contributing to the degradation of the world's biodiversity and undermining nature's ability to provide ecosystem services to society, from the other side has all the potentialities and the resources required to re-design our cultural paradigms from the current to a more hopeful and sustainable one.
However, if there is one thing that has grown in tandem with consumption in fashion, this is the information available in large and small companies able to better manage the complexity of a system so interconnected and rich in variables.
The ability to access millions of data from every sector prove that the latest expertise needs a keen awareness to bear on the world’s most complex problems.
The data deluge is already starting to transform business, government, science and everyday life: telecommunications, financial services, retail, healthcare, media and communication are just some of the sectors most involved.
The rich information landscape available today is nourished by every sector that moves objects, which it sells to consumers, that uses machinery, that generates or uses content, that provides a service or that deals with money. For these reasons, the ability to collect, understand, give meaning and communicate information has become fundamental, with enormous consequences and relapse on how to operate and act, becoming a strategic reading of the reference context quantifying the sustainable and unsustainable aspects not only to individual level but above all collective.
Applications of data analysis strategies can be the most diverse, from organisational and strategic decisions within the development of new products and/or services for the consumer. (Banica et al. 2016)
Linkedin, for example, thanks to accurate data analysis on the use of its web service, has developed an extremely sophisticated recommendation system, sensing "people you may know", "groups that might interest you" and discovering "who has looked at your profile ". Still, Netflix, a service for the distribution of movies,

television series and other entertainment content, identifying and defining about 80,000 different micro-genres, has come to define the first custom TV, ... (Marr, 2016)

In general, it can be inferred how the data in companies have not only changed technologies but above all processes, management and orientation of organisational culture.

Investigating and considering concepts like sustainability, transparency, traceability and awareness as a final goal, this article aims to investigate the technical, social and creative challenges useful for re-configuring the fashion industry from the use of data.

Big data are acquiring crucial and ever-increasing importance in the fashion world since the last decade. The essential experiments regulate trend forecasting, strategies for optimising supply chain management, analysis of customer attitude online and offline, customer preferences and the more forward-looking the definition of their pattern behaviour (Tham, 2008). The fashion world today is subject to rapid, continuous and difficult to interpret changes. The client's needs move transversely from a customised style to the homologation that obliges millions of people to request the same types of garments with only small details of difference (Farley, 2015).

Some, unfortunately still separate, case studies tell how to have new data categories available can be useful to create new services and make the shopping experience more inclusive of consumer needs, more profitable for the company and have a low impact on the environment.

The methodological approach applied to the case studies to follow was exploratory through the use of bibliographic reviews and using data from individual websites. The aim was to highlight as many case studies as possible to understand how the use of a data oriented strategy could in some way increase or facilitate sustainability practices by connecting or increasing the amount of information circulating in the fashion system.

ASAP54, for example, is the most comprehensive dataset of fashion garments and it can able to simplify the phases of a search for a specific outfit. Relying on the app's database, it is enough to photograph a dress, or a simple detail of a fantasy to trace the coincidence with a garment. The system that refers to images taken from catalogues can recognise the object being photographed, but if this is not available on the database, the app will provide a set of similar products. Finally, the system can redirect the user to the site where to buy online. This project that offers a research service has the potential to become a portal for shopping on many sites.

Another service able to create a profitable relationship between the management of information for the company and the consumer is Arket. Born with the mission of democratising quality through widely accessible, well-made, durable products, their design aim to be used and loved for a long time avoiding the need for ever-new garments. The Arket system is based on the Arket ID a unique 9-digit code given to and shown with each product. This system was created to make it easy for the customer to find and re-find product both in physical and digital stores. The code functioning also as a tool to archive, record and preserve the company’s product.

This system not only allows indexing the products and knowing the details but also makes the relationship between the user's research and the management of company information useful.
However, this useful project lacks a substantial contribution of transparency and traceability of the garments which, by making known the steps of the production of a garment would give the consumer greater ability to choose between their products.
In this sector, the Provenance case study seemed complete. In collaboration with Martine Jarlgaard, an English fashion producer, Provenance tracked the world's first garment with a unique ID holding location mapping, content and timestamps from every step of the production. The journey information was made accessible via the garment's smart label. This case demonstrates that a significant database could support blockchain implementation in fashion supply chains in order to enhance sustainable value.
Working with data in the fashion industry means to bring the intangibility of the experience of purchase and consumption to something tangible: Amazon does this through a gathering of photos collectable through its new device in order to compare outfits to find out which looks better. Among all the projects sought, this is one of the few that takes into account the consumer experience after the purchase and aiming to create a lasting relationship between the customer and his clothes improving the management of the outfits and the wardrobe. Echo Look is capable of handling the wardrobe automatically by integrating other sources of data like weather, occasion, season, and more mixing territorial and personal data.
It is precisely on the personal experience, on the way we dress, but also on the way in which we present ourselves to the world, the Stitch Fix platform bases its business in a manner to change the entire shopping experience for the consumer.
Collecting data on the fundamental elements of what a customer prefers and condenses within an algorithm, Stitch Fix provide personalised advice for each of its customers. This radically changes the shopping experience: in the traditional sales model, customers enter a store, look for available clothes and look for items that best fit their overall style.
With data-driven personalisation, however, machine learning systems and AI best understand customer psychology. The company, therefore, acts as an intermediary between the customer and the personal style of the consumer, focusing on different aspects of the shopping experience, that is the emotional value rather than focusing on a weak relationship based on the logic of trends and consumption. The consumer is then sent a box of pieces, and human input and his personal decision-making process become an integral part of the algorithm. Ultimately the whole process is based on the idea that data-driven decisions are functional not only to their customers but also to the entire company similar to what happens in other companies Stitch Fix leverages data to automate internal and external processes.
However, the real strength of this vision is never to neglect the human factor in the entire system design process but instead to integrate it by making the whole process adaptive to this variable.
Another case where the contribution of the personal data is crucial is the Data Dress develop by Google in collaboration with Ivyrevel: the app stores the activities and

the lifestyle of the user giving life to the perfect Ivyrevel outfit for the occasion. You only need to specify the type of event: business, party or gala.
Integrating user personality into the design process, the system creates a digitally tailored dress.
This quick round-up of case studies demonstrates a considerable lack of a scientific take into account data relating to clothing use and sustainability production impact. New technologies can offer a new value chain, one that through the collection and analysis of data allows players not only to engage potential customers or increase the number of sales, regardless of where they are and what they are doing but also to direct production to a sustainable path and style in line with user characteristics.

Influence of big data technologies in sustainable fashion supply chain

Today Big Data deluge is more than a trend or a fleeting fad, and this is demonstrated by the repackaging of many researchers in different academic or not fields in order to fit within the advent of new technology and to better understand the new scenario.
In many levels of interest Data could influence the entire supply chain and for the fashion industry this will it can become crucial. These new possibilities could have a considerable impact from the choice of raw materials to production, up to consumer awareness within the system. Starting from the early stages of production by knowing the preferences of the target client, it is possible to perform short-term forecasting and suit to ever-changing market trends, avoiding the significant risk of overproduction.
However, the use of big data remains limited without the appropriate technologies that support not only the collection but also the management and new production processes that could develop from such a considerable amount of data in continuous dynamism.
The following section presents some of the emerging technologies and some projects which, in improving and optimising the fashion supply chain, do not shirk environmental and social responsibilities and whose impacts are easily traceable.
First of all, the data analysis of customer preferences and options can be redirected to design and e-prototyping.
Being aware of the physical characteristics of consumers for the company is not new: through sales data, companies can manage and optimise the flow of sizes in the warehouse (Loker, 2008) Despite this, a 3D body scanning technology can offer the customer and company a new pool of data more precise and accurate through which get lower their environmental impact.
However, as Fashion-Tech journalist Lorraine Sanders says: “There are fascinating things that happen with the mapping of human bodies, and the attempt to create a

predictable sizing through the use of big data could help many sectors - and almost certainly could help the fashion industry" (Sanders, 2015).
The new body sizing and scanning technologies, the intelligent scales and all the wearables can create a significant data pool for this sector, through these data the companies can create garments perfectly adapted to the needs of their customers eliminating the modification conjectures.
Body scan data can reduce the flow of unsold and returned apparel due to poor fit and assist in building a more sustainable fashion system, providing speedy, consistent, and accurate data that could redefine apparel sizing systems, and customer preferences.
Custom-sized clothing by definition means that consumer is involved in the design and production process to make garments uniquely for them, based on their individual measurement, not only with one or more fitting and match but also with some decision about style and fabric.
The data resulting from a body scan can keep track of large-scale anthropometric studies giving to the research a measurable impact: from the particular in the guise of the consumer, to the general in the perspective of a territory or the global impact of a given collection. The use of body scan in the fashion industry can also support medical analysis and size can be used to explore related diseases.
Opening the research to increasingly interdisciplinary scenarios and an expanded concept of well-being and human-centred design.
The goal in both approaches is to reduce the flow in the sustainable fashion system by eliminating the production of the unsold garment in a specific territory, and improve the customer engagement to
In marketing phases, collecting consumer data allows a more user-centred design but is not the only advantage. Using data in a systemic way enable companies to fill the gap between the reality and the perception they have of their consumers by measuring, for example, the impact of their advertising campaigns, thus having a continuous feedback system of their users.
Based on finding from social media, blogs, emails preferred product for a specific customer, and the effects of a promotion campaign, management can identify new product and services opportunities, optimise pricing, and improve customer loyalty and satisfaction.
Sentiment analysis helps companies to analyse every aspect of customer demand through the collection of the responses (likes, shares, comments, re-tweet) to a specific product; thus, not only sales but also marketing and advertising become useful tools for a sustainability transition.
Interlacing this data with sales in a particular time or with the activities of definite influencer it becomes possible to explore the driver of a target sector and determinate a pattern of behaviour.
When a company has feedback on his marketing activity, and awareness about his impact can invest more safely on customer experience and can sustainably improve their products and service.
Furthermore, the use of sentiment analysis to map consumer behaviour can be extended to areas of data collection that are still inaccessible to businesses.

All usage data of fashion products are currently not collected and conceal a huge potential in terms of sustainability and customer awareness within the system.
RFID technology is currently able to monitor the entire chain from production to sales, to enable an information flow strategy is essential to recognise the value of this technology also to enhance aspects such as the traceability and transparency of the system and not just the logistics aspects. An RFID system is able to capture an extensive amount of data in this context.
For example, when big data are integrated into a clothing company, refers to the connection of location with the flows of goods. By receiving information from a territory related to traffic congestions and safe routes, delays, or customer complaints, the management can make the best decision regarding the shipment planning, product delivery, and the security of the transport activity. Nevertheless, mapping territorial resources and activity management can design an intelligent and environmental safe transport plan through visualisation and analysis of real-time data about the supply chain networks.
Therefore, is also crucial adopt information technology to monitoring the product and facilitate communication and information exchange among supply chain partners to satisfy customer needs, enhance operation efficiency, and improve decision making in the supply chain context. (Choi, 2016)
Nevertheless, the real value of RFID technology is that unequivocal identification carried out in real time that allows you to handle the many variables that the fashion industry must manage.
Increase system transparency by increasing traceability of pattern of use puts fashion companies in a position to collaborate with their peers and external stakeholders on sustainability more productively.
Traceability becomes in this way a prerequisite for identifying and improving the environmental, social and ethical impact of fashion.
It is interesting to explore how to manage the data and understanding how to make use of it to improve sustainable decision-making.
Another aspect of experimentation through big data collected with RFID technology is, for example, the installation of a system that allows identifying the garments tested in the dressing room to better understand the movements and the selection criteria of fashion products.
The possibility of knowing which items are not purchased makes it possible to reason in a more systemic fashion on the processes of fashion, on the arrangement of goods in the store, but also on the design during production and on possible future developments of textile material.
Data that the RFID technology allows to generate are new both for fashion and, in particular, for retail. Learning to make it a treasure, also and above all concerning environmental sustainability is one of the critical points of this research. A recent survey by the World Economic Forum reveals that 92.1% of business leaders believe that 10% of people will wear clothes connected to the Internet by 2025. It means that we will be able to generate data that can even go beyond the management of the production process, beyond the mapping of the products in the closet. In this scenario, we will be in a position to map, under the strict control of the privacy rules, the whole experience of use and consumption of fashion items.

The physical space that opens up the possibility of new scenarios through the use of big data is undoubtedly the retail: here data can collect the true essence that drives the decision to buy an item or not.
Retailers have long been studying how their customers make decisions about what goods and services to offer. It goes back as far as the Victorian shopkeeper who was the original one-to-one relationship manager working hard to understand customers' tastes and quirks.(Strong, 2016)
Retail responsibility in the relationship with the consumer and his awareness of sustainability must, therefore, be tied up for obvious reasons: in this sense, the retail must assert its social impact.
In a data-driven fashion industry a retailer has a direct connection with customers, so they are in the best position to know customer options and to want to know more: in an integrated big data system, retailers have full access to everything related to the product it sells and the person who buys it.
However, mapping customer inside the retail does not mean to create the perfect sales for the company, the aim of a data-driven retail strategy has the ultimate goal of gender a closer relationship between consumer and product to lengthen the product lifecycle. The research aims above all to increase his awareness in order to improve the global consumer experience with the fashion product. The collection of wardrobe data, which currently do not represent a priority for fashion system, hide an unspeakable value concerning sustainability.
They could show to the consumer an overview that gives a snapshot of his current relationship with his clothes, with the aim to prevent "errors" and follow the garment cycle of use.
The role of design in this scenario rich of data changes radically. Big data are not there to offer a solution like an oracle, but to guide insight to the point of always putting the human in the centre of every kind of project related to the fashion industry, that as we say at the beginning of this article, has the most profound social nature.

Discussion and Final Considerations

The present exploratory work contributes to identify information gap and guidelines to develop an integrated strategy of data planning and collection.
Have been recognized three datasets dedicated respectively for consumer, product and company. The ongoing research, analysis, development, and application carried out by this research present three main types of information are identified to be crucial to the efficient, economical, and sustainable strategies on fashion system:

(1) customer information,

(2) product information, and

(3) the flow of information.

Customer information are important to replace human need over profit, product data could express and share awareness about the process behind, and last but not least, the structure of information flow can be a useful leverage point in the fashion system, if the information is delivered where it was not before, causing people to change behavior (Meadows D H, 2008).
In the fashion industry, adding to or changing the flow of information between companies in a supply chain or between retailers, designers and consumers can create significant changes for little effort. Contrary to what happens with the sustainability strategies currently in use, that are focused on symptoms, and endorse methods that try to solve single problems not caring about existing relationships, systemic design approach can be an effective tool to restore the lack of information that concern the whole process and all actor.
This approach, which looks at the larger picture, focuses on the transition from a linear vision, where individual environmental issues are addressed, to a systemic approach, where an improvement of the individual components, if put in relation, corresponds to improvements for the whole industry.
Data can be involved with this innovative approach in the phases of fashion creation and at the same time can implement processes and applications in a more sustainable direction and themselves become tools and materials for design, being a fundamental component of the project and not just its objective
This means that for quantitative input of information it is possible through design and a circular approach to create sustainable value within the system. (Gaiardo & all. 2013). It should be noted that these indications associated with a systemic use of data through the fashion industry are currently lacking experimentation, but attempts have been made to visualize the data if they were available (Remondino, & all. 2015).
This work was part of our master thesis in Ecodesign at the Polytechnic of Turin, discussed on December 22, 2017.
As a proposal for future research, there is no doubt that of prototyping and testing reactions to such visualizations before planning a structured collection of data. This can also be implemented by research on new technologies that can make the collection less manual as possible and it is assumed that the data collected and displayed are effective especially at the stage of purchase and consumption where you can change the habits and behavior of consumers.

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