

KOÇ UNIVERSITY
GRADUATE SCHOOL OF SOCIAL SCIENCES AND HUMANITIES

Identifying Specifications for a Participatory Design Model Tailored to Fashionable Wearables

By Gül Kaner



A Thesis Submitted to the Graduate School of Social Sciences and Humanities
in Partial Fulfillment of the Requirements
for the Degree of Master of Arts in Design, Technology & Society

Koç University

August, 2018

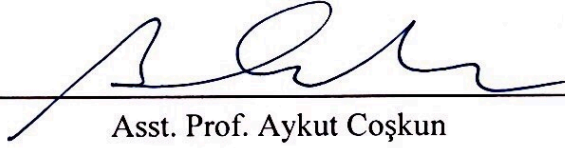
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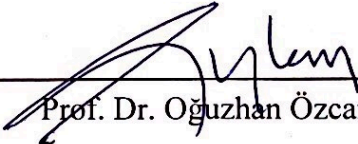
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IDENTIFYING SPECIFICATIONS FOR A PARTICIPATORY DESIGN MODEL TAILORED TO FASHIONABLE WEARABLES

GÜL KANER

The significance of fashion for designing wearable technologies have been appreciated by recent studies. Designing fashionable wearable technologies requires a collaboration between various stakeholders from fashion and technology industries. However, as fashion and technology are known to represent two distinct fields, realizing such a multi-stakeholder and interdisciplinary collaboration is a challenging endeavor. To help practitioners and researchers overcome this challenge, this thesis investigates, and documents existing product development and participatory design models used in fashion, textile industries and information technologies. Moreover, through data gathered from a literature review, 20 in-depth semi-structured interviews with experts from fashion and technology industries, and observations based on three sessions of participatory design workshops, it identifies the specifications of a participatory design model for designing fashionable wearable technologies while cultivating existing ones.

Keywords: Fashionable Wearables, Wearable Technologies, Participatory Design, Fashion System, Expert Interviews, Design Workshop

Advisor: Asst. Prof. Aykut Coşkun

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Date: _____

MODAYA UYGUN GİYİLEBİLİR TEKNOLOJİLERE ÖZEL KATILIMCI TASARIM MODELİNİN ÖZELLİKLERİNİN BELİRLENMESİ

GÜL KANER

Giyilebilir teknolojilerin tasarlanması sürecinde modanın önemi, son akademik ve sektörel çalışmalarda vurgulanmaktadır. Modaya uygun giyilebilir teknolojilerin tasarlanması, moda ve teknoloji sektörlerinden çeşitli paydaşlar arasında bir işbirliği gerektirir. Ancak, moda ve teknolojinin iki farklı alanı temsil ettiği göz önünde bulundurulursa böylesi çok paydaşlı ve disiplinler arası bir işbirliğinin gerçekleştirilmesi zorlu bir süreçtir. Bu tez, sektör çalışanlarının ve araştırmacıların bu zorluğun üstesinden gelmesine yardımcı olmak amacıyla; öncelikle mevcut ürün geliştirme ve katılımcı tasarım modellerini inceler. Bu modeller üzerine moda ve teknoloji endüstrilerinden gelen uzmanlarla yapılan 20 derinlemesine, yarı planlanmış mülakat bulgularına, literatür araştırması bulgularına ve üç gruptan oluşan katılımcı tasarım atölye çalışmasının gözlemlerine dayanarak modaya uygun giyilebilir teknolojilerin tasarlanması için olması gereken katılımcı tasarım modelinin özelliklerini tanımlar.

Anahtar Sözcükler: Modaya Uygun Giyilebilirler, Giyilebilir Teknolojiler, Katılımcı Tasarım, Moda Sistemi, Uzman Görüşmesi, Tasarım Çalıştayı

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Abstract

The significance of fashion for designing wearable technologies have been appreciated by recent studies. Designing fashionable wearable technologies requires a collaboration between various stakeholders from fashion and technology industries. However, as fashion and technology are known to represent two distinct fields, realizing such a multi-stakeholder and interdisciplinary collaboration is a challenging endeavor. To help practitioners and researchers overcome this challenge, this thesis investigates and documents existing product development and participatory design models used in fashion, textile industries and information technologies. Moreover, through data gathered from a literature review, 20 in-depth semi-structured interviews with experts from fashion and technology industries, and observations based on three sessions of participatory design workshops, it identifies the specifications of a participatory design model for designing fashionable wearable technologies while cultivating existing ones.

Keywords

Fashionable Wearables, Wearable Technologies, Participatory Design, Fashion System, Expert Interviews, Design Workshop

Özet

Giyilebilir teknolojilerin tasarlanması sürecinde modanın önemi, son akademik ve sektörel çalışmalarda vurgulanmaktadır. Modaya uygun giyilebilir teknolojilerin tasarlanması, moda ve teknoloji sektörlerinden çeşitli paydaşlar arasında bir işbirliği gerektirir. Ancak, moda ve teknolojinin iki farklı alanı temsil ettiği göz önünde bulundurulursa böylesi çok paydaşlı ve disiplinler arası bir işbirliğinin gerçekleştirilmesi zorlu bir süreçtir. Bu tez, sektör çalışanlarının ve araştırmacıların bu zorluğun üstesinden gelmesine yardımcı olmak amacıyla; öncelikle mevcut ürün geliştirme ve katılımcı tasarım modellerini inceler. Bu modeller üzerine moda ve teknoloji endüstrilerinden gelen uzmanlarla yapılan 20 derinlemesine, yarı planlanmış mülakat bulgularına, literatür araştırması bulgularına ve üç gruptan oluşan katılımcı tasarım atölye çalışmasının gözlemlerine dayanarak modaya uygun giyilebilir teknolojilerin tasarlanması için olması gereken katılımcı tasarım modelinin özelliklerini tanımlar.

Anahtar Sözcükler

Modaya Uygun Giyilebilirler, Giyilebilir Teknolojiler, Katılımcı Tasarım, Moda Sistemi, Uzman Görüşmesi, Tasarım Çalıştayı

Dedication

This thesis is dedicated to my beloved Golden Retriever, Grunge whom I lost during the process of this research. Rest in peace and take care of all Grunge musicians sleeping with you.

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List of Publications

Thesis Related Publications

1 - Kaner, G. & Coskun, A. (2017) "Collaborative Design for Fashionable Wearables: A Fashion System Perspective". *NORDES*, Oslo, Norway. 2017.

Other Publications

1 - Kaner, G., Genç, H,U., Erdoğan, D., Dinçer, S,B., Coskun, A. (2018) "GROW: A Smart Bottle that Uses its Surface as an Ambient Display to Motivate Daily Water Intake". *CHI*, Montreal, Canada. 2018.

2- Coskun, A. Kaner, G. & Bostan, I. (2018) "Is smart home a necessity or a fantasy for the mainstream user? A study on users' expectations of smart household appliances". *International Journal of Design* Vol. 12 No. 1 2018.

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1. INTRODUCTION

Fashion industry has been recently criticized for leading to unethical working conditions, pollution and waste of resources. Fast fashion is often considered as one of the reasons of such criticism. Fast fashion means producing inexpensive designs moving quickly from the catwalk to stores for meeting new trends (Oxford Dictionary, 2018). Rapidly growing supply chain of global fast fashion brands causes too much pressure on the designers, factory workers, store employees, and logistics departments participating in the creation, distribution and sales of fashion goods. The fast production cycle speeds up the product life-cycle too. Fashion consumers are pushed to buy and consume more. For example, while fashion brands were used to launch two seasonal collections a year in the past (winter and summer), now they launch new collections almost in every month. Unlike high fashion products, fast fashion goods are produced in vast quantities in an inexpensive way, ready to use even child labour during their production phases to decrease their overall cost. Their large number of production also pollutes the environment and increases waste. As global fast fashion brands distribute their products all around the world, the pollution caused by this distribution is also a threat for the environment. Furthermore, the materials and methods used in fast production processes pollute the environment, and the system continues to use existing resources without creating new ones. Total harm caused by the production, transportation and consumption of fashionable goods makes fashion industry the second environmentally dangerous industry (Fisher, 2015).

A similar criticism has been made for the technology industry as well (Blevis, 2007). Electronic waste (e-waste) is one of the most dangerous pollution reason of our age. E-waste pollutes fresh water resources and harms our ecosystem. Meanwhile, global technology brands follow planned obsolescence strategies triggering users to buy new devices every two years (e.g. smart phones). Technology brands provoke intentional software malfunction and inefficient battery performance to push the users replace existing products sooner than their lifetime is over. Plus, when electronic products are not designed in line with users' expectations, they are more likely to be abandoned, and to be turned into e-waste. Wearable technologies provide a good example for this situation. These technologies are technological devices that can be worn on the body such as smartwatches, virtual reality goggles, activity trackers, posture correcting t-shirts and solar paneled jackets. These technologies have potential to provide personal, social, environmental and political benefits such as democratizing the user in the system. For instance, Tommy Hilfiger's sustainable coat (2014) collects solar power and uses it to charge smart phone batteries or Adidas sneakers (2018), which had it's 1 million pairs being sold, were produced by recycling ocean waste. Other benefits of using wearables may include water recycling (Phys, 2015) of bodily liquids (e.g., urine, saliva, sweat), early diagnosis of hearth attack (iBeat, 2017), or protection of women against violence (Revolar, 2017) and so on. However, despite their potential in solving these problems, it appears that users accept these technologies very slowly and give up using

them quickly. For example, a recent study showed that more than 30% of the users tend to abandon their activity trackers within six months (Ledger, 2014). This finding indicates that the design of wearable technologies should be reconsidered from a critical perspective.

The recent convergence between technology and fashion (e.g. Levi's Google Jacquard Jacket and Apple Watch Hermes Edition) has a potential to ensure more sustainable, ethical and environment-friendly production and consumption conditions for wearable technologies. This convergence led to the emergence of a new line of products called fashionable wearables. Fashionable wearables combine aesthetics and style with functional technology (Seymour, 2008). Taking style and aesthetics into consideration can be a solution to the slow adoption of wearable technologies and their premature abandonment through making them useful and attractive to wear.

Fashionable wearables may not only be a solution to early abandonment, but also can create new domains for fashion industry to deal with social, environmental and political problems, thus responding to the criticism mentioned before. Fashion is a cultural phenomenon with political, social, ethical and environmental agendas (Crane, 2001). Fashionable wearables can eliminate negative influence of current production and consumption dynamics. For example style-adapting, upgradable clothes can ensure cultural, self-reflective and fashionable changes by avoiding production and consumption of new products; a t-shirt downloading information from the cloud may show the level of pollution around an area; a glove reducing the physical effort required for the task of a factory worker can minimize the negative impacts of oppressive work conditions. Therefore, the integration of technological capabilities into garments and clothes would enable fashion to deal with environmental, social and political issues through fashion.

In short, fashionable wearables have a potential to alter the negative conditions in fashion. First of all, they may change the way fashion designers work, because these wearables require both (1) creativity of fashion; and (2) functionality and usability of technology (McCann, 2005). Fashion designers will need to work in an interdisciplinary team consisting of various stakeholders from technology and fashion fields. The professionals may be fashion designers, engineers, technology developers, fashion media experts, public relations consultants, sales and marketing specialists, product developers and more. Second, they have a potential to change the consumers/users' role in design. The passive consumer of the past will become the active user in the future. As indicated above, previous studies in this field indicate high abandonment rates of wearable technologies. This problem is based on the user dissatisfaction with current wearables (Ledger, 2014). Thus, gathering user's insights and incorporating them into design are crucial in facilitating the wider adoption of these technologies. However, these changes will not happen in one day due to several challenges. For example, the multi-stakeholder and interdisciplinary team structure may bring problems like lack of common terminology among different individuals/entities, conflicts due to the differences in design, and the distribution of power in decision-making. Furthermore,

unlike technology fields that adopted the user centered design practices long time ago, fashion studies exploring the users' participation in the design process are very rare (Cramer, 2015; To, 2000). These problems may lead to design failures, which in turn may hinder the development of fashionable wearables.

We believe that participatory design offers a way to overcome these challenges, and help fashionable wearables realize their full potential. This is because (1) participatory design provides methods for ensuring the participation of each stakeholder including the user, (2) it deals with challenges in a multi-stakeholder environment, (3) participatory design literature provides the best practices that can serve as exemplars for parties interested in addressing social, political and environmental issues through design. However, this available knowledge in participatory design literature is not sufficient for designing fashionable wearables with a participatory design methodology, because none of the previous studies in this domain explored fashionable wearables before. Even studies applying participatory design to fashion are very rare (Cramer, 2015; To, 2000). Regarding this gap in the literature, this thesis aims to investigate existing product development and participatory design models and identify the specifications of a participatory design model by cultivating existing models with regard to the new knowledge that will be gained through expert interviews and participatory design workshops.

1.1. Aim

The aim of this thesis is to identify the specifications of a participatory design model that can be used by diversified stakeholders participating in the design process of fashionable wearables. Because, we believe that fashionable wearables have a potential to transform fashion and technology industries into a more ethical, environment-friendly and sustainable condition. However, professionals from fashion and technology industries are currently having financial, organizational, practical and technological difficulties to collaborate for the design of fashionable wearables. Thus, we endeavor (1) to reflect the current state of wearable technologies and specifically fashionable wearables; and document existing product development and participatory design models, (2) to gather the experiences, ideas, expectations and projections of experts from technology and fashion industries, (3) to observe the practice of participatory design workshops in fashion and technology groups, and (4) to integrate the results of these studies in order to identify what is needed to develop a participatory design model tailored to fashionable wearables.

1.2. Research Questions

The thesis examines the following questions,

Main Question: What are the specifications of a participatory design model tailored to fashionable wearables?

Sub Questions:

- What is the current status of fashionable wearables design?
 - What sort of project experiences do fashion and technology professionals have?
 - What challenges do they face?
 - What kind of expectations do they have concerning the future of fashionable wearables?
 - What are the participatory design models and current product development models used in fashion and textile industries?
- How can participatory design help addressing the challenges that fashion and technology experts face?

1.3. Research Context and Method

The thesis aims to determine the characteristics of a participatory design model based on the exploration of (1) the current status of wearable technologies and fashion technology products, existing product development and participatory design models; and (2) perception, expectations, needs and desires as well as the challenges of stakeholders participating in design of fashionable wearables. To achieve this aim, we conducted a review of literature on wearable technologies, fashionable wearables, fashion system and participatory design. We interviewed 20 experts from fashion and technology industries to share the current research in this field. The interviews included fashion designers, product developers, who are responsible from the beginning and the end of design ideation and merchandise production process, fashion media editors and public relations consultants, textile engineers, interaction designers, software developers, hardware engineers, academicians, and researchers. Finally, we conducted a design workshop with prospective stakeholders, who are likely to participate in designing fashionable wearables. The participants of these workshops were fashion designers, textile engineers, hardware engineers, software developers, and users of fashionable wearables; since they are the main stakeholders in the design process, as indicated by the results of literature review and interviews. Figure 1.1 presents the research questions, methods followed to answer these questions and outputs.

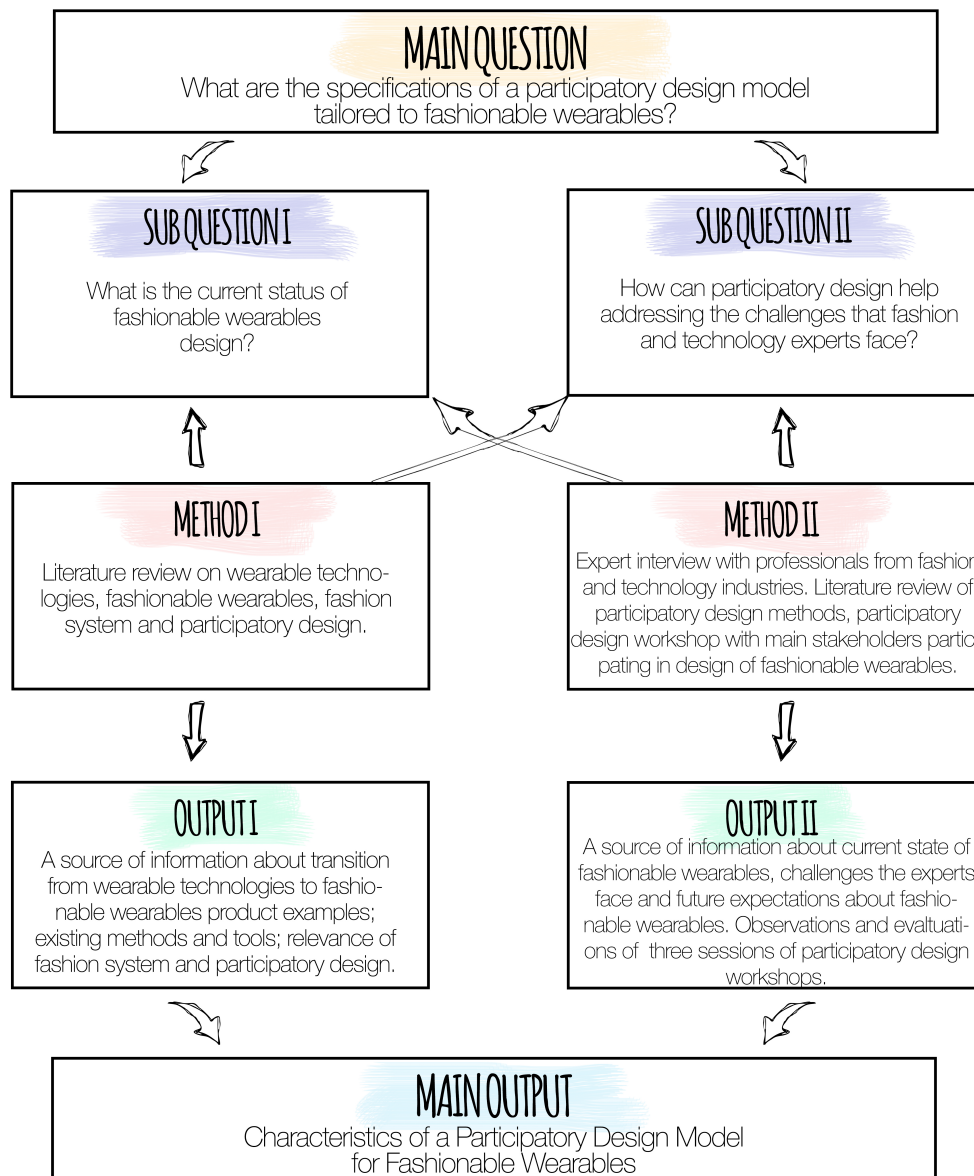


Figure 1.1 - Research Question

The main research context of this thesis is the relationship among the stakeholders, who design and use fashionable wearables from a perspective of participatory design. The stakeholders include professionals from fashion and technology industries, who have experience in working with wearable technologies, and prospective users, who already have participated or can participate in the design process of wearables. The product category in this thesis i.e. fashionable wearables, covers the products bringing brands in fashion and technology together. The literature on smart textile technologies that are not in the form of clothes or accessories was out of the focus of this research. We also excluded fashion literature on the organizational management concentrating on financial gains as our concern is not profit oriented.

1.4. Hypothesis and Expected Contributions

Hypothesis of this thesis is formulated as “since applying a generic participatory design model to design of fashionable wearables creates domain specific challenges, a tailored participatory design model is required.”

This thesis is expected to make the following contributions to the literature;

- **A source of information** derived from the literature review, expert interviews, and three sessions of participatory design workshops. This source is valuable to exhibit the current state of the domain and expectations of stakeholders. No previous study reveals expert opinions and experiences in wearable technologies and collaboration between fashion and technology.
- **Characteristics of a participatory design model bringing stakeholders in design of fashionable wearables.** Although some studies focus on participatory design in fashion and textile industry, their focus is on either increasing profits or reducing costs. The studies on fashion system are quite rare; and no study determines the specifications of a model, stages of design process, and roles of the stakeholders for wearable technologies and fashionable wearables.

1.5. Thesis Outline

The thesis consists of 5 chapters. The following chapter consists of the background and state-of-the-art in wearable technologies, fashionable wearables, fashion system and the participatory design. Chapter 3 elaborates on the study methodology, as expert interviews and workshop. Chapter 4 exhibits the findings and the results of the research by exploring current state of fashionable wearables, documenting expectations of the experts and sharing observations and comparisons of three sessions of participatory design workshops. Finally, Chapter 5 discusses and evaluates the findings from a participatory design perspective with the aim of a sustainable, ethical and environment-friendly fashion and technology system, and identifies the specifications a participatory design model, which can be used to design fashionable wearables; and concludes the thesis by exhibiting future work and limitations.

2. BACKGROUND AND RELATED WORK

The following figure illustrates the scope of the literature review of this thesis, which surveyed fashion studies, information and communication technologies, human computer interactions; and participatory design (Figure 2.1).

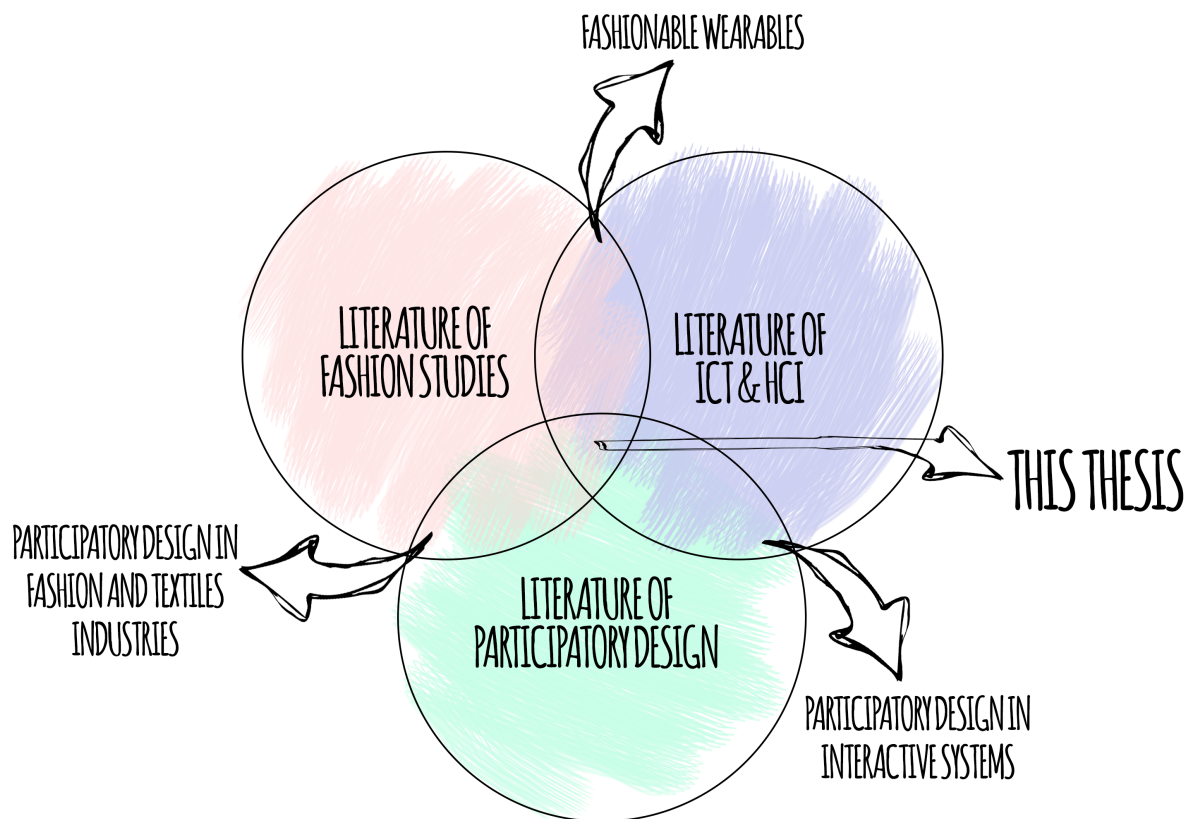


Figure 2.1 - Research Scope

We used many keywords while reviewing the literature. Keywords as *wearable technologies*, *fashionable wearables*, *fashion and technology*, *fashion system*, *smart clothes*, *e-textile*, *smart wearables*, *co-work*, *participatory design* are searched in database of fashion, technology and participatory design publications as listed in Table 1.1. content provides information about;

- (1) the history of wearable technologies
- (2) progress from wearable technologies to fashionable wearables
- (3) indicating the convergence between fashion and technology industries and studies
- (4) product development models that are used in the case of interdisciplinary design requiring fashion and textile were focused.

Furthermore, commercial and academic product, and project examples as well as company white papers are reviewed from aforementioned literature in addition to online news and blog platforms as *The Wired*, *Wareble*, and *Business of Fashion*.

Lastly, review of the participatory design literature covers theory of participatory design and studies related to wearable technologies, fashion and textile industries. Additionally, well-known participatory design models (e.g., STEPS, MUST, CESD) are also examined.

Literature review is valuable to exhibit the past, present and future of the domain with academic studies and product and prototype examples. Moreover, the purpose of reviewing participatory design literature is to express the aim of participatory design and document the methods used in interdisciplinary design environments.

Database & Publications	Journal	Conference
ACM Digital Library	International Journal of Design	Participatory Design Conference
JStor	Journal of Textile Institute	CHI
IEEE	International Journal of Fashion Design, Technology & Education	NORDICHI
Springer	Fashion Practice	NORDES
Taylor&Francis	Journal of Global Fashion Marketing	Global Fashion Conference
SAGE	Fashion Theory	
BERG	International Journal of Fashion Studies	
Thames&Hudson	International Journal of Clothing Science and Technology	
Emerald	Journal of Fashion Marketing and Management	
Amazon	International Journal of Interdisciplinary Research: Fashion & Textile	
Google Scholar	International Journal of Co-Design	

Table 2.1 - Resources Searched for Literature Review

2.1. Genealogy of Wearable Technologies and Transition to Fashionable Wearables

An early study (Berglund, 2016) on the development of wearable technology as a field identified three periods of growth. The first period, from the 1980s to 1997, is represented by the development of

mainly technology focused products like wearable computing. The second period, between 1998 and 2000, is represented by the integration of fashion and textile materials with garment forms. The third period, between 2001 and 2004, is represented by the growth in smart clothing and garment integration in the commercial sector. This progress shows that, throughout the development of wearable technologies, technology and fashion have been more integrated with each other as well as electronic components have been transformed from hardware into garment form. Recent studies in this field indicate a fourth area of growth. This area is fashionable wearables. i.e. wearable technologies that successfully combine functional and aesthetic value. For example, the percentage of fashion and lifestyle products as a new category has increased among the product categories of sports, fitness, and gaming (Berglund, 2016). There are more lifestyle products responding to functionality and fashionability rather than gadget for entertainment as gaming or sports.

Furthermore, regarding the convergence between fashion and technology for information technology (IT) products, the studies treating wearable technologies (e.g. smart watches) as fashion products rather than gadgets have recently emerged. For example, Choi and Kim (2016) investigate whether a smartwatch is an IT or a fashion product. They argue that a smartwatch has two clusters of external factors to be considered as a technological innovation and as a luxury fashion product. Because these devices are converging point of cutting edge IT and everyday fashion products. These research examples show that there is a convergence between these two fields and especially recent wearable examples of technology companies and academic works contain fashion factor for various purposes such as visibility or new technologies, trustworthy image of brands, self-reflection of the wearer via fashionable goods etc.

Motti and Caine's (2014) study is another example indicating the integration of fashion component into wearable technologies. Their study exhibits 20 principles considering the demand, need and desire of the end-users. They state that these principles should be taken into consideration while designing wearable technologies because they directly influence user's decision to use a wearable device. Several of these principles are directly related to fashion context. These are aesthetics, customization, fashion, satisfaction, and wearability.

There are more studies highlighting that wearable technologies include fashion attributes. Brand value is a factor that is highly relevant to fashion industry. Name of the fashion brand may increase the price and the value of an ordinary piece of clothing to very expensive price tags. This influence of brand factor is studied by Jung et al. (2016) for the case of wearable technologies. They mention that brand and price have a significant influence on consumers choice of product or service as cited in Brucks et al. (2000); and Dodds et al. (1991), and its value is even more obvious in uncertain products (Erdem and Keane, 1996) as newly launched categories like wearable technologies. People prefer to purchase trustworthy and well-known brands. They mention that while functioning of a technological device such as a

smartwatch, is the first factor to consider purchase, fashion attributes follow functionality, and therefore fashion is critical for the diffusion of these technologies. Addition to Jung et al. (2016) another study by Choi and Kim (2016) also investigates brand factor on the decision making process of consumer. They say that people are more convinced to pay for well-known brands to buy wearable devices.

Silina and Haddadi (2015) document the unfashionable aesthetics and gadgetry that do not take consumer preferences into account, and thus fail to create desirable wearables. Examining jewelry-like wearable technologies such as a smart watch of a brand like Michael Kors or Swarovski, they found that these type of wearables expand the consumer profile (e.g. women with different tastes and age groups) through bringing diversification to the appearance, and even in the functions of a device. Diversified user segments encourage designers to increase the number of product choices for these user profiles.

Mihaleva and Koh (2016) have a different approach towards convergence of fashion and technology. They question how smart materials transformed fashion into a more technological state; how hardware such as conductive yarn, smart fabrics and sensors influence fashion design in terms of functionality, interaction and expression. Similar to what Berglund (2016) says, they highlight that, in the 1970s clothing was used only as a support for the electronic component and fashion was not the major concern. However recent examples show that aesthetics and function are thought as independent of each other. They also point out that aesthetics is indispensable from function. They state that *"there may be misconception that aesthetics is less important than practicality. What is of neglected is that these two concepts are interrelated and have a symbiotic relationship. Fashion is linked with design, and design aims to fulfill needs of the consumer whether it is aesthetic or functional."*

McCann et al. (2005) has a more methodological approach to design of wearable technologies. They argue that designers are in a field that they have never experienced before, because wearables should involve the participation of the end-user, fashion designers, interaction designers, engineers, technologists, media and more. They say that all these stakeholders should work as a team to design usable and fashionable wearables. They offer a critical path and highlight factors to be taken into consideration, when designing fashionable wearables such as technological capabilities, cultural and bodily demands, and aesthetic considerations. Although this study is highly relevant to interdisciplinary environment of fashionable wearables design, it does not specifically mention participatory or collaborative approaches.

Juhlin (2015) is another researcher focusing on the balance between fashion and technology. He argues that it is not enough to make technologists more fashionable, but fashion designers should also be digitized to produce more desirable and usable wearables and smart garments. So, technology and fashion should participate equally to improve design of fashionable wearables. This argument is valuable

to highlight the equal participation of all the stakeholders and democratization of the design process as the literature of participatory design is also concerned.

Aforementioned studies indicate that there has been a transition from wearable technologies to fashionable wearables in the development of product and project examples. Technology industry has realized the relevance of the fashion impact in the wider acceptance and usage of devices. On the other hand, fashion industry is also influenced by the technological developments and the contemporary user profile of the user/wearer. Therefore, literature indicates the emergence of a convergence between fashion and technologies industries, and fashionable wearables constitute the result of this gathering.

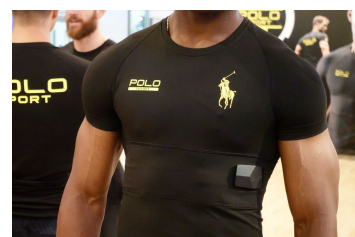
2.2. Definition of Fashionable Wearables, Product Examples from Industry, Research Studies & Art Projects

In the book named “Fashionable Technology, Intersection of Design, Fashion, Technology and Science”, Seymour (2018) introduces the term fashionable wearables and defines them as “*designed garments, accessories, or jewelry that combine aesthetics and style with functional technology*”. She argues that the end users of wearable technologies are fashionable beings, because garments are the interface that aid us to communicate our emotions, experiences and meaning. She also adds Marshal McLuhan’s (1995) observation of the garment being to the exterior mediated through digital technology. She states that fashionable wearables are the mediators of information and amplifiers of fantasy. This argument implies that fashionable wearables can be important for self-reflection and social interaction as well as functionality.

The most recent fashionable wearables examples bringing the collaboration of fashion and technology brands are from diversified product development stages. Commercially available ones are in the market and on sale with different price tags. Haute couture examples are available to use, but made on order and priced on request. Academic examples are either under development or at prototype level. The following sections present products from these three categories and document us the current commercially available or developing examples of fashionable wearables.

I. Commercially Available Fashionable Wearables

Examples in this category are mass produced by the collaboration between fashion and technology brands. Some of these corporations are global-sized and well-known, however some of them are start-ups with a focus on wearable technologies. These products either had been on sale and sold out or they are still available to purchase.



i. Ralph Lauren OmSignal Polo Shirt: (Figure 2.2) This is a

Figure 2.2- Ralph Lauren OmSignal Polo Shirt

workout shirt designed by the collaboration of fashion brand Ralph Lauren and technology startup OmSignal. It has silver fibers woven to the fabric and a small sensor box attached on the t-shirt to track biometric stats as heart rate, breathing and energy burnt. Shirt is made for men and in only black color with a basic sport wear look. (The Verge, 2015)

ii. Victoria's Secret Sport Bra: (Figure 2.3) It has a built in electrodes on the chest strap to follow heart rate. The bra has gray and pink color options and the technological component has a pink heart icon representing the corporate identity of the brand. (Self, 2014)



Figure 2.3- Victoria's Secret Sport Bra

iii- Tommy Hilfiger Solar-Powered Jacket: (Figure 2.4) A collaboration of fashion brand Tommy Hilfiger and solar panel manufacturer Pvillion created jackets for women and men with an array of solar panels on the back to collect solar power for charging gadgets. The jackets had a tartan design representing the brand's usual collections. Moreover, 50% of the product price is donated to Fresh Air Fund to raise awareness for energy recycling. (Cnet, 2014)



Figure 2.4- Tommy Hilfiger Solar-Powered

iv- Emel+Aris Smart Coat: (Figure 2.5) A smart coat with heat-technology with a wire-free polymer heating panels placed in chaser blend. It keeps the wearer warm in cold climates with a battery lasting for five hours. The product has two models for women and men as winter coat and autumn trench coat with four color options. The look of the coat is not different than any ordinary coat, which means it does not offer a new surface and does not require the wearer to change his/her dressing habits. (EmelandAris, 2018)



Figure 2.5- Emel+Aris Smart Coat

v- Pauline van Dongen PhysioPal Smart Top: (Figure 2.6) Collaboration between Elitac display company and Dutch fashion designer Pauline van Dongen creates a smart top vibrating to correct the bad posture for people having back pain or spine disorders. The top can be worn on its own or under other clothes. (Dezeen, 2016)



Figure 2.6- Pauline van Dongen PhysioPal Smart Top

vi- Levi's Commuter Jacquard by Google: (Figure 2.7) This example is one of the promising collaboration of fashion and technology industries. Commuter Tracker Jacket is Levi's very well-known denim jacket that has been on sale for years. Smart version of this jacket contains Google's conductive yarn technology in the denim woven. A snap tag placed on the sleeve of the jacket connects

the user's mobile device and allows the user to receive notifications, make phone calls, follow directions for the maps via earplugs and informs the user with visual and haptic feedbacks. The battery lasts for two weeks. This example is considered promising because Google allows public sharing for the development of software for this product. Moreover the conductive yarn technology can be applied to almost all fabric types, therefore Jacquard is considered as a beta version for the development of new fashionable wearables. (Google ATAP, 2017)



Figure 2.7- Levi's Commuter Jacquard by

II. Haute Couture Fashionable Wearables

Examples in this category are made on order. They are designed by the collaboration between technology brands and fashion houses of star fashion designers. Technological equipment and aesthetic details require the endeavor of handmade production, therefore they are not suitable for mass production yet.

i. EzraTuba Butterfly Dress: (Figure 2.8) Intel and Turkish fashion designers duo Ezra and Tuba Çetin collaborated for a smart wedding dress decorated by butterflies that can fly with the sensors placed under the wings. The dress is designed for wedding ceremonies and the butterflies are expected to fly when the bride says yes. (EzraTuba, 2017)

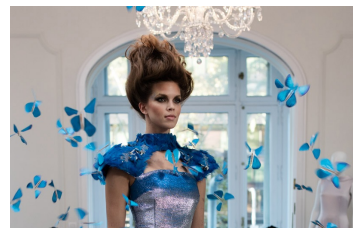


Figure 2.8: EzraTuba Butterfly Dress

ii. Chanel Boy Bag with LED: (Figure 2.9) Karl Lagerfeld, Creative director of Chanel prefers to present the new collection of Chanel in thematic fashion shows. The brand's 2017 Spring Summer collection had a theme of technology. Models wore robot masks and the show was performed in a data center-like designed environment. Complementing this futuristic theme, the brand launched smart versions of its classic hand bag models named Boy Bag and Clutch with LED decorations. LEDs on the bags were blinking with a software. The blinks or the text appearing on the bags could be changed with the button placed in the bag. (Vogue, 2017)



Figure 2.9 -Chanel Boy Bah with LED

iii. The Unseen Gorget Jacket: (Figure 2.10) It is a jacket looking like a cape and revealing the emotions of the wearer. The brand developed a chemical material which is reactive in color change to 7 facets of the wearer's biosphere, enabling her/his to formulate bespoke materials that respond to atmospheric fluctuations and

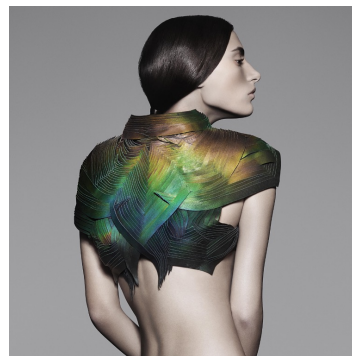


Figure 2.10-The Unseen Gorget Jacket

individual desire. It is responsive to body temperature and the environmental conditions. (The Unseen, 2016)

III. Fashionable Wearables Projects From Academia

Examples in this category are neither mass produced nor made on order. They are either academic or artistic project examples that are either ready to be in mass production or still under development.

i. Fleurtech (2016): (Figure 2.11) A transformable dress incorporating servomechanisms to change the length of the skirt to mini or long as well as allowing to change the size of the dress with its flexibility and adaptability to various contexts. It aims to extend the lifespan of the product with aesthetic design and transforming functions. (Lee, et al. 2016)



Figure 2.11 - Fleurtech

ii. Nebula (2015): (Figure 13) This is a prototype for examining the properties of textiles, fashion and digital technologies for garment design. By this way it aims to experience making and wearing of interaction and functional aesthetics. (Elblaus et al. 2015)



Figure 2.12-Nebula

iii. Loom (2013): This example fits right around the upper body, and supports the posture to avoid big movements, that way smaller movement becomes the focus of the interaction. It aims to explore the boundaries between human body, bodily movement and technological capabilities, while bringing interaction design, fashion design, and new design practices together. (Tomico, 2013)

2.3. Participatory Design, Fashion System and Their Relevance to Fashionable Wearables

Participatory design refers to different meanings depending on the case applying the level of participation. Some studies confuses co-design, collaborative design, and even user-centered design with participatory design. Halskov and Hensen (2014) offer three different definitions for the word of participation in the domain of participatory design.

Implicit: Works that do not define or explain what they mean by participation, and what level of participation they apply.

User's point of view: Defining only the level of user's participation such as user-driven but not the other stakeholders.

Mutual Learning: Transfer of knowledge between user, designer and other stakeholders, which means active participation of all stakeholders.

This research approaches participatory design from a mutual learning aspect. Because participatory design says that "*people who are affected by a decision or event should have an opportunity to influence it.*" (Halskov and Hansen, 2014). This means that not only the designer and the end-user of a product or service but also other stakeholders, which might be directly or indirectly influence the design or is influenced by the design should participate in the design process. Moreover, unlike co-design and user-centered design approaches, participatory design contains political perspectives in terms of power relations between stakeholders and democratizing the weak stakeholders against the powerful ones.

Participatory design is considered as the applicable method to design fashionable wearables, because designing these wearables requires active and equal participation of interdisciplinary stakeholders. Possible power conflicts that might be occurred during the collaboration between fashion and technology professionals, and the democratization of the user compared to conventional design dynamics of fashion industry can be provided by participatory design methods. Some contemporary projects involve only the fashion designer to the process, however, involving only the fashion designers to design of fashionable wearables would not be sufficient as fashion should be considered as a systems of institutions (Kawamura, 2018). Material and symbolic production of fashion is a collective process. Designer, engineer, fashion magazine editor, academician, fashion stylist, garment modelist, factory workers, merchandisers and more parties perform collectively to create material goods of fashion and the meaning of fashion. Therefore, active participation of these stakeholders, as Kawamura (2018) also highlights, is significantly important.

Yuniya Kawamura (2018) considers fashion as a system of institutions that consists of a collective activity and process involving various institutions such as media, designers, advertising agencies, consumers, editors and more. Fashion is not created by one single person or institutions but these institutions, either in the form of groups or individuals, decide what fashion is.

This collective creation process can be considered similar to collective nature of participatory design. There are examples from fashion studies showing how ordinary wearer/user of fashion products can alter purposes of clothes and recreates new meanings for fashionable goods and how the participation of fashion wearer/user can alter the design of wearable technologies in order to create new purposes and meanings for them.

Jeans for example were produced for the laborers due to their working conditions. Workers needed thick fabric to perform comfortably in fields and farms. It was a supply offered by the fashion industry in reply to the demand of the workers in the field. However, jeans started in time to represent the rebellion culture. In the 1930s and 1940s, creative and artistic types began wearing jeans in U.S.A., arguably more violent and less creative subculture groups took them up in the 1950s. Activists from the New Left started wearing jeans around the 1960s, as did hippies, introducing a more intellectual, but again, no less marginal mark to the product (Barnard, 2002). Jeans became the symbol of resistance in the 1950's (Crane, 2000), because all of these groups "stood strongly in opposition to the dominant conservative, middle-class, consumer-oriented culture of America" (Davis, 1992). It was an anti-fashion element to demolish the values of upper classes. Due that revolutionary nature of jeans, people of various social groups, economic and educational backgrounds began to wear them. Currently, they can be seen as the most neutral and egalitarian piece of clothing because people from every class wear them almost every day.

Punk Culture, for example was an attempt to oppose and challenge a dominant, middle-class view, or ideology, of beauty in women and value in jewelry (Barnard, 2002). Punk appeared to develop "as a reaction against the massive commercialization of both music and fashion for the young" (Rouse, 1989). It was a rage against the "boring" mainstream music bands and dominant life style. Punk enabled the production of the streets' own music, fashion and culture. Punk was an anti-fashion movement that was performed as the fashion of its consumer. In time, the high fashion designers such as Vivienne Westwood also appropriated it and the street style of subcultural movement started to be consumed by the people, which it was in fact a protest against.

The fashion of the lesbian feminist used gender as an agenda of fashion as well. They encouraged the upper-class and middle-class, independent, educated women to wear trousers, and therefore they utilized trousers as identical symbol of free women. Especially *working-class women, who became models of artists and photographers in Montparnasse and Montmartre began wearing trousers towards the end of the First World War. These women belonged to an urban bohemian subculture in which some of them functioned as "fashion leaders"* (Crane, 2000). The widespread acceptance of trousers by middle-class women appears to have been pioneered by marginal groups within that class. In the postwar period, masculine uniforms for women gradually appeared in occupations, where women were performing work similar that of men (Crane, 2000).

As the examples show that fashion and technology products require participation of institutions as designers, editors, stylists, engineers, developers, academicians, researchers, technicians, managers, material providers, media, and most importantly the user and the wearer. Therefore, the design of these products should provide possibility for interdisciplinary groups of participants, equal and active participation of stakeholders and certain tools and methods. When we look at this nature of fashion

system, we see that the underlying concept of participatory design becomes relevant to fashion. Participatory design supports the active participation of all the stakeholders similar to fashion system. Additionally, design of fashionable wearables can be more complex than design of ordinary fashion goods since it requires collaboration of interdisciplinary stakeholders. Therefore, participatory design tools and methods can be applicable for the complex design of fashionable wearables. In order to do that we research fundamentals of participatory design and common models below.

2.3.2 Fundamentals of the Participatory Design and Methods

Participatory design says that *"people, who are affected by a decision or event should have an opportunity to influence it."* (Halskov and Hansen, 2014) This argument promises that stakeholders, who are directly or indirectly influenced by a product or service should have a voice to be heard in design of it. This argument emerged in Scandinavia in the 1960s. It aimed to involve workers, who had difficulties to work with computer softwares and perceived these softwares as threatening or degrading their jobs. So, designers of the softwares co-worked with the workers to design better tools to support their work-life. In time, participatory design involved users of all designs with a user-centered approach. In the 1990s participatory design started to take not only the users but also other stakeholders into the process. Since the 2000s participatory design studies aim to engage all stakeholders, who are influenced by the design and say that all stakeholders should have access to the information, as well as have a voice in the decision making. (Halskov and Hansen, 2014)

Development of studies in the literature of participatory design in parallel to the practices show that studies of this domain have three main perspectives as political, theoretical, and pragmatic. (1) Political ones reflect people's beliefs and give right to people to influence the design. (2) Theoretical ones aim to develop participatory design studies and literature with philosophical discussions. (3) Pragmatic ones aim to do the job better by improving it with participatory design methods. Regarding these three perspectives of participatory design studies, the level of the user participation have also changed in time. Studies had ethical (political), curiosity (theoretical) and economic (pragmatic) perspectives. Ethical studies had a focus on the democracy and giving power to the people by giving right to participate. Curiosity perspective aid to share knowledge in this domain and case representing different types of participation for cooperation, mutual learning, communication and contribution. Studies with economic perspective aimed to provide cost efficiency and improve work conditions to do a job better. (Bergvall et al., 2008). Our study is positioned closely to theoretical perspective, but also covers political and pragmatic ones. It is political by involving all the stakeholders, who are influenced by design of fashionable wearables and placing mutual learning in focus; pragmatic by using participatory design

methods to improve design of fashionable wearables; and theoretical by developing a model in contribution to the literature of participatory design.

In order to determine the specifications of a participatory design that can be used for the design of fashionable wearables, we reviewed the literature focusing on the formulation and the evaluation of participatory practices. For examples, Bossen et al. (2016) aims to develop systematic evaluation criteria helping practitioners apply participatory design methods. They determine the basic elements of participatory design as:

- 1- **input** (i.e. decisions and resources),
- 2- **implementation** (i.e. process including organization, and participants),
- 3- **output** (i.e. concrete accomplishment of the process as the end product or service),
outcome (i.e. the change influencing the participants),
- 4- **impact** (i.e. long-term change for an organization or society)

Secondly, Frauenberger et al. (2014) develops a *tool-to-think-with* based on their practical experiences derived from *ECHOES Project* (Frauenberger 2013). They offer four lenses to take into consideration while applying participatory design methods. These are:

- 1- **epistemology** (i.e. gaining understanding, gathering knowledge),
- 2- **values** (i.e. ideas and qualities that are considered by individuals or groups),
- 3- **stakeholders** (i.e. partners and actors participating),
- 4- **outcomes** (i.e. impact of the participation as product, service, or a change)

Thirdly, Basballe et al. (2016) analyze papers from the 25 years of Participatory Design Conference and documents how participatory design was perceived and applied. Based on this, they formulate the fundamental aspect of participatory design and mention that participation design practice should contain the following aspects:

- 1- **Politics**: People, who are affected by a decision should have an opportunity to influence it.
- 2- **People**: People play critical roles in design by being experts in their own lives.
- 3- **Context**: The use situation is the fundamental starting point for the design process.
- 4- **Products**: The goal of participation is to design alternatives, improving quality of life.
- 5- **Methods**: Methods are means for users to gain influence in design processes.

Finally Gerrard and Sosa (2014) gives six dimensions to be used in participatory design practices based on their practices derived from *Participatory Evaluation (PartE) Framework* (2014). These dimensions are : 1- **objective**, 2- **practice**, 3- **interaction**, 4- **barriers**, 5- **representation**, 6- **impact**.

When we look at all these studies attempting to formulate and systematize participatory design practice we see a pattern that can be formulated around four main elements and can be applied to the case of fashionable wearables.

	Results	Considerations	Actors	Applications
Bossen (2016)	Output, Outcome, Impact	Input		Implementation
Frauenberger (2014)	Outcomes	Epistemology, Values	Stakeholders	
Basballe (2016)	Product	Politics, Context	People	Methods
Gerrard & Sosa (2014)	Impact	Objective, Barriers		Practice

Table 2.2 - Elements of Participatory Design

1- **Result:** What is achieved with the participatory design. For example it can be fashionable wearable as an end product, and impact of fashionable wearables in fashion and technology industries (i.e. sustainability, reformation in consumption and production conditions)

2- **Considerations:** Knowledge, objectives and values that are determined in order to design the result and barriers to take into considerations (i.e. existing dressing behaviors of ordinary fashion wearer.)

3- **Actors:** Stakeholders participating in the process and different stages (i.e. fashion designer, software developer.)

4- **Application:** The roles that stakeholders perform (i.e. repurposing existing technologies for fashionable wearables); and tools, techniques, and methods used to accomplish the process (i.e. team building activities.)

These four elements constitute the first level of our participatory design model in order to highlight necessary elements. When we look at the literature of participatory design we also observe a second level drawing the stages that are followed. There are four participatory design models offering these stages. *STEPS* (Floyd et al. 1989) was developed as a methodological framework for software development systems. *MUST* (Kensing et al. 1998) was created for the needs of contemporary organizational businesses. *CESD* (Grønbaek 1997) was developed for cooperative and experimental approach to frame life-cycle of information systems. The fourth model is a complementary one based on the aforementioned three models. Bratteteig et al. (2012) analyze all these three well-known methods of participatory design and emphasize that *a participatory design method refers to a coherent set of organizing principles and general guidelines for how to carry out a design process from start to finish – within a Participatory Design perspective* as our model also aims to determine a similar process. Furthermore, they formulate the essential characteristics of participatory design methods. They highlight three main core issues; having a say, mutual learning and co-realization. *Having a say* argues that participatory design is practiced by people for the people, so people should have the power to influence the outcome. *Mutual learning* claims that participatory design is a process that all stakeholders learn from each other such as the designer learns from the user the use cases (i.e. user experience) and the

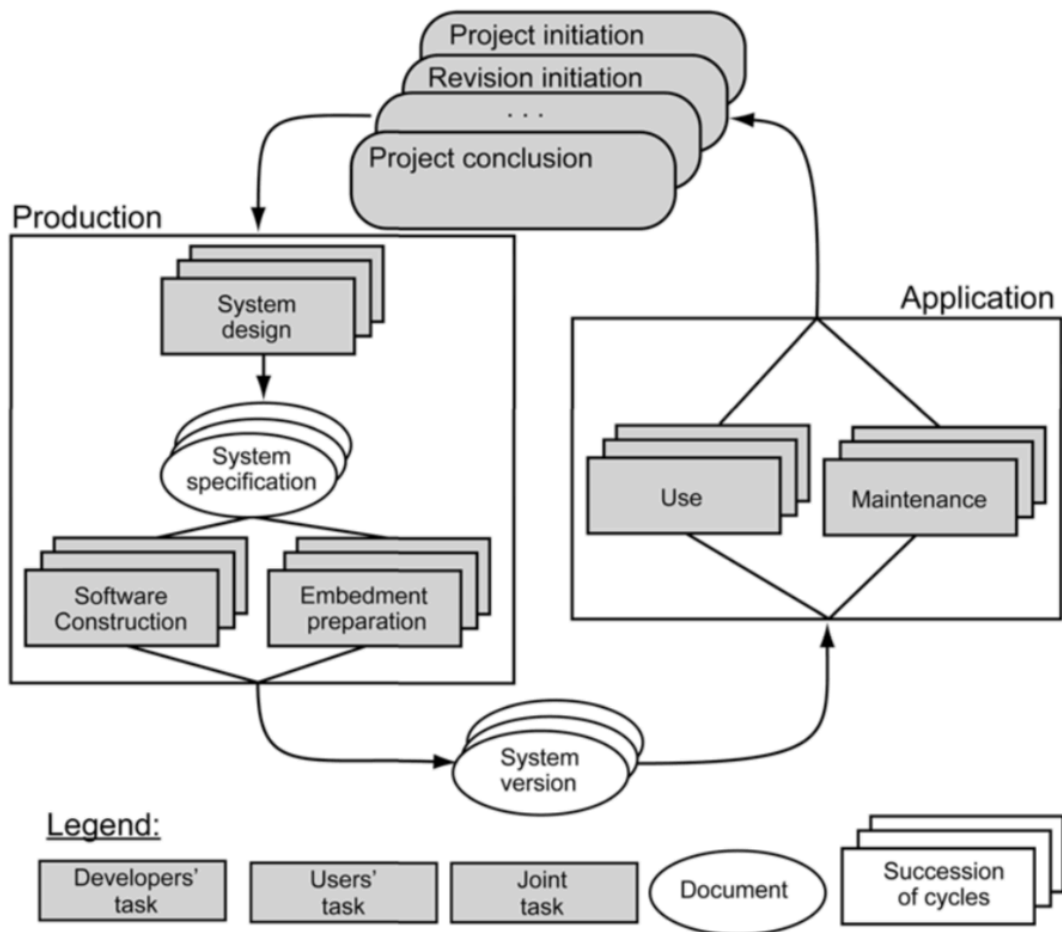


Figure 2.13 - STEPS (Software Technology for Evolutionary Participatory Systems Development)

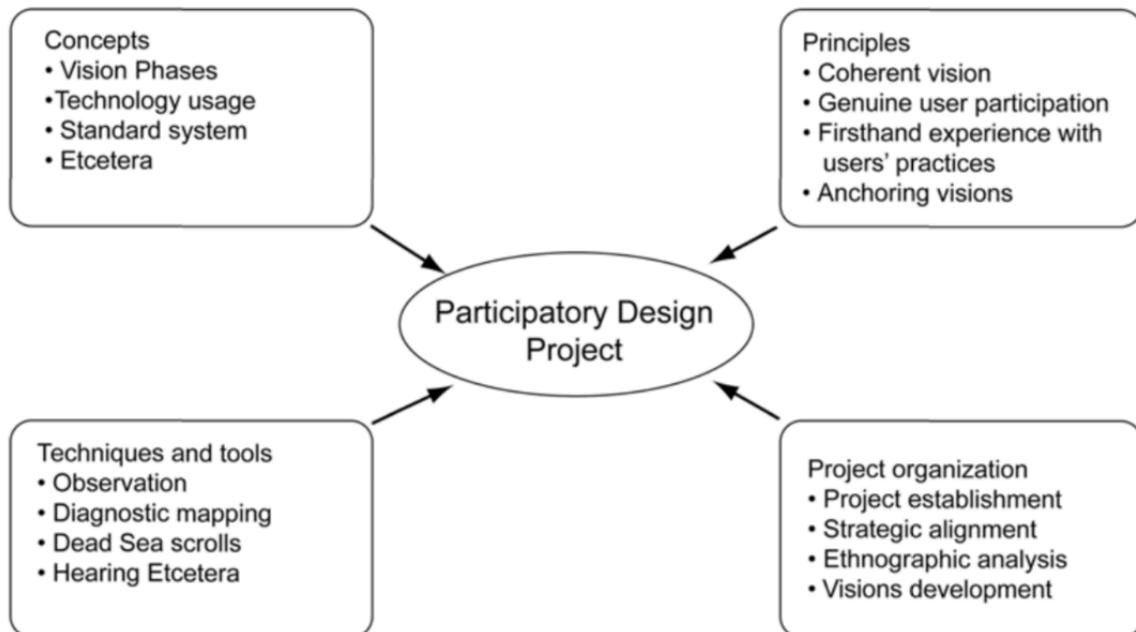


Figure 2.14 - The MUST

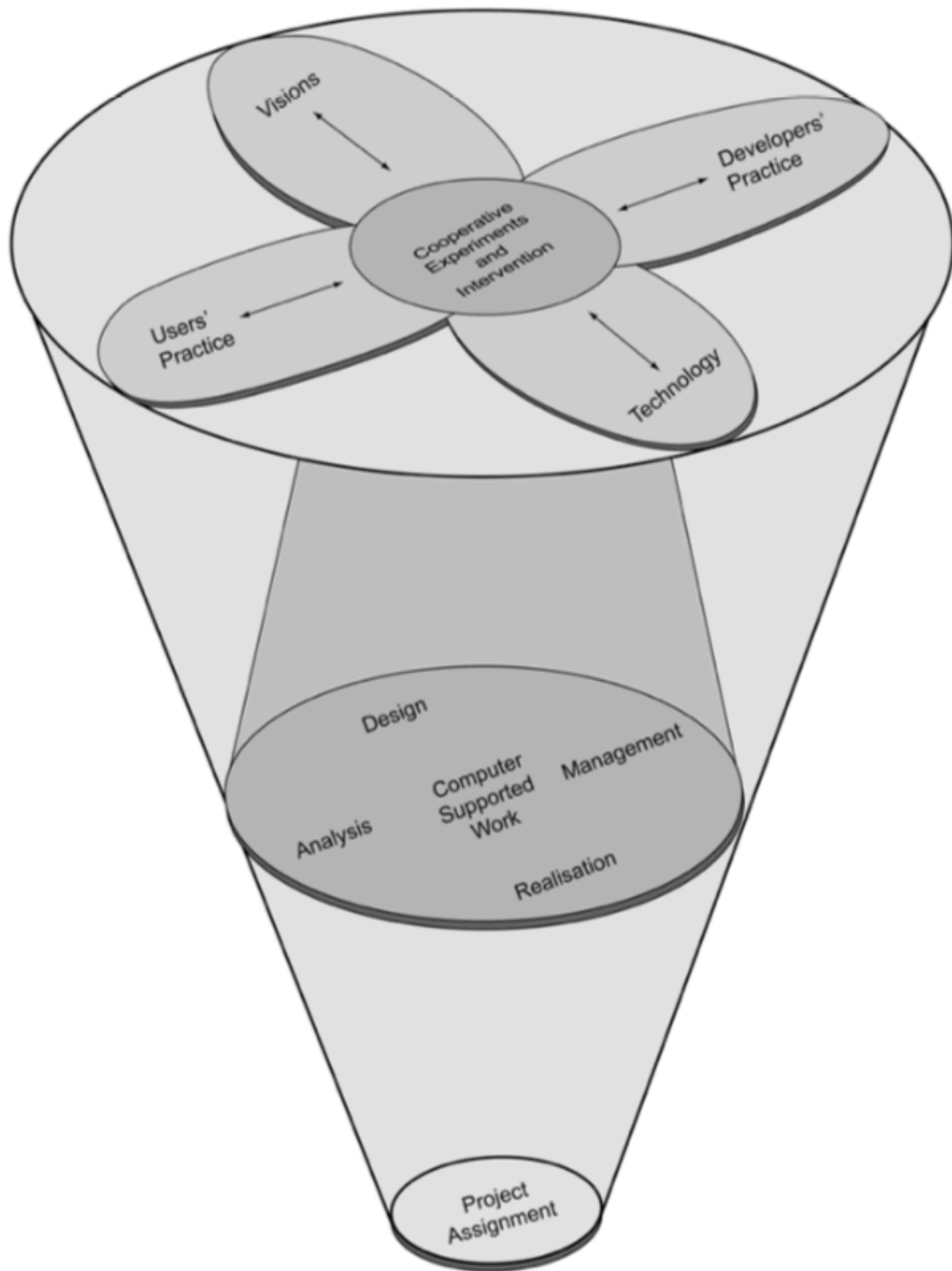


Figure 2.15 - CESD (The Cooperative Experimental System Development)

user learns from the designer about the technical possibilities. *Co-realization* is to involve the user in activities i.e. visualization of ideas, prototyping and learning from the use settings to form the artifact. While practicing *having a say*, *mutual learning* and *co-realization*, communication difficulties, struggles to

share know-how due to “*tacit knowing*” (Schön, 1983), and equalizing the power conflicts might appear as challenges. These core issues also aid us to determine the stages of our model.

Last study, which does not offer a specific method but documents the practical guidelines for the participatory design practices is from Sanders et al. (2010) They offer a specific framework for organizing the tools and techniques of participatory design. Five elements are required to design a participatory design process. These are tools, toolkit, technique, method and approach.

Tools contain material components that are used in the activities. Cards, post its, Lego blocks, 2-d or 3-d collage materials, dairies, game boards, love letters, are example of tools that are used during participatory design sessions.

Toolkit is the collection of tools that are used in combination to serve a specific purpose.

Technique describes how the tools and toolkits are put into action. For example many different techniques can be used with a deck of image cards. They can be sorted, categorized, prioritized, used to make collection, tell a story and/or used to spark conversations. Game boards or Lego blocks can be used to play and design imaginary environments.

Method is the combination of tools, toolkits, techniques and/or games that are strategically put together to address defined goals within the research plan. Determining methods should consider the experience that the participants will go through. Each activity should prepare them to the next one. For example planning of a whole participatory design workshop may begin with training, sorting cards with a

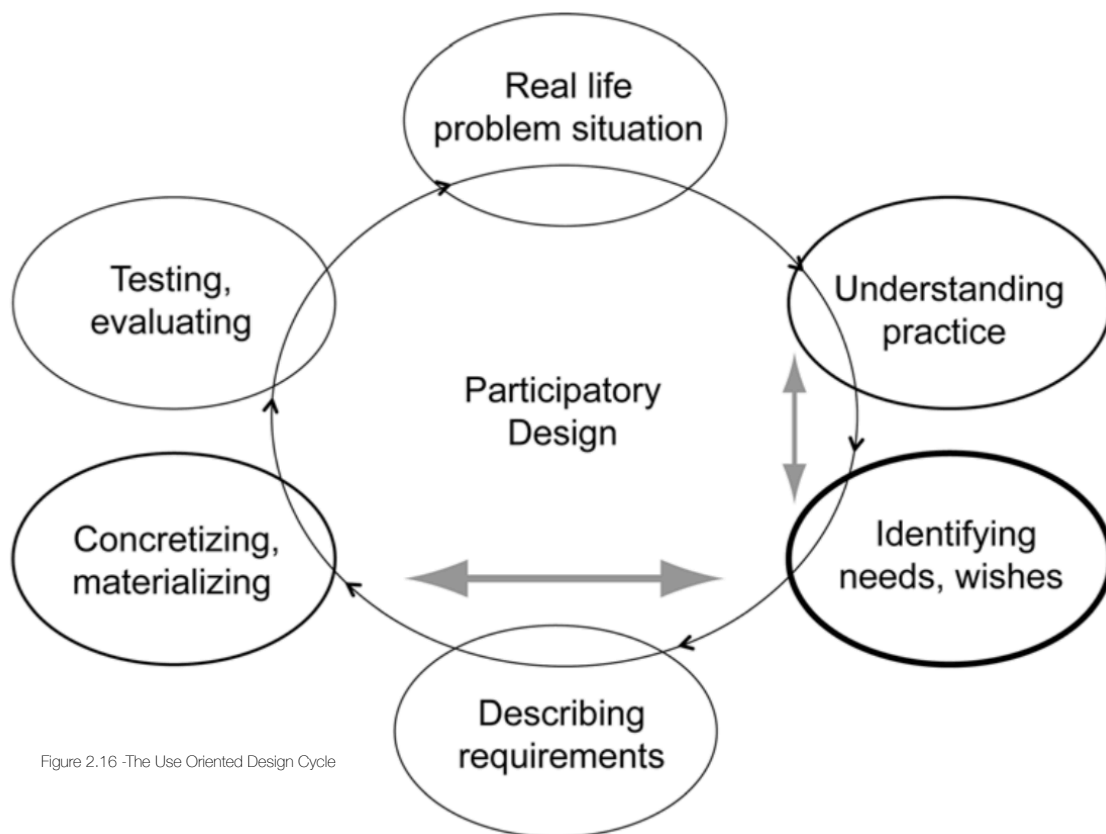


Figure 2.16 -The Use Oriented Design Cycle

group of participants, in order to start writing/drawing storyboards as a next step, by improvisation of a future situation to guide a real experience.

Approach describes the overall mindset with which the research plan is to be conducted. For example, Sanders et al (2010) assumes a participatory mindset characterized by the belief that all people are creative. This means that tools, and techniques should provide opportunities to perform out people's creativity. These elements also aided us to plan our participatory workshops.

2.3.3 Fashion and Textile Industry Cases in the Literature of Participatory Design

To best of our knowledge there is no study focusing neither on products designed by the collaboration of fashion and technology industries nor specifically on design of fashionable wearables from a participatory design perspective. However, there are a few studies, which investigated the participatory design and co-design methods in fashion and textile industries. One of them aims to develop an integrated co-design approach for production of better, cheaper and faster products with multidisciplinary teams of textile industry with a customer oriented approach. It discovers problems that are faced in late stages of production and consumption, which are difficult to solve in multidisciplinary teams. Results state that problems that are faced at the late stages of production and consumption should be solved at the early stages, so customer oriented collaborative approach should be applied in order to increase success. (Bhamram, 2000)

Another study is from Cramer (2011) focusing on the participation of user in creation of fashion. She analyses how participatory fashion has changed in terms of the involvement of the wearer/user in the design process. Before mass-production, the wearer used to advise the tailor on her/his preferred cut and fabric. Back then, women even used to make their own apparels. Tailors and dressmakers were facilitators of their clients' sartorial desires. After the mass production and especially with the emergence of fast-fashion, wearer's participatory role has been disappeared. However, in recent years, mass customization has let wearers have voice in the design parameters of a garment by combining a range of design components selected from a pre-determined list.

There is another study (To and Harwood, 2000) focusing on the integration of collaborative design process for global fashion and textile products of international fashion based. The study documents case studies from eight Asian-based fashion-buying companies that supported existing top-listed fashion retail institutions in Australia, Europe and the US. The findings emphasize that design and development of global-oriented products require plural functional entity or enterprise to be able to perceive all the perspectives of phases of product life-cycle and it is difficult to manage these multi-entity process containing several stages. They suggest a strategic product designing model for integrating

design processes to provide insight, to assist the collaboration of a large number of multi-disciplinary teams across countries. The model represents the fashion buying companies' dynamic business processes and the process of several inter-dependent stakeholders and entities. The process starts with

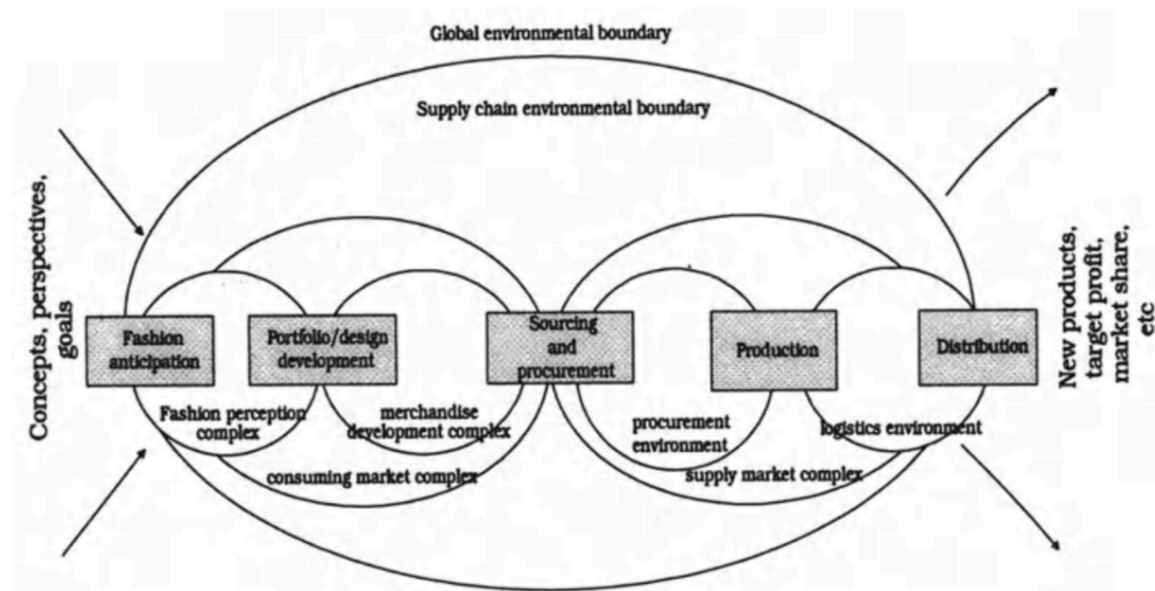


Figure 2.17 - To & Harwood

determination of global fashion trends, creation of portfolio based on trends, supplying the materials, production of merchandises and the distribution. However, these stages are performed in different countries between inter-disciplinary and plural functional stakeholders; so the process requires specific integration mechanisms and tools. This product design and development model also provided us data to consider while developing our model.

Although participatory design in information and communication technologies (ICT) related fields such as human computer interaction (HCI) and interaction design is mature, participatory design studies on fashion are still rare. Plus, to best of our knowledge no study investigate participatory design in the context of fashionable wearables, despite the few studies investigating fashion and textile industries as mentioned above. Aiming to determine the characteristics of a participatory design model for fashionable wearables, we reviewed developments in the domain of fashionable wearables, product examples, existing participatory design methods and participatory aspects of fashion system. Therefore, we believe that, the thesis would be a valuable source of information for the professionals, who are interested in collaboration with either fashion or technology for design of fashionable wearables.

3. METHODOLOGY

In order to project current state of fashionable wearables and find out fashion and technology professionals expectations, we interviewed fashion and technology professionals. Depending the data collected from the interviews, we designed participatory design workshops to observe how fashion and technology experts collaborate for a given fashionable wearables design brief.

3.1. Expert Interviews

We conducted 20 in-depth interviews with fashion and technology professionals from Germany, The Netherlands, Denmark, Sweden and mostly from Turkey. We preferred to talk to these professionals because they have key roles in the creation of new garments, invention of new technologies and communicating to the user in the most effective way. First phase of this interview study focused on fashion professionals including fashion designers, fashion and textile brand executives, a fashion editor, and a public relations manager. The second phase focused on technology professionals including engineers, developers, researchers, technologists and academicians. Interviews were structured under four themes:

- (1) Experts' role in collaborative projects: the role the experts take in collaborations and how they perform.
- (2) Their previous experiences: what were the problems and challenges as well as success stories that experts encountered in previous collaborative projects
- (3) Their expectations on collaborating with each other: what these experts expect from collaborating with each other, how they position the roles of other partners in a project, with whom they prefer to work with.
- (4) Their evaluation of the current state of wearables: how experts assess the current state of wearables and how they project a future for fashionable wearables.

The inclusion criterion of the experts was having a minimum of 2 years of experience in the industry and collaborative projects bringing either fashion and technology or other industries together as we looked up in their portfolios and CVs. We started from asking our personal acquaintances whether they would like to participate. We continued with profile searches in Google Scholar and LinkedIn. The purpose was to identify professionals from industry and academy. We used wearable technology, fashionable technology, and smart textile as search terms. When we found an expert, with a minimum of 2 years of experience in the field, through one of these techniques, we asked whether they know anyone who has

experience in designing wearable technologies with the inclusion of fashion perspective. At the end, we contacted with 41 individuals. Among them 20 responded to our request. (Table 3.1). Interview questions were approved by Koç University Committee on Human Research.

Interviews were voice-recorded and transcribed into text. These transcripts were analyzed through qualitative data analysis (Miles and Huberman, 1994). We used deductive coding and inductive coding during analysis. Deductive coding helped us categorize the data according to the interview structure, while inductive coding helped us identify themes and built a participatory design model. During deductive coding we used codes such as barriers, process, environments, expert roles, current state and expectations. Inductive coding revealed codes such as power conflict and design approaches as fashion and technology drive. We asked them questions depending on their experiences and projects they were involved. Questions (Table 3.2, Table 3.3) were customized according to the expert's experiences and the field of expertise. For the second phase, the interviews with technology professionals, we also asked the participants to reflect on the results of first phase.

Occupation	Year of Experience	Field of Expertise	Employment	Experience Details
Fashion Designer I	20+	Fashionable Wearables	Owens her/his own business	Managed several FW Design Projects
Fashion Designer II	15-20	Fashionable Wearables	Owens her/his own business	Managed several FW Design Projects
Fashion Designer III	15-20	Collaboration of Fashion and Other Industries	Works for a multinational fashion brand	Participated in collaborative design projects of the brand s/he works and other designers and artists.
Fashion Designer IV	5-10	Smart Textiles	Works for a global fashion brand	Participated in several smart textiles development process
Fashion Designer V	5-10	Smart Textiles	Works for a global fashion brand	Participated in several smart textiles development process
Fashion Editor	15-20	Smart Textiles	Free-lance editor worked 15 years for a global fashion magazine	Participated in development of smart textiles for fashion garments
Fashion PR Consultant	10-15	Fashionable Wearables	Owens her/his own business	Managed the design project of a technology company and a fashion designer
Product Developer I	10-15	Smart Textiles	Works for a global fashion brand	Participated in development of smart textiles for the fashion brand s/he works
Product Developer II	10-15	Collaboration of Fashion and Other Industries	Works for a multinational fashion brand	Managed the collaboration of fashion brand s/he works and other fashion designers
Product Developer III	5-10	Smart Textiles	Works for a global fashion brand	Participated in development of smart textiles for fashion garments
Computer Engineer I	10-15	Fashionable Wearables	Academician and researcher in a university	Participated in development of a fashionable wearable product in domain of health and wellness. Project failed.
Computer Engineer II	5-10	Collaboration of Technology and Other Industries	Academician and researcher in a university	Participated in collaborative design projects of academia and industry

Occupation	Year of Experience	Field of Expertise	Employment	Experience Details
Software Engineer	0-5	Fashionable Wearables	Software developer at a start-up focusing on fashionable wearables	Participated in development of an fashionable wearable project
Technology Developer	15-20	Fashionable Wearables	A senior developer with experiences of project management, interaction design and invention of new technologies and products	Participated in several academic and industrial projects of wearable technologies and fashionable wearables
Interaction Engineer I	0-5	Fashionable Wearables	Researcher in a university	Participated in development of fashionable wearables process in collaboration with industry
Interaction Engineer II	10-15	Fashionable Wearables	Academician and researcher in a university	Participated in design of a fashionable wearables at an academic level
Textile Engineer	0-5	Smart Textiles	Academician and researcher in a university	Participated in development of smart textile materials for automative and interior design
Researcher I	10-15	Fashionable Wearables	Academician and researcher in a university	Participated in development of fashionable wearables process in collaboration with industry
Researcher II	5-10	Fashionable Wearables	Fashion design researcher in academia	Participated in design and development of fashionable wearables in collaboration with industry, state offices and NGO's
Researcher III	5-10	Fashionable Wearables	Researcher in a university	Participated in development of fashionable wearables process in collaboration with industry
Table 3.1. - Fashion and Technology Experts Profile				

Fashion Experts Interview Questions
i. About Fashion Industry and Cooperation
How do you position your profession (designer, editor etc) in the fashion industry?
What other specialists do you work with in your team?
In which phases do you participate in your collaboration? (Ideation, design, prototype)
Depending your business, there are situations where you need to work with other professionals such as engineer, designer artists, etc. How do you manage these interdisciplinary works? How do you come together with different experts? Can you describe with examples?
Did you have any collaborative experience that did not work out and failed?
Can you share this experience
ii. About Collaborative Projects
Have you ever worked with a technology brand?
Could you explain the processes of those collaborations?
What are the most difficult challenges you face when work with people outside your own sector?
How do you overcome these challenges?
Are there situations where you need to overcome difficulties and take responsibility for problem solving?
How should the role of the project partners be to solve these challenges?
iii. About Wearable Technologies
What are your first wearable technology products come to your mind?
If you make a definition for wearable technology, how do you define it?
Wearable technologies, although not a new agenda, have risen in recent years according to the past. What is your expectation from a wearable product? (Technology, aesthetics, functionality)
What do see in the future of wearable technology?
What features should a wearable technology product carry in order to be fashionable?
iv. About the Collaborative Working Environment for Fashionable Wearable Technologies
What is necessary to bring professionals from fashion and technology industries to design fashionable wearable technology products? (You can share details about your previous experiences.)
What is necessary for a fruitful design environment?
Who should these partners be?
How often should they come together?
On which platforms should they come together?

Apart from wearable technologies, is there any other product, sector or project that previously required fashion and technology industry to work together?
What do we need to design fashionable wearables (which we call wearable technologies that fit fashion trends)
What should be the product features for these designs to reach more users?
What role would you prefer to play in the design of fashionable wearable products?
Table 3.2 - Interview Questions Asked to Fashion Experts

Technology Experts Interview Questions	
i. About Technology Industry and Cooperation	
	How do you position your profession (engineer / software) in the technology industry?
	What other specialists do you work with in your team?
	In which phases do you participate in your collaboration? (Prototype, Final Product, Ideation ...)
	Depending your business, there are situations where you need to work with other professionals such as engineer, designer artists, etc. How do you manage these interdisciplinary works? How do you come together with different experts? Can you describe with examples?
	Did you have any collaborative experience that did not work out and failed?
	Can you share this experience
ii. About Collaborative Projects	
	Have you ever worked with a fashion brand?
	Could you explain the processes of those collaborations?
	Did you have any collaborative experience that did not work out and failed?
	What are the most difficult challenges you face when work with people outside your own sector?
	How do you overcome these challenges?
	Are there situations where you need to overcome difficulties and take responsibility for problem solving?
	How should the role of the project partners be to solve these challenges?
iii. About Wearable Technologies	
	What are your first wearable technology products come to your mind?
	If you make a definition for wearable technology, how do you define it?
	Wearable technologies, although not a new agenda, have risen in recent years according to the past. What is your expectation from a wearable product? (Technology, aesthetics, functionality)
	What do see in the future of wearable technology?
	What features should a wearable technology product carry in order to be fashionable?
iv. About the Collaborative Working Environment for Fashionable Wearable Technologies	
	What is necessary to bring professionals from fashion and technology industries to design fashionable wearable technology products? (You can share details about your previous experiences.)
	What is necessary for a fruitful design environment?
	Who should these partners be?
	How often should they come together?

On which platforms should they come together?
Apart from wearable technologies, is there any other product, sector or project that previously required fashion and technology industry to work together?
What do we need to design fashionable wearables (which we call wearable technologies that fit fashion trends)
What should be the product features for these designs to reach more users?
What role would you prefer to play in the design of fashionable wearable products?
iv. About Findings of the Previous Study
In data of previous interviews with fashion experts, we documented that current projects are driven either by technology or fashion brands/designers/professionals. How do you compare fashion-driven and technology-driven approaches for design of fashionable wearables.
Table 3.3 - Interview Questions Asked to Technology Experts

3.2. Participatory Design Workshop

We conducted three sessions of participatory design workshops to examine how prospective stakeholders can collaborate when designing fashionable wearables i.e. what kind of problems occurred during this collaboration, how they overcome these problems, and what they think about collaborating with each other in the context of fashionable wearables. The participants received a brief (Table 3.5) asking them to design a fashionable wearable that collect bodily liquids and the environment liquids to refine drinkable water. Design constraints were being fashionable to catch trends, upgradable to technological developments, adjustable to users' body, adaptable to geographical, cultural, climate changes, and sustainable for long term usage. The reason we preferred this brief was to avoid participants to be influenced by the existing fashionable wearable examples and to encourage them to imagine a cutting-edge example. Secondly, expert interviews highlighted that fashion will be needed in every condition even in a dystopian scenario because it is a social phenomenon. So, we aimed to observe how participants perceive fashion in a scenario that is difficult to prioritize fashionability of a garment. First group consist of fashion professionals as 1 fashion designer, 1 textile engineer and 1 wearable technology user. Second group consists technology professionals including 1 mechanical engineer, 1 software developer and 1 wearable technology user. The third group consist of combinations of these experts as 1 fashion design, 1 textile engineer, 1 software developer, 1 mechanical engineer and two wearable technology users. We preferred these participants, because they were mentioned in almost all wearable technology and fashionable wearables project that were shared during expert interviews. Therefore, we considered fashion designer, textile engineers, mechanical engineers and software developer as the most significant experts, whom have potential to work on the ideation of fashionable wearables. Additionally, we preferred to involve experienced user, who have had used a wearable technology product for minimum one year. These sessions aimed at observing approach



Figure 3.1 - Participatory Design Workshop

differences between fashion and technology professionals as well as collaboration of them in the third session. All groups received the same brief. We firstly presented the topic and well-known examples of fashionable wearables. They worked individually during the first 15-20 minutes. After they shared their individual ideas, they started to co-work for three hours and developed a conceptual fashionable wearable within the framework of the design brief. The tools and toolkits (Halskov and Hansen, 2014) of this workshop were large sized papers, markers, white board, post-its, a presentation including images of contemporary fashionable wearables. First participants were asked to individually think about the given design brief. These tools aided them to create ideas on their own. Secondly participants were asked to share their ideations. They organized and wrote down their ideas on white board and large sized papers. They responded to one another and comment on each others' ideas. In the third step regarding their personal ideas and collective brainstorming output, they organized an imaginary product and presented it collectively. Participants worked around a meeting table in a meeting room with projection, and all other tools and toolkits. Workshop procedure and design brief were approved by Koç University Committee on Human Research.

Occupation	Year of Experience	Field of Expertise
Fashion Session		
Fashion Designer	10-15	Fashion designer at a fast-fashion brand
Textile Engineer	5-10	Product developer at a fast-fashion brand
Wearable Technology User	Using device for 1 year	Violin player, Apple Watch User
Technology Session		
Mechanical Engineer	15-20	Sound Engineer and Performance DJ
Software Developer	5-10	UX and software developer at a bank
Wearable Technology User	Using device for 1 year	Design Researcher-Academician, Apple Watch User
Fashion and Technology Mixed Group		
Fashion Designer	5-10	Owns her own brand
Textile Engineer	10-15	Product developer at a fast-fashion brand
Mechanical Engineer	5-10	Freelance designer and developer
Software Developer	5-10	Computer engineer
Wearable Technology User I	Using device for 1 year	Human Resources director at a global pharmaceutical company
Wearable Technology User II	Using device for 2 years	PhD in computer engineering

Table 3.4 - Participatory Design Workshop Participants Profile

DESIGN BRIEF

i. CONTEXT

We are at a time when we face with the depletion of our clean water reservoirs due to the harm that fashion, textile and technology companies (and other industries in general) cause. A crazy stateman or a futurist brings fashion designers, textile engineers, software and hardware developers, and most importantly, users to work on a solution for this problem.

ii. OBJECTIVE

To design a garment that allows the wearer to meet his or her daily water needs by converting body or ambient fluids into drinking water.

iii. PRODUCT FEATURES

- Sustainable: can be used for many years (more than 15-20 years), and renewed without consuming resources
- Upgradable: remain up to date of technological developments
- Adjustable: Has the ability to adjust to different forms and measurements of the user
- Adaptable: To different geographical, climatic and cultural conditions and environments
- Fashionable: Variable and adaptable according to the soul of time, trends and fashion codes

iv. CONSTRAINS

Avoid non existing technologies such as invisibility or teleportation

v. TARGET AUDIENCE

Can be Female, Male, Child, Unisex or Ageless.

You can draw the boundaries of this. Since it will eventually be a product that can be used by everyone, it can be started from any specific group or everyone.

vi. BUDGET

There is no budget limit.

vii. TIME PLANNING

We have 1.5 hours to develop the product idea.

You need to make a realistic time schedule for the realization of this product.

viii. OUTPUT

- For whom? (for which user group did you design the product?)
- How is it used? (how the product is used in a real scenario?)
- What is it and how does it work? (Required materials, technologies, hardware, software, etc.)
- How is it produced? (simply explain design and production process)

Table 3.5. - Participatory Design Workshop Design Brief

4. RESULTS

Findings of the expert interviews collected under two main titles (1) the current state of fashionable wearables that the experts depict, which includes four sub-themes and (2) expectations of the experts concerning design of fashionable wearables, which includes seven sub-themes.

4.1. Current State of Fashionable Wearables Design

Current Fashionable Wearables have not Reached Their Potential

The experts considered wearable technologies luxurious, expensive and inaccessible items for end-users. They indicated that industrial acceptance in factories and laboratories can be as a first step for their widespread adoption.

Experts thought that existing wearable technologies are designed as one size fits all solutions. These technologies usually are attached to a wristband, t-shirt, or a jacket. When users are not wearing these accessories and garments, they cannot use the technology.

Current Projects are Mainly Technology Driven

Technology professionals considered the market as engineer-driven rather than fashion-driven. Projects managed by technology companies are more than the ones conducted by fashion companies. Therefore, technology brands usually lead the fashionable wearables projects. Projects initiated by fashion companies are very rare. They also mentioned about projects initiated by NGO's, and government offices such as associations, chambers and ministries. However, these were led by either fashion or technology teams.

Fashion and Technology Professionals have Different Attitudes towards User Involvement

Professionals from fashion industry preferred to invite the users in stages where their contribution is needed in testing and evaluation phase. They tended to treat the users as information providers. However, technology professionals (e.g., engineers, developers) preferred to invite the users in all stages as they are familiar with following a user centered design process. Users have a more active role; they can influence design decisions at the early stages of the design process. For instance, technology professionals involve the user in ideation to determine their needs and desires, and in design evaluation phase so that unsatisfying situations can be solved before the production starts.

Fashion-Driven Design Approach vs. Technology-Driven Design Approach

Two collaboration approaches were drawn depending on the statements of experts. The first one is fashion-driven, which the fashion designer initiates. This approach leads to the development of new technologies. Fashion designers inspire the invention of new technologies, (e.g. inventing a new textile that can transmit electricity). After generating the design idea, the designer brings together the stakeholders required to invent the essential technology and design the product. Personal acquaintances are perceived as highly beneficial and rewarding for this phase. In the fashion-driven approach, the fashion company, textile company or a fashion atelier, which has a vision for investing on new textile technologies and smart garments, hosts the invited stakeholders and provides all the required material and environment for the realization of the design idea. After a period of research and development, and after all the stakeholders agree on the final prototype, production stage starts. Lastly, as this approach may require invention of new technologies, the generated concepts are more likely to become haute couture pieces that may never reach to mass production. If the existing technology can perform the idea of fashion designer, it can also be used instead of inventing new ones. The butterfly dress of EzraTuba is an example to this approach (Figure 2.8). The fashion designer duo came up with the idea of a fashionable wearable and collaborated with Intel in order to realize their imagination.

The second approach is technology-driven in which the design process starts after the invention of new technology. In this approach, technology brands start the process and invites fashion designers. An example scenario shared by the experts is that Apple was in search of a fashion designer to make their wearable technologies more fashionable for localized communication and the public relations agency they work with introduced them to Les Benjamins high-fashion brand for the collaboration. In this approach, the main drivers of the process could be the technology companies, brands or other partners as state authorities or NGO's that bring all the stakeholders together for the design process. Aside from fashion designers' initial ideation and research on technology development, this approach follows the same steps as in the first one. However, as the experts revealed, the technology-driven approach moves faster than the fashion-driven one, because the required technology is already available.

The interviews with technology professionals showed that although they acknowledge the importance of fashion, many prefer to stay distant to the fashion-driven approach. Technology experts who have participated in the design of fashionable wearable technologies said that this approach is fruitful for the invention of new technologies and creative products. However, other experts, who have not collaborated with fashion designers preferred technology-driven approach, since they thought that the execution of a product with existent technology is more realistic and feasible goal. They stated that developing a working product (or at least proof of concept) before making it fashionable is more convenient. Nevertheless, they also highlighted that whether the approach is fashion or technology-driven, fashion designer and engineer should participate from the beginning of the process.

There are Challenges Appearing Specifically in Design of Fashionable Wearables

Some of the challenges emphasized by the experts are common barriers faced in participatory design projects i.e. communication barriers, power conflicts, while others are characteristic to wearable technology cases and project specific i.e. uniqueness of projects and preconceptions of stakeholders to other professionals discourse. One of the most emphasized challenge is the uniqueness of projects. Each project determines its own route to follow, improvisation is required. Stakeholders are obliged to solve problems basing on the specific situations.

The second problem is dealing with power relations between stakeholders. Experts indicated that fashion system considers itself privileged among other industries. Experts we interviewed from the fashion system desired to be the coordinator of such projects. Technology professionals on the other hand stand distant to the professionalism of fashion system. They emphasized the necessity of a talented project manager in order to avoid power conflicts, have better time and team management, and attain project goal.

The third challenge is keeping up with industry's time requirements. Designing wearable technologies is a race against time. Technology grows fast, simultaneous projects in the field are done all around the world. Projects are expected to reach to a final product as quick as possible. While partners are busy to solve technical and practical problems in the process, they waste time, and fall short behind the time plan.

The fourth problem experts reported appears during the user testing process. During these tests, the users cannot clearly understand the capabilities and features of a prototype or an end- product. The experts stated that this decreases the reliability of the feedback received from the users. Therefore they need a systematic approach for the recruitment of prospective users of developing design output.

The fifth challenge is the difficulty in working with diversified team dynamics with multi-stakeholder environment. They reported that design teams consist of various partners that can change depending on the problem domain, and that each stakeholder usually desires to lead the design process. They suggested having an industry neutral project coordinator or a project manager directing the process and the stakeholders to deal with these challenges. Moreover, failed project attempts shared by the experts indicate that partners' knowledge in the field of technology and fashion concepts, end-product and production process is highly crucial to bring success to the project. For example, fashion designers are considered free-spirited by the corporate partners, while fashion designers consider corporate partners falling short to understand creative processes. Such misconceptions between partners negatively influences the process.

The final challenge is establishing an efficient communication between stakeholders who have diverse professional backgrounds and level of expertise. Each stakeholder has her/his own understandings of the project goal, the problem, the process and the outcome. This diversity makes sharing knowledge, ideas and expectations challenging.

4.2. Expectations Concerning the Future of Fashionable Wearables Design

Collaboration Between Fashion and Technology can Facilitate the Widespread Adoption of Wearables

Experts indicated that technology should be modular and adaptable to different fashionable items. Since the form of fashion artefacts have already been used for centuries, adaptability and modularity of technological hardware to these artefacts can spread the use of wearable technologies. This would expand the use of wearable technologies to various environments and cases.

Another key requirement for making wearable technologies desirable for the mainstream users is fashion's involvement in the process. They mentioned that professionals from fashion industry should be more involved in the design process. They indicated that this involvement would help users relate a technology to their daily life easily. For example, although e-textile has been in usage for 20 years, they have recently been taken into the scope of fashion and have become more popular in smart clothes.

The experts stated that fashion designers could have a “matchmaking” role between fashion and technology. Fashion designers have knowledge of human body and creating form for the physical, social, psychological needs of human. They are responsible for making a technology valuable to use. Fashion designers can also have a role beyond matchmaking. When they lead the design process, they can push the boundaries of technology professionals as turning speculative technologies into reality as in the example of Butterfly Dress (EzraTuba, 2017). Therefore, the role of the fashion designers is highly significant in designing wearable technologies.

Fashion Impact should be More Prominent

Experts stated that fashionable wearables should be more expressive about the wearers personality; adaptable to cultural, seasonal and fashionable changes; and sustainable for the environment. Fashion experts mentioned that because clothes are an inseparable part of one's identity and self-expression, fashionable wearables should be customizable and well-integrated into users' daily garments. In other words, they think that the impact of fashion should be more prominent in the end-product. They also added that fashionable wearables should offer solutions to the environmental, social and political issues.

Current production dynamics in fashion industry that impose rapid production of clothes and their rapid disposal is very harmful to the environment. Moreover, this pressure on fastness results in highly brutal conditions for the workers and even increase in child labor. Fashion experts believed that fashionable wearables should be durable, long-lasting, environmentally and culturally adaptive to overcome such problems.

Design Team should Consist of Various Stakeholders, and Team Composition Varies According to the Problem Domain

Most of the experts agreed that fashion and technology professionals are the obligatory stakeholders in a fashionable wearable project. Unlike the most of participatory design practices, experts preferred a degreed participation in the process. They said a fashion designer, technology developer are main stakeholders participating in the process. Fashion designers should contribute with their knowledge of body and form; cultural, and sociological insights, while technology professionals should contribute with the knowledge of technology and user interaction.

It was frequently highlighted by the experts that there are always several stakeholders that should participate depending on the project and purpose of the end-product. The additional stakeholders also provide their domain knowledge with their consultancy to the process. These are considered as secondary and complementary stakeholders. For instance, doctors and physicians should participate in case of a medical product, or coaches and professional athletes should participate in case of a sport wearable.

Pattern makers, tailors, mechanists, and material providers (e.g. textile, yarn) participate in the production stage of the process. Finally, academicians, universities, state authorities and NGO's should also be involved to enlighten and educate people and provide opportunities and conditions for people to participate in design process.

Recruitment of Stakeholders and Distribution of the Roles are Decisive in the Process

While all these stakeholders have predefined roles in the process, especially in small groups, these roles might change depending on experts' background. For instance, as in one of the cases an expert shared, a product designer can also work as the creative director of the project, while creative director might work as technologist. Experts stated that this flexibility facilitates problem solving.

Experts emphasized the significance of choosing the right stakeholder for a successful collaboration. Decisions concerning whom to collaborate mainly depend on the project and output. Along with these, the existence of highly motivated stakeholders having a common vision and even having a friendship

between partners were mentioned as a criterion for selecting the right partner, thus bringing success to the project.

Efficient Tools are Required to Avoid Communication Gap

Participatory environment requires partners to come together physically, particularly at the early stages of the design process. In further phases, after the stakeholders agreed upon the concepts and the project brief, they can participate in the process through digital communication and project management tools. However, in case of fashionable wearables, experts mentioned that they do not use specific tools. They communicate via existing tools and apps i.e. e-mail, *Skype*, *Whatsapp*.

Experts expected that the stakeholders should participate personally. However, it is neither easy nor common to ensure the active participation of all the stakeholders every time. Therefore, partners meet up with others only in cases of emergencies and crises. As a solution to this experts added that the role of the project manager or creative director become highly crucial in these cases as s/he manages and mediates the process and reconciles the stakeholders.

Design should be Independent from Financial Support

Experts believed that big sponsors and brands should finance the process to afford the cost of collective creation process. Opportunities of a big partner can provide better possibilities to the collaboration environment. Companies as Apple and Samsung have means to afford innovation of new technologies and products.

While a powerful financial support is decisive, it was also highlighted that the work environment should be independent from these sponsors and brands to be free from limitations. To avoid the oppressiveness of the big corporations, some experts determined start-ups as the most fertile environment for the invention of new technologies. Since their nature is flexible to take risks, they are more suitable for the innovative products.

Fashionable Wearables have Potential to Revolutionize the Fashion System

Interviewees had a negative attitude towards existing tailor-made artistic products or LED decorated expressive prototypes of wearable technologies. They thought that wearables have a bigger potential than this. For instance, one of the most promising prospect is their potential to change the fashion system, and dynamics in textile and fashion industries. It was highlighted that fashion system 's creative process has been stuck in a vintage culture since the 1970s. After the industrial revolution, garment forms had changed in every decade. For example, the 1920s or the 1940s have appreciable silhouettes. Nevertheless, new forms have not been designed since 1970s. Creations are being back and forth between previous decades. Professionals from fashion industry thought wearable technologies

as a fresh blood in terms of creativity and ethics. They are expected to alter the fashion, create new understandings of fashion with a new creative and technological path. They stated that such changes would also alter the production dynamics (especially in fast fashion), working conditions, waste of resources and pollution. It will alter the goods and production system to a sustainable, socially respectful and environment friendly state.

4.3. Workshop Session

4.3.1- Fashion Group

Solutions and Output

This group designed two parallel projects which are complementary. (I) aims to collect sweat and (II) aims to collect urine. Project I is made of a three layered suit that can be worn individually or underneath other clothes. First layer of the fabric has holes in the weaving which is to receive the sweat from the wearer's skin. Second layer of the fabric has canals in the weaving to collect and keep the sweat. Third layer is to cover and protect body from heat and cold. The color of the garment can change depending on the shade and pattern of the top layer. This garment can also respond to aesthetic concerns with textile technologies. For example, it can push up breast and hip, make it look bigger or smaller. It can

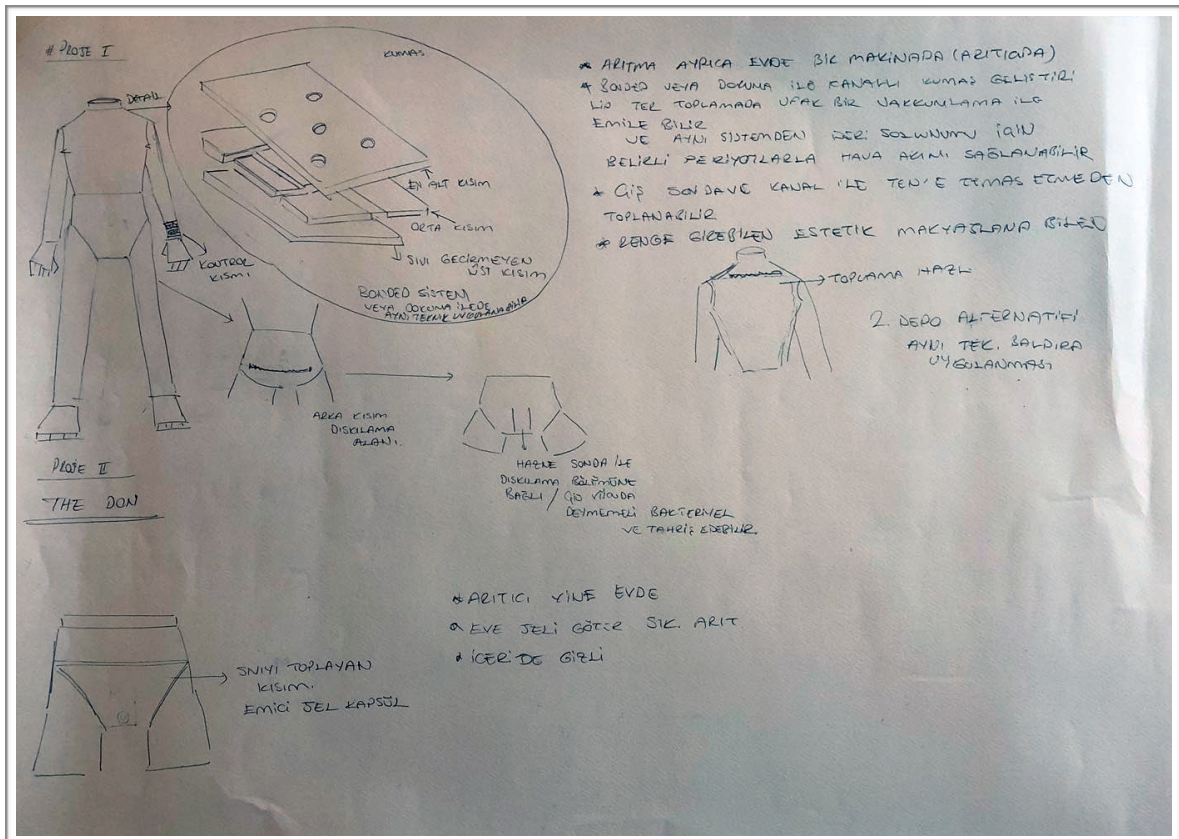


Figure 4.1 - Participatory Design Workshop Output of Fashion Group

also show torso and the legs fit or thinner. The color can be darker or lighter than the skin color of the wearer in case s/he prefers to look more tanned. The collected sweat can be purified in a system that the wearer owns at home. Suit also has a screen based device on the wrist showing numeric date of consumed, collected and purified liquid level.

Project II is designed as an underwear for woman and man to collect urine with a cannula system. So, it does not let urine to touch human skin and avoid bacterias. The fabric collects the urine, transforms it into a gel; and the purification system placed at home re-transforms the gel into consumable water.

Process and Observations

This group consist of one fashion designer, one textile engineer and one wearable technology user. Fashion designer was experienced in working with technological materials specifically for Middle East. Therefore he had a vision of warm and tough climates. Textile engineer was experienced in electromagnetic motion-reactive fabrics. They kept the individual thinking process shorter than other groups and took initiative to pass collective working process. At the beginning of the process they thought that such a project is not applicable. After collective brainstorming, they start to make up solutions to given problem.

User had difficulty to perceive and perform her role in the process. Designer and engineer did not make extra effort to involve the user to the process. The user seem to be excluded since designer and engineer mostly discussed pairwise. They often interrupted user's conversation too. This was the most challenging situation to eliminate in a participatory design workshop. The reason might be that the fashion industry does not follow a user-centered approach. In the middle of collective work, user felt more comfortable and the other two were more open to collaborate. Designer lead the process and provided a fun conversation between participants. After that, user shared her needs and desires which were valuable for the output. She mentioned that during concert performance, her sweating level increases. So, she might need extra patch to collect her sweat. She also stated receiving numeric data about water consumption and percentage of purified liquid can be valuable to know. Accordingly, designer added a screen based device on the arm of the suit in Project I.

Participant Insights

Participants said that they enjoyed working in a project which does not limit the budget. Since, the designer and engineer work for different fast fashion companies, they said they always feel the pressure of deadline and budget. So, they liked having opportunity to choose whatever material they can work with such as the most expensive zipper brand used by high fashion designers.

They also stated that such a project can be difficult to apply in real world because wearability is even more important than the look. So, if the garments are not comfortable and practical, the wearer would never accept to purchase it. For this reason, they stated that given brief can only be successful in a disaster scenario when humanity is obliged to use such garments.

They also emphasized that in such projects *"fashion experts are generally expected to be the decision maker of only color or the decoration of the garment"*. However, they also have experience in *"feasibility and technology of designing, making, producing and using a garment which is mostly ignored by other industries"*.

Concerning the real design environment of fashionable wearables, participants said that brief has technical gaps so working with technology expert would be helpful to fill these gaps and provide better solutions for such complex design problems.

4.3.2- Technology Group

Solution and Output

Technology group had struggle with bringing a solution to a garment form. First, they considered having a water refinement factory that people visit everyday to deliver their dirty and receive the same amount of clean water. However, they did not trust in the safety of the system and they did not think this was what the brief asked from them. In the end, they developed a system kit that can be adaptable in different garments and accessories such as backpack (Figure 4.2). This backpack kit contains the technological equipment and the water packs. Depending on the size of the water pack, the kit can be replaced at the back of a t-shirt, or in the pockets of a short or a jacket. They did not keep the product as a garment, but also developed an application which works as a challenging game for the users comparing the amount of they recycle. Firstly garment or accessory receive liquid from the sources such and human body, rain, lake etc. It collects in the backpack like container. The system placed at home purifies the collected liquid and purifies it to consumable or drinkable water. Referring to engineer's security concern, they added a lock working with user's fingerprint. They also developed an app to collect and reach numeric data as well as a social platform that people connect and play games such as *"pissing contest"*. They named the product as "Serap" which means mirage.

Process and Observations

The technology group consists of one mechanical engineer, one software developer and one wearable technology user. Their ideas were influenced by personal priorities and professionals experiences and the occupation. Software developer focused on the usability and meaning of data, while mechanical

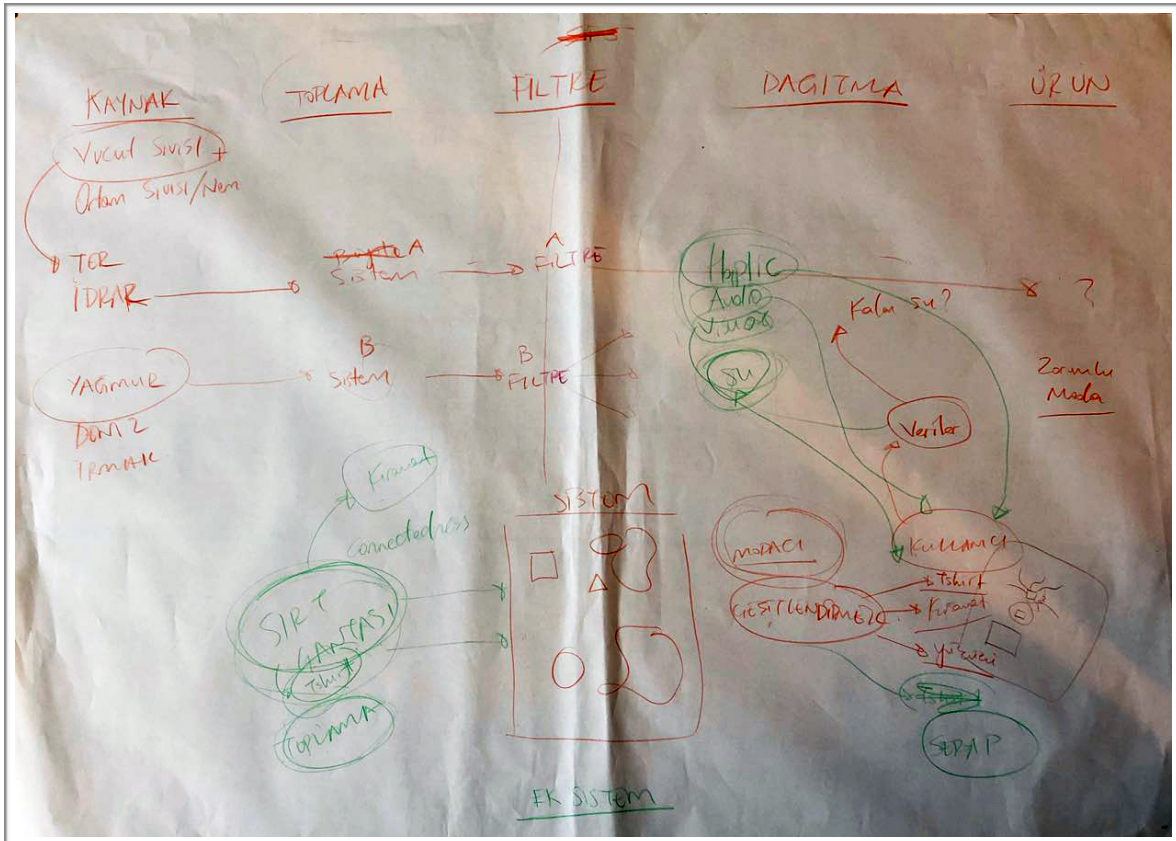


Figure 4.2 - Participatory Design Workshop Output of Technology Group I

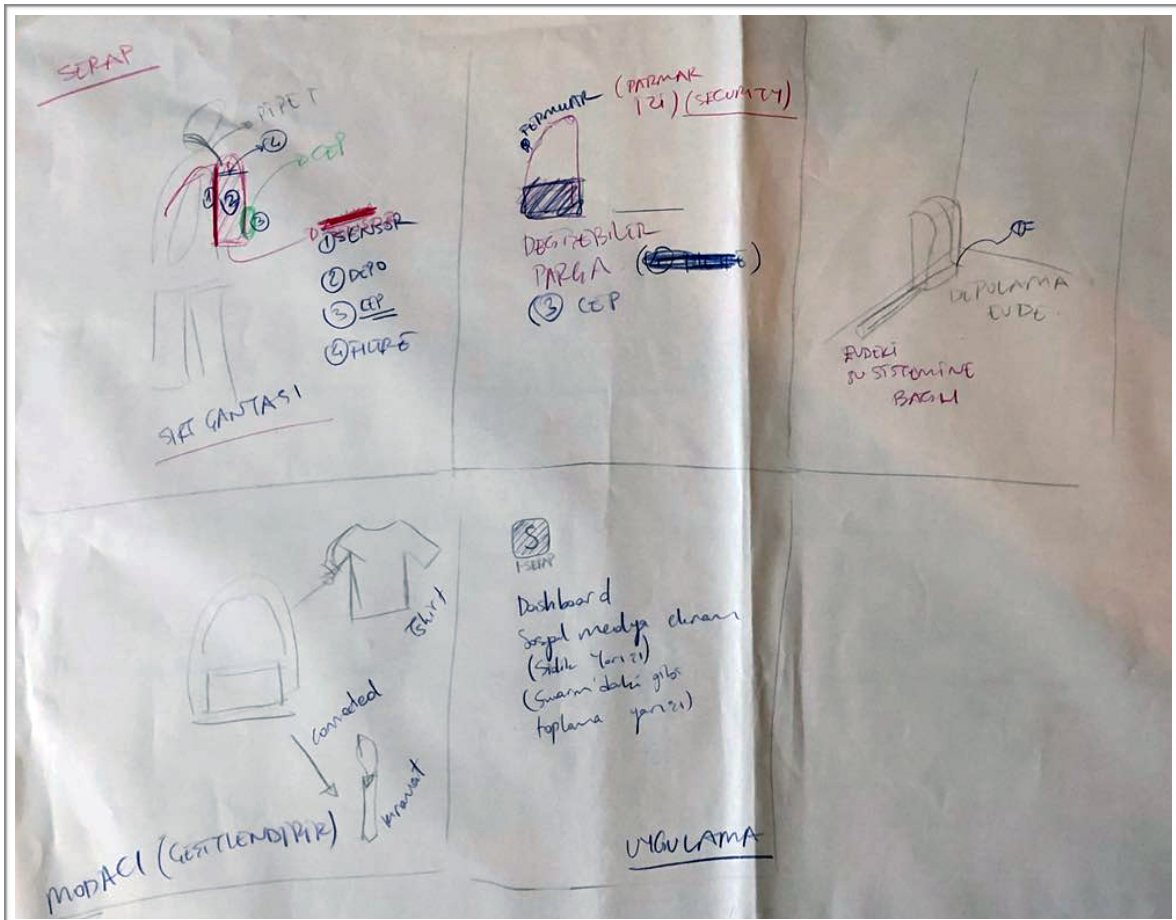


Figure 4.3 - Participatory Design Workshop Output of Technology Group II

engineer was worried about privacy since he considered himself as distant to sharing personal information. The user on the other hand had a different approach concerning the ways of interacting the water. After they shared their individual output, they start to work collectively for 2,5 hours. It was difficult for them to prioritize the product specifications because each insisted on their own concerns. User was highly enthusiastic about the technology while engineer was more skeptical about it. Therefore, they had conflicts. In the end user compromised in order to continue the process. The discussion was mainly about the technological details as the components of the system, hardware and software requirements. The user took big role in the finalization and presentation of the product.

It seems in participatory design, occupation and experience of the user influences the process. For example the user who is an academican in design lead the process and aided other participants when the process was interrupted.

Engineer began with determining the necessary components, because he said that a fashion designer should know what sort of non-technical components the garment should contain. The user began with determining the interaction scenario of an ordinary user with experience of drinking, consuming, using water. Software engineer focused on the collection and the interpretation of the data and the interaction of the user with the end product. After individual ideation session, their ideas clashed. They debated to convince each other. It took a while to reach a decision. At this point user took the responsibility and summarized the ideas of all participants. However, the clash of the ideas also positively influenced the discussion and they developed more ideas collectively. For example, they had more than one solutions and had chance to choose the most convenient one by discussing it. High number of ideas and solutions also provided opportunity to develop the most convenient solution thoroughly.

The discussion was mainly about the technological components, usability and functionality of product instead of the design and wearability of it.

Since no participants from fashion attended in this group, the experts determined the role of the fashion designer and textile engineer. They stated the form and the look of the garment should be decided by fashion experts as well as fabric. They also delegated the matters that they could not solve to them. For example, choosing the best fabric and where to put the technological equipment by not avoiding comfort of the wearer. They also added that since they determine the role of a fashion designer they were not sure if it was the job of a fashion designer or not. If there were a designer s/he could have said that it was not possible or it could have been done in a different way than they thought. They stated that fashion partners should have participated since the beginning otherwise they could offer limited solutions because the product has almost reached to its final version. If technology and fashion experts work together, than they can create solutions to one another's problems.

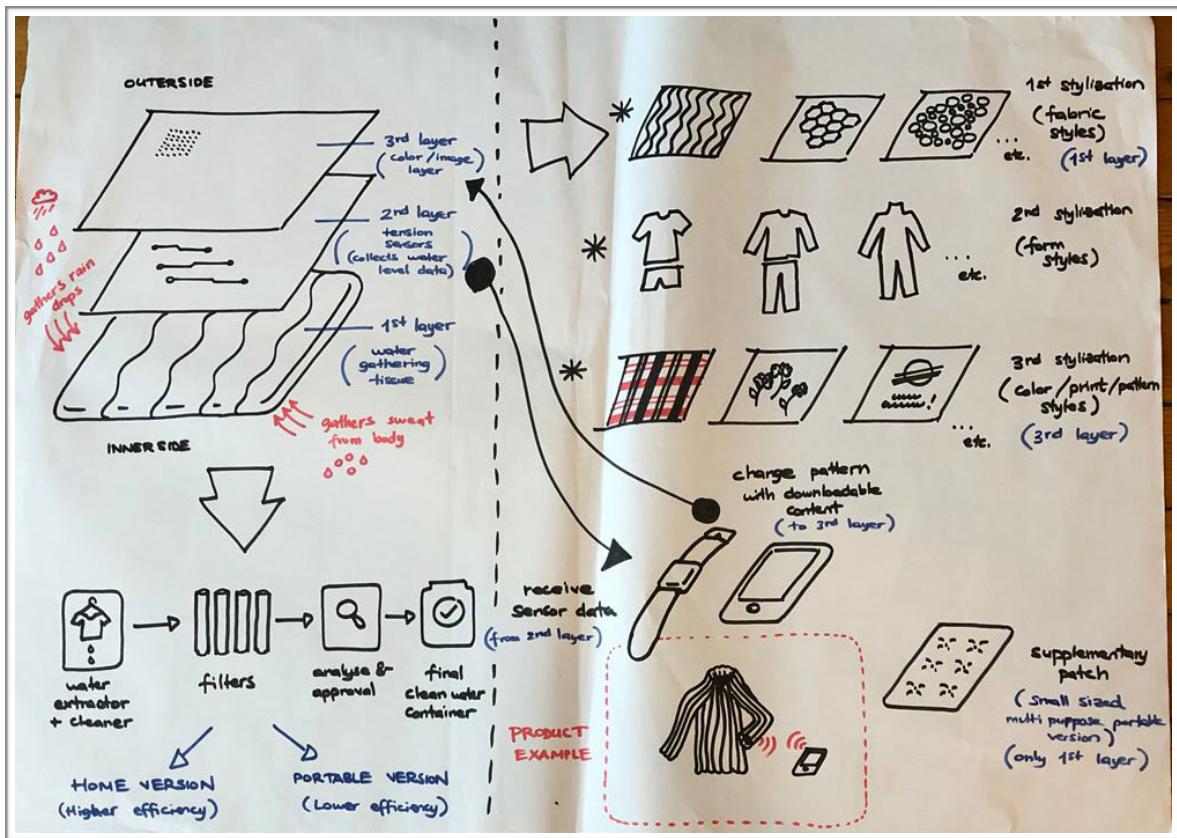


Figure. 4.4 - Participatory Design Workshop Output of Fashion and Technology Mixed Group

Participant Insights

They stated that what they designed is actually a system and "a fashion designer should shape and style it". After saying that they corrected themselves and stated that: "they gave fashion experts a job. if they had participated since the beginning of the process, they could have performed different roles than technology experts determined". This means that they were not sure about what to expect from fashion experts. They said "the expert group -either fashion or technology- who initiate the process is the leader of the process". So who starts first, leads the process.

They also highlighted the importance of domain specific participants role in such process. According to the design brief, they needed the domain knowledge of a physiologist and a nutritionist.

In the case of actual design of fashionable wearables; it was mentioned that experts should have personal interest and the professional experience about the problem domain. They also stated that while a project manager or a creative director is necessary for such an interdisciplinary group, diversified perspectives of different backgrounds can enrich the process. Therefore, it is important not to avoid different voices while trying to meet at a common language.

4.3.3- Fashion and Technology Mixed Group

Solution and Output

Their output was a three layered garment that can be designed as either jacket, pants, t-shirt, swimsuit or more (Figure 4.3). One layer contains sensors since they have to touch body of the user'. Second layer contains the other technological equipment as battery, processors etc. The third layer covers these two layers with the fabric. The first layer also contains the water that is collected from the body and the environment. However, they offered a bigger scale system in order to refine the collected water into consumable and drinkable water. They placed the water purification machine at user's home. So, the water is collected from the user's body such as urine, sweat, saliva and the environment such as rain, vapor, steam with the system which is worn by the user. However, the purification of the water is done in the larger refinement system at home. By this way, they reduce the weight of the machine that is carried on the body. Moreover, such an home system also offers a more sustainable and environment-friendly solution since the purification is not designed for every product but shared by the family members living together. The fashionable aspect of the output is provided via color, pattern and design options that is provided by connecting to a database in *Cloud*. The look of the design bases on a smart textile

technology. It can be updated and upgraded via a software depending on personal choices, climate, geographical conditions. For example, if the user travels to a new country and s/he does not know what to wear depending on weather and the local culture. The system offers options and share tips so the user can set the look of the garment whether it is short sleeve or long sleeve; dark colors or the colors etc. The size of the fabric can be expanded, since this is a fabric technology, this can be applied in all forms of fashion garment.

Process and Observations

This group consisted of fashion and technology professionals. One fashion designer, one textile engineer, one mechanical engineer, one software developer and two wearable technology users. During sharing the individual ideas, they all participated actively and fashion designer already had an idea of end product as a hand bag accessory. Engineer and developer had a problem-focused approach as how to solve refinement of the water and how to make it upgradable and up to date to fashion. Users did not limited themselves since this was an imaginary design process so they directed the group very creatively. Textile engineer and fashion designer contributed as partners. There was less conflicts in this group compared to technology group because every participant were highly respectful. Interdisciplinary environment increased the tolerance of the participants. Mechanical engineer was the most interdisciplinary participants, since he is also an interaction designer. Therefore, he lead the design process. He directed people in order to finalize their ideas and present the end product and its

capabilities. Fashion designer did not feel confident to draw the garment since it has technological components.

Personal communication capabilities of the participants influenced this group as well. For example a user participant who is an human resources director in a global company was good at managing the conversations.

Experts encouraged the users to imagine without any restrictions in order to expand existing capabilities of materials and technologies.

Fashion designer and textile engineers performed carefully with the capabilities of technologies. They firstly wanted to be sure whether their desire can be applicable or not. Fashion designer and textile engineer worked closer compared to other participants. They asked for each others confirmation before sharing their ideas to the group. A similar approval also appeared between computer engineer and mechanical engineer.

General attitude of the group was highly positive and constructive to the problem solution. They all were aware of that all participants had equal voice on the end-result. Therefore, they were respectful and positive on the decisions.

Participant begin with offering solutions with their own expertise, however, after collective working process started they also respond to solve other experts' problems. For example while textile engineer thought of offering fabric design alternatives for the garment, computer engineer offered solving the design alternatives with a database changing color and pattern via *Cloud* technologies.

Conflict arose when there was a mismatch between the priorities of the experts. Experts had diversified concerns and it was a challenge to prioritize these concerns. For example, fashion designer had aesthetic and wearability concerns in order to satisfy tastes of the wearer. She wanted to be sure of wearers comfort, while mechanical engineer had concerns about energy efficiency.

The human resources director user and the mechanical engineer lead the process to make sure that the details in the design brief are answered.

Participant Insights

Participants highlighted that they found an interdisciplinary design environment very fruitful, because it provided opportunity to expand their vision. They stated that at the first session of individual working, they mainly focused on the impossibilities of their ideas. However, during the collective work on product

development, experts from other disciplines offered solutions. So, it was efficient to discuss collectively. They mentioned they were glad to work collectively. They also stated that: *"While an expert is busy with a problem they think its the most important one. However, sharing these problems helps participants prioritize these problems and offer, collective solutions."* They mentioned the value of cross-cultural teams to resolve conflicts and open minds in such a process.

They added they did not think of coming to such a result while they were at the individual thinking stage. They also added the brief made them a little bit nervous at the beginning. However, collective experience opened their mind and they easily offered solutions to the problem. They were also satisfied with creating an idea and conceptually realizing it. They also shared their experience in their social media accounts.

However, participants mentioned that they were disappointed about their lack of knowledge in fashionable wearable projects. They said that although they have experience in either fashion or technology, they did not participated in design of a fashionable wearable product. So, this negatively influenced their contribution to the output.

For a real fashionable wearables design, they advised to consider that (1) recruitment of the participants, (2) their level of expertise in their own domain and specifically in fashionable wearables, and (3) a real project management and planning for the stages as ideation, production, distribution.

Comparison of Three Different Design Groups

The outputs of the design created by all the groups had too many common points such as considering it as system, excluding the purification system from the garment and making more than one garment form or textile instead of designing only one jacket.

On the other hand their approach to the user was different, as we also observed in the expert interviews fashion group was distant to the user compared to technology and mixed group. They interrupted user while she shared her ideas and mainly followed the fashion designer's opinions. This also supported the emphasis made in the interviews as fashion designers being the dominant partner of the group. However, dominance of the fashion designer was not that obvious in mixed group.

The fashion group was the one that had the most fashion-focused approach. They consider the wearability, aesthetic and censurability concerns the most compared to other groups. Fashion designer and textile engineer kept the wearability and comfort of the user during entire process. Washability and hygiene of the garments were also focused by engineer. She preferred fabric not requiring to be washed but can be sterilized.

5. DISCUSSION & CONCLUSION

This thesis aimed at identifying the specifications of a participatory design model that can be used by the diversified stakeholders participating in the design process of fashionable wearables. To fulfill this aim, it examined the following research questions:

Main Question: What are the specifications of a participatory design model tailored to fashionable wearables?

Sub Questions:

- What is the current status of fashionable wearables design?
 - What project experiences do fashion and technology professionals have?
 - What challenges do they face?
 - What kind of expectations do they have concerning the future of fashionable wearables?
 - What are the participatory design models and current product development models used in fashion and textile industries?
- How can participatory design help addressing the challenges that fashion and technology experts face?

5.1. What is the Current Status of Fashionable Wearables Design?

Overall, the literature review showed that fashionable wearables represent a growing field, which has gained popularity among researchers and practitioners. However, the expert interviews indicated that there is still more room for advancement. Experts believed that there are various challenges that hinder a successful collaboration between fashion and technology professionals, thus preventing wearable technologies from achieving their potential. To name a few of these challenges, the uniqueness of projects requires selecting the stakeholders based on the problem domain. Both expert interviews and participatory design workshops showed that fashion professionals appear to be distant towards user participation. Therefore, it will take time for them to change their approach. Another reason why collaborations are not easy is that there can be power conflicts in collaborative environments. For instance, interviews showed that everybody wants to lead the process. Participants might also have misconceptions of each other's profession. Finally, the role of the funding partner could also create power issues. They should not manipulate the process.

Observations based on the workshops and the evaluations of the participants also revealed that design of fashionable wearables requires the participation of multi-stakeholder experts, who are experienced and trained in the domain. Because communication problems might occur in the process, either a leading stakeholder from the group or an assigned person for this role should lead the process. On the other hand, domain specific knowledge is also emphasized to solve a domain specific design problem.

While the experts determine the current state and share the challenges they faced, they also stated their expectations of the design and end-product. They said that collaborations between fashion and technology can facilitate the widespread adoption of fashionable wearables. They agreed that fashionable wearables should revolutionize the fashion and technology industries and transform them into a more sustainable, ethical, environment-friendly state.

5.2. How can Participatory Design Help Addressing the Challenges that Fashion and Technology Experts Face?

Overall, participatory design can help designing fashionable wearables into two ways: (1) by providing methods to overcome challenges and (2) by discussing how adoption of a more critical approach can provide an ethical, sustainable and environment-friendly system.

Interviews and the evaluation of the workshops showed that in addition to the generic participatory design challenges, there are certain challenges that can appear specifically in design of fashionable wearables. Designing fashionable wearables with multiple stakeholders having different responsibilities in the process can raise power conflicts, create communication problems (difficulty in understanding each other and in sharing knowledge across stakeholders) and lead to project failure. As experts reported, these challenges mostly occur due to the lack of knowledge in the field of others' expertise, the lack of empathy between stakeholders, and team composition. Stakeholder meetings, co-design workshops, mutual learning (Robertsen et al. 2014) and up-skilling workshops (Whittle, 2014), which have been commonly used in participatory design practices, can be used to construct a clear communication between partners and to develop empathy. During the participants evaluation of the workshops, they emphasized the importance of being trained and experienced about the problem domain as explained in chapter 4. On the other hand, participants' personal skills such as team management, coordination can also be valuable for the success of process. Therefore, such research taking personal capabilities and talents can be valuable to consider in the recruitment of participants in addition to domain-specific experience.

Working together with other partners in interdisciplinary environments brings communication challenges such as difficulty in understanding a different terminology, difficulty in sharing knowledge and diversity in the imagination of the outcome. Thus, stakeholders should be trained due to overcome such communication barriers. Stakeholder meetings, participatory design workshops, training and up-skilling

workshops are some of the methods that can be used to construct a clear communication between partners and to develop empathy. For example, training can help fashion designers and technology developers, who represent the stakeholders coming from different fields, learn how others think and work as well as differences in their approach to fashionable wearables. Furthermore, users should also participate in these training workshops and meetings. This would allow stakeholders, who usually do not come together with the end-users during the process, empathize with the users as well as give power to them to influence the process from the beginning (Kensing, Greenbaum, 2012).

Stakeholders should also be trained briefly about the technology and capabilities of fashion, engineering, as well as material and products. Having a grasp of the context, material and methods can inspire the stakeholder, who can consequently come up with innovative ideas. In addition to the technology of the product, tools and techniques are important components of participatory design, as stated by Halskov (2014). Stakeholders should also be trained about the tools and technologies used during the design process (Kensing, Greenbaum, 2012). As experts also emphasized the lack of digital or analogue tools to aid communication and problem solving, project-specific or existing project management tools can be used. However, such tools and software should be explained to stakeholders during training sessions.

Trainings and workshops help participants to share the same goal and interest. Sharing similar expectations and objectives increases the productivity of projects. Having mutual objectives positively influences teamwork. By the aid of training and teamwork, stakeholders' interest can be aligned done and appropriate conditions for this alignment can be provided. Pre-training and pre-communicatory activities can avoid waste of time.

Following a participatory approach in the design of fashionable wearables can also spur bigger changes in the fashion industry. As Juhlin (2015) also highlights that while fashionizing technology experts, we should also digitize fashion experts. This argument indicates the democratic participation of all convenient stakeholders and the importance of mutual learning (Bratteteig et al. 2012), which are also among the principles of participatory design. Following a participatory design approach can create new venues to deal with social, environmental and political problems. Fashion is a cultural phenomenon that contain political, social, ethical and environmental agendas as Crane's (2000) examples also indicate. Participatory design can provide opportunities to perform this role of fashion and to address environmental, social and political issues; for example, a dress that can provide drinkable water through recycling bodily liquids as participants of the workshop also explored. Such a fashionable wearable can aid climate change while it can perform cultural, geographical, and self-reflective roles of fashion goods. A jewelry, which is also fashionable, and sustainable can enhance the experience of deaf women by translating sounds into vibration, light patterns and shape change (Wilde and Marti, 2018). A glove can decrease the physical effort of factory workers that they are responsible to perform as one of the experts' startup company already researches about (Thread in Motion, 2017). So, it can provide ethical

working conditions for stressful environments. Secondly, participatory design can change design of fashionable wearables into a more interdisciplinary environment. If the stakeholders such as designers, users, providers, workers, NGO's, state authorities work together; all the participants can communicate about the problems from different perspectives. For example, applying participatory design methods in design of fashionable wearables can combine creativity of fashion and functionality of technology (Smith, 2007) with a more systematic and interdisciplinary approach (Lee et al., 2016), (Mihaleva and Koh, 2016). Third, the role that user plays in the fashion can evolve to a more user centered way. User involvement in the design process can also facilitate the wide adoption of fashionable wearables through increasing user satisfaction (Lee et al., 2016).

As a result, a fruitful design that is provided by participatory methods, and that facilitates development of fashionable wearables and user adoption of fashionable wearables, can alter production and consumption dynamics of fashion and technology products.

5.3. What are Specifications of a Participatory Design Model Tailored to Fashionable Wearables?

Design of fashionable wearables differs from any other interdisciplinary design, because fashion and technology experts have distinct approaches, when it comes to fashionable wearables. Technology experts consider it as an IT product, while fashion experts consider it as a garment or accessory. This difference also causes conflicts in design. Therefore, a participatory design approach used for fashionable wearables should be tailored to this domain. As an answer to the main research question, we determine the specifications of a participatory design model tailored specifically to fashionable wearables based on the participatory design methods and product development models documented in Chapter 2. Four elements (result, considerations, actors, applications) are to be taken into consideration while planning participatory design, they constitute the first level of this model (Figure 5.1). The first element **result** is centered in the model. The result can be either a fashionable wearable as a concrete output or the discourse that can be constructed by the diffusion of fashionable wearables. For example, providing of a more sustainable, and ethical fashion and technology system can be the result of the design.

Consideration is the second layer of the model. It determines the approach that should be followed in design. Design teams can follow a fashion-driven, technology-driven, user driven or a community-driven approach. Knowledge, objectives and values are considered depending on the design approach. Fashion and technology driven approaches emphasized by the experts as matching with the existing commercial projects, make a valuable remark for the model. For instance, the collaboration between Apple and Hermes (Apple, 2015) is an example to the technology-driven approach, while Butterfly Dress (EzraTuba, 2016) smartwatches exemplify the fashion-driven approach.

Both fashion-driven and technology-driven approaches have strengths and weaknesses as experts emphasized in the interviews (i.e. in the context of fashion-driven approach invention of new technologies might take long time). They can be preferred depending on the project goal and available resources. Technology-driven approach is usually chosen for short-term goals by using existing technologies and it is performed within small-scale groups. Technology professionals such as engineers, software and hardware developers, and fashion designers are the main stakeholders, which participated in each stage. Researchers, users and project specific experts are consultant stakeholders, which participate in specific stages of the process. Fashion-driven approach is preferred for large-scale scenarios for the invention of new technologies, or repurposing the existing technologies aiming a long-term outcome (since the technological inventions might take time). Fashion designers, engineers and developers participate as the main stakeholders, and users and project specific experts join as consultant stakeholders.

Having only fashion and technology driven approaches falls short for the potential of fashionable wearables if we involve sustainable, ethical and political discussions into considerations. As proposed in the model, we argue that users and communities should be taken into account as the drivers of collaboration. User driven approach is essential because of high abandonment rates of current wearable technologies and fashionable wearable examples that arise from neglecting the priorities and desires of the user. This was also prominent in the interview results. Although experts mentioned the importance of user involvement in design process, their concerns were mainly related to evaluation of aesthetics and function, ignoring users' other concerns such as privacy (Ledger, 2014). This attitude reflects the fashion companies' tendency to introduce a brand-new product to the market and expecting users to adopt it without hesitation. However, the fashion history provides examples on how users altered the meaning of clothes and dressing. As also mentioned in the literature review, the feminist movement adopted wearing trousers to represent the gender equality via clothes, and the punk subculture used unmatched and ragged clothes as a criticism against the mainstream music, fashion and consumerism (Crane,2001). These examples show that fashionable goods can be re-purposed and re-appropriated by the wearer for political and social purposes. We believe that this legacy requires fashion education to adopt a more user-centered approach to fashionable wearables so that the users can invent new usage areas and purposes for them. Workshop also exhibited that when the user is allowed to participate creatively in the process they can stimulate the creative thinking process of the other stakeholders as designers too. As Halskov (2014) also states, all people are creative.

Community driven approach is also essential because NGOs, government offices, local communities play an important role in the diffusion and actualization of social and political matters that fashion can address. For example, a militaristic and masculine female silhouette was drawn and used as a propaganda to motivate women to work in the unoccupied work positions left by the men during the WWII. However, fashion is presently perceived as the second environmentally dangerous industry in the

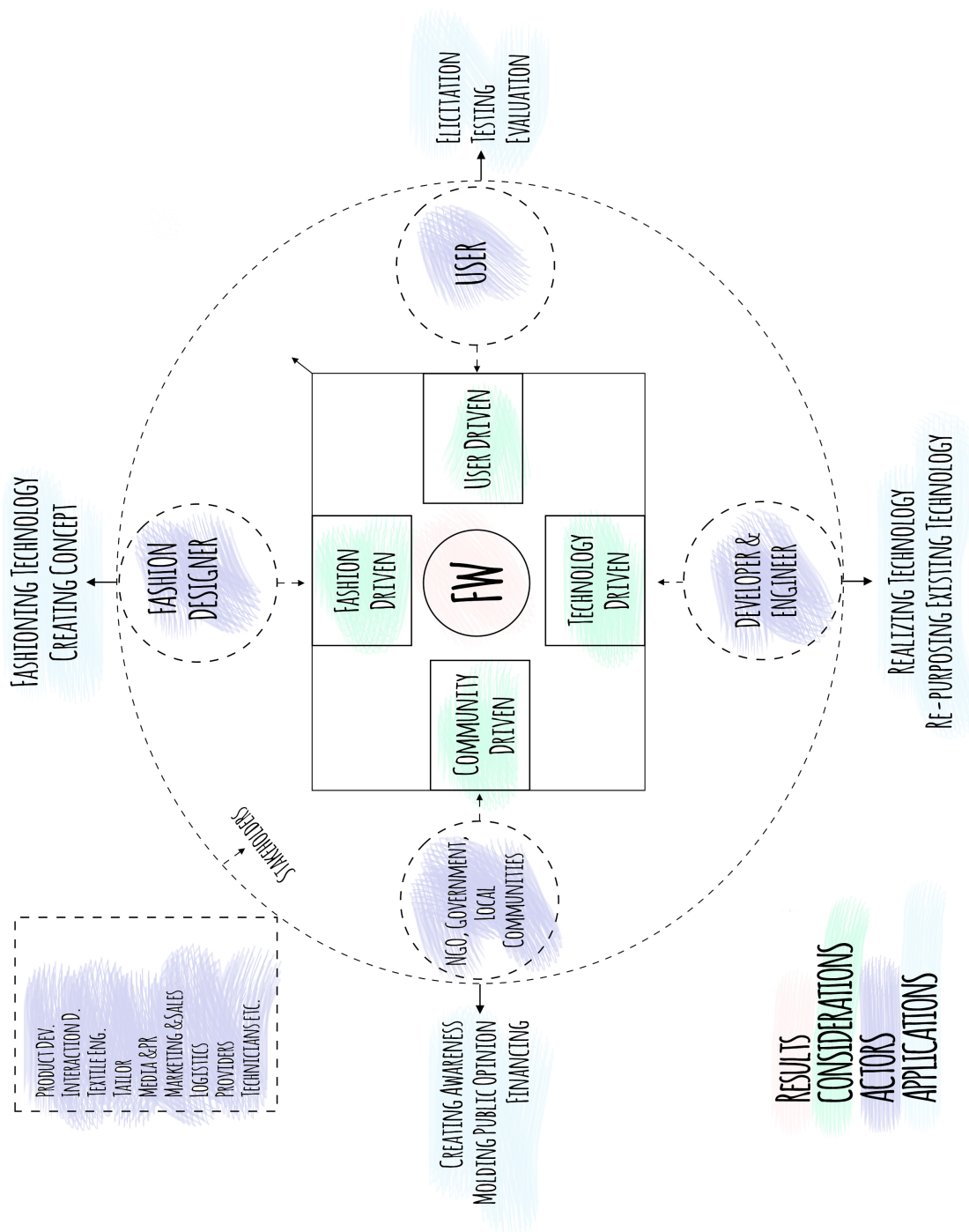


Figure 5.1 - Participatory Design Model for Fashionable Wearables Level I

world as also mentioned in the first chapter. Fashion brands are accused of polluting clean water, consuming resources and causing toxicity in the environment. As participants highlighted in the interview sessions, fashion brands are forced to change their production dynamics to produce environmentally conscious products. Depletion of resources, water supply, climate change and oppressive working conditions are the issues that fashionable wearables can offer solutions (e.g. clothes protecting against extreme cold or warm weather, clothes refining bodily liquid to drinkable water). Thus, the participation of NGOs, activists, academicians, associations, politicians, global conferences and international platforms are essential to bring these environmental, social and political discussions into the fashion agenda so that the problems and requirements can be well-defined, discussed and diffused. By this way

fashionable wearables can change the world we live in not only aesthetically and functionally but also socially, politically and environmentally.

The third element of the model describes **actors**. The actors are the stakeholders participating in the process. The primary stakeholders are fashion designers, users, technology developers, engineers, NGOs, government offices and local communities. The fourth element emphasizes the **applications** referring to the roles the stakeholders perform in the process. These stakeholders have various roles in the process. Fashion designers are mainly responsible for the envision of a new concept that triggers the invention of new technologies or fashioning an existing concept that can be realized with current technologies. Engineers and developers are mainly responsible for inventing new technologies or re-purposing existing technologies. Users participate in the process to elicit the problem and needs, to evaluate the interaction and to test the design output. Community members take role in creating awareness, pointing out the problems and issues of focus as well as moulding public opinion. Besides these primary stakeholders, there are other stakeholders that can participate in the process depending on the features of the end-product and the problem domain. These are interaction designers, textile engineers, tailors, media, public relations, marketing, sales, logistics, material providers, and technicians.

The second level of the model represents the stages that can be followed in design of fashionable wearables. Although this research mainly focuses on the design stage, the findings motivated us to highlight all the stages from the beginning to the end. This model can be integrated with many of the generic product development processes. There are several process models determining the stages of fashion and the creation process of fashion products, e.g. Davis (1992) and Kawamura (2018) or fashion and textile product development models proposed by To and Harwood's (2000). Following these models, we proposed that a design process of fashionable wearables consists of nine stages: Initiation > Determining the Design Approach > Team Building > Training > Design > Production > Diffusion > Consumption > Sustaining (Figure 5.2). Being tailored specifically for fashionable wearables, this process model differs from existing ones as it emphasizes the significance of team building and training stages for the success of any fashionable wearable project.

When it comes to the stages in the model, *initiation* is the inception of the whole process when the first spark and gathering appear. *Determining the design approach* is the step whether the process is fashion, technology, user, or community driven. The approach is implicitly determined according to the project goal and the end-product. *Team building* is the recruitment of stakeholders. Expert interviews revealed that it may be necessary to come back to team building stage in some situations and invite new participants to the process if necessary, e.g. when a product concept requires development of a new material. *Training* is the stage, where all the stakeholders are trained about the technologies, tools, communication skills and each other's perspectives. This stage is particularly important for a successful collaboration as it would overcome the challenges stemming from the differences in stakeholders' level

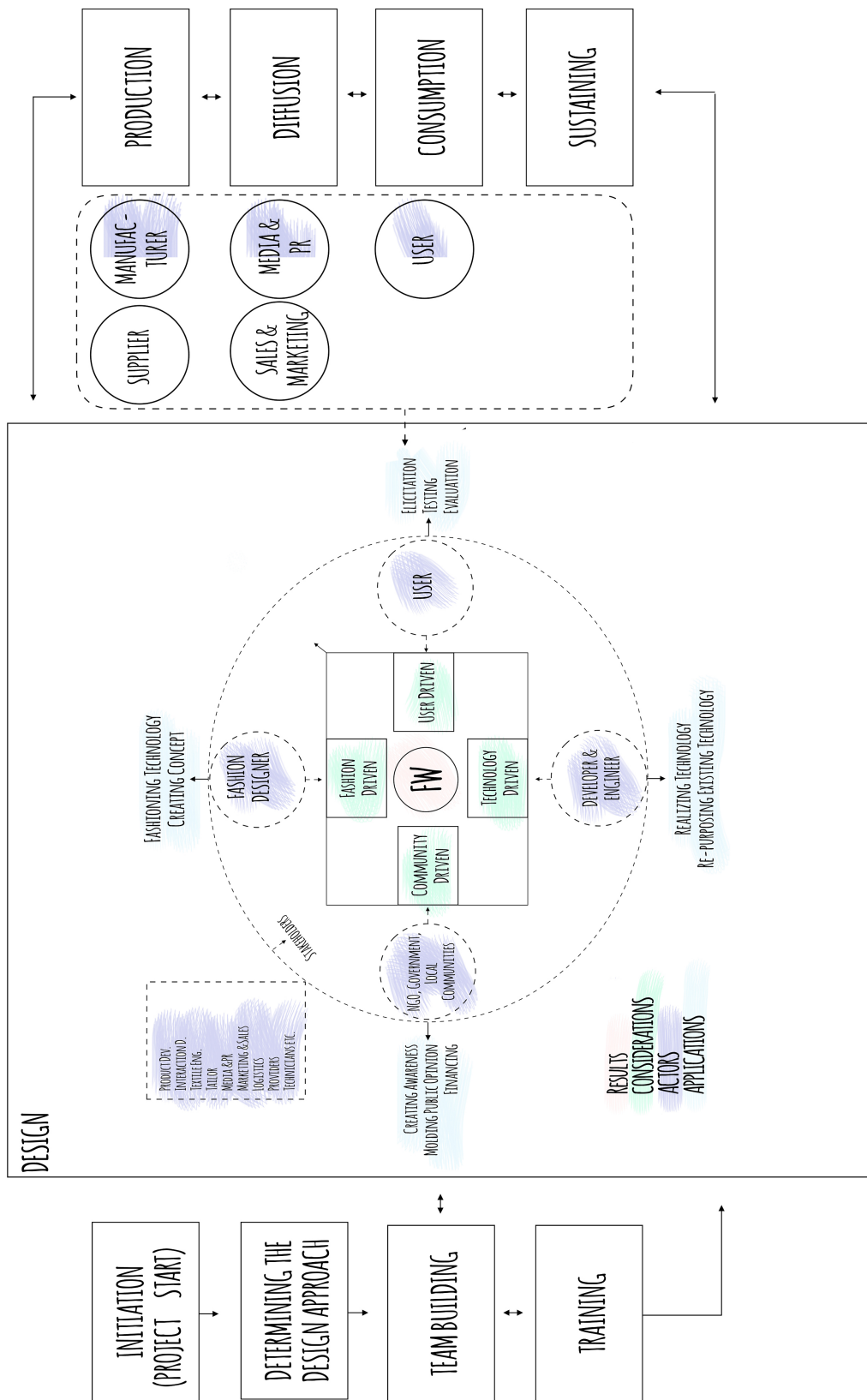


Figure 5.2 - Participatory Design Model for Fashionable Wearables Level II

of experience and their approach to design. Initiation, determining the design approach, team building and the training stages can be considered as the most valuable specifications that this model offers. Because, as Bratteteig et al.(2012) also emphasize that having a say, mutual learning, co-realisation are the core issues of participatory design. Expert interviews and workshops also emphasized these issues. These stages can aid stakeholders to build a fruitful communication, which leads to an easy-to-manage team environment.

Design includes ideation, prototyping, testing and revising the product. *Production* is the stage that the end-product is manufactured in factories, production houses, ateliers and etc. *Diffusion* is introducing and communicating the concept of the end-product, its features and culture by media, public relations executives, marketing and sales specialist. *Consumption* is stage, when the user utilizes the product. *Sustaining* is maintaining the fashionable wearable product, upgrading and keeping it up to date with contemporary fashion and technology trends, as well as having it cater to emerging needs and desires of the users. This stage also refers to the prospect concerning revolutionary role of wearable technologies as a solution to over-consumption and over-production. In other words, sustaining is the stage for not only the product but also for fashion and technology industries to be sustainable.

We argue that this model not only identifies the specifications of an ideal design tailored for designing fashionable wearables with participatory design methodology, but also serves as a guide that helps overcome the potential challenges the stakeholders can face during the process. Since the product development process of different projects might differ, the model depicts an iterative and adaptive process depending on the roles of stakeholders. It does not proceed linearly but moves cyclically. For example, production, diffusion, consumption and sustaining stages can give feedback to next and previous stages as well as to the design stage, and thus influence the whole process. We believe that these specifications along with the design process steps discussed above will serve as a valuable information source for researchers and practitioners that intend to participate in fashionable wearable projects in the future.

5.4 Limitations

Reaching experts for interview and convincing them to meet face-to-face or do meetings online were difficult to manage due to their busy work schedule. Gathering all the experts for workshop sessions was also challenging, There were too many experts that cancelled their attendance during the last minute. These scheduling and practical management issues should be important to take into consideration while planning a bigger-size project. Since most of the current fashionable wearable projects can be considered as revolutionary, data privacy avoided some of the experts to share detailed information in

the interviews. Finally, since almost half of the experts are from Turkey, it is difficult to generalize the results to a global scale.

5.5. Future Work

As a next step to this study, we aim to apply this model in a multi-national group consisted of fashion and technology experts; designers, engineers, developers, editors, NGO's, state authorities, academicians and most importantly the users. We plan to gather these participants to design an ethical, sustainable and environment-friendly fashionable wearables, which have a potential to alter the current dynamics in fashion and technology industries, which could eventually be leaded into a better condition.

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7. GLOSSARY

Fashionable Wearables: Designed garments, accessories, or jewelry that combine aesthetics and style with functional technology.

Wearable Technologies: Technological devices worn on the body.

Fashion System: Considering fashion as a system which is consisted of several institutions such as designers, editors, engineers, providers, academicians, and more.

Participatory Design: A design approach for technological and organization systems, aiming to involve active and equal participation of all the stakeholder who is directly or indirectly influence by the end-product.

Expert: A knowledgeable and experienced person in the domain field.

Model: An exemplar guide or procedure created to be followed for the application of a process.

Approach: A way or mode of dealing with a problem.

User: A person who uses the end-product of a design process.

Wearer: A person who wears the end-product of a fashion design or fashionable design process.

8. APPENDICES

ORIGINAL VERSION OF DESIGN BRIEF

i. ORTAM

Moda, tekstil ve teknoloji firmalarının (ve tabii diğer endüstrilerin) çevreye verdiği zarardan dolayı temiz su rezervlerimizin tükenmesiyle karşı karşıya kaldığımız ve su sıkıntısının ciddi boyutlar aldığı bir zamandayız. Çılgın bir devlet adamı, bir futurist veya bir patron içinde moda tasarımcıları, tekstil mühendisleri, yazılım ve donanım geliştiren uzmanların ve en önemlisi de kullanıcıların olduğu bir ekibi bir araya getirerek bir çözüm üzerinde çalışmamızı istiyor.

ii. AMAÇ

Giyen kullanıcının sıvı ihtiyacını karşılamak için vücut veya ortam sıvılarını içme suyuna dönüştürerek günlük su ihtiyacını kendi vücudu üzerinden karşılamasını sağlayan bir giysi tasarlamak.

iii. ÜRÜN ÖZELLİKLERİ

- Sürdürülebilir (Sustainable): Uzun yıllar boyunca (15-20 yıldan fazla) kullanılacak, doğal kaynakların tüketimine gerek duymadan yenilenebilir, yükseltilebilir (upgradable) ve güncellenebilir olan
- Ayarlanabilir (Adjustable): Farklı form ve ölçülere göre ayarlanma özelliğine sahip
- Uyum sağlayabilen (Adaptable): Farklı coğrafi, iklimsel ve kültürel koşullara ve ortamlara uyum sağlayabilen
- Modaya Uygun (Fashionable): Zamanın ruhuna, trendlere ve modanın kodlarına göre değişebilen, çeşitlenen ve uyum gösterebilen.

iv. KISITLAMALAR

Işınlanma, görünmezlik gibi mevcut olmayan veya gerçekleşmesi pek mümkün olmayan ihtimallere ve teknolojilere yönelmemeniz gerek.

v. HEDEF KİTLE

Kadın, Erkek, Çocuk, Unisex veya Ageless olabilir.

Bunun sınırlarını siz çizebilirsiniz. Nihayetinde herkes tarafından kullanılabilir bir ürün olacağı için herhangi bir gruptan başlanabilir veya herkese uygun düşünülebilir.

vi. BÜTÇE

Herhangi bir bütçe sınırlaması yok.

vii. ZAMAN PLANLAMASI

Ürün fikri geliştirmek için 1,5 saatimiz var.

Geliştirdiğiniz fikrin gerçeğe dönüşmesi ihtimali için gerçekçi bir zaman planlaması çıkarmanız gerek.

viii. ÇIKTI

- Kim için? (ürünü hangi kullanıcı grubu için tasarladınız?)
- Nasıl kullanılıyor? (ürünün nasıl kullanıldığının bir senaryo içinde anlatılması)
- Ne gerekiyor ve Nasıl çalışıyor? (Gerekli malzemeler, teknolojiler, donanım, yazılım vs)
- Nasıl üretiliyor? (basitçe tasarım ve üretim süreci)

TURKISH VERSION OF INTERVIEW QUESTIONS ASKED TO FASHION EXPERTS

i. Moda Sektörü ve İş Birlikleri Hakkında

Mesleğinizi (moda tasarımı/editör) moda endüstri içinde nasıl konumluyorsunuz?

Ekibinizde başka hangi uzmanlar ile çalışıyorsunuz?

Ortak çalışma sürecinizde hangi aşamalarda yer alırsınız? (Prototip, Nihai Ürün, Ideation...)

İşinizin doğası gereği başka tasarımcılar, medya çalışanları, mühendis, artist gibi kişilerle çalışmanız gereken durumlar oluyordur. Bu tarz iş birliği süreçleri nasıl ilerliyor? Nasıl bir araya geliyorsunuz? Yaptığınız projelerden örneklerle anlatabilirsiniz.

Daha önce ortak proje geliştirme sürecine girdiğiniz ve sonucu olumlu bitmeyen iş birliği oldu mu?

İsim vermeseniz de bu deneyimi anlatabilir misiniz?

ii. İş Birliği Deneyimleri Hakkında

Hiç bir teknoloji markası ile birlikte çalıştınız mı?

Varsa o birlikteliklerin süreçlerini anlatabilir misiniz?

O projelerde hangi birimler ile hangi pozisyondan kişilerde hangi proje rolleriyle ilerlediniz?

Moda sektörü dışından kişilerle çalışırken en çok karşılaştığınız zorluklar neler oluyor?

Yaşanan bu zorlukları aşmak için nasıl bir tutum izlemek gerekiyor?

Zorlukları aşma ve sorun çözme sorumluluğunu sizin almanız gerektiği durumlar oluyor mu?

Projedeki partnerlerin (PM, FD, PD) rolleri bu zorlukları çözüme ulaştırmak için nasıl olmalı?

iii. Giyilebilir Teknolojiler Hakkında

Aklınıza ilk gelen giyilebilir teknoloji ürünleri nelerdir?

Giyilebilir teknolojiler için bir tanım yapmanızı istesem, nasıl tanımlarsınız?

Giyilebilir teknolojiler her ne kadar yeni bir gündem konusu olmasa da geçmişe göre son yıllarda yükselişe geçmiş durumda. Sizin bir giyilebilir üründen beklentiniz nedir? (Teknoloji, estetik, fonksiyonellik)

Giyilebilir teknolojilere dair nasıl bir gelecek görüyorsunuz?

Hiç bir giyilebilir teknolojinin tasarım sürecine dahil olduğunuz mu?

Bir giyilebilir teknoloji ürününün moda olabilmesi için hangi özellikleri taşıması gerekir?

iv. Modaya Uygun Giyilebilir Teknolojiler için Ortak Çalışma Ortamı Hakkında

Moda ve teknoloji sektöründen profesyonellerin bir araya gelip modaya uygun giyilebilir teknoloji ürünleri tasarlayabilmeleri için uygun çalışma ortamı neleri gerektiriyor? (Önceki deneyimlerinizde faydalı bulduğunuz veya problemlili olduğunu düşündüğünüz detayları paylaşabilirsiniz.)

Farklı endüstrilerden bir araya gelecek partnerlerin bir arada verimli çalışabilmesi için en uygun ortam nasıl sağlanmalı?

Bu partnerler kimler olmalı?
Ne sıklıkla bir araya gelinmeli?
Hangi platformlarda bir araya gelinmeli?
Giyilebilir teknolojiler dışında daha önce moda ve teknoloji sektörünün bir arada çalışmasını gerektiren başka ürün, sektör, proje oldu mu?
Fashionable wearables olarak adlandırdığımız modaaya uygun / moda olan, estetik değeri yüksek giyilebilirler teknoloji ürünleri tasarlayabilmek için neye ihtiyacımız var sizce?
Bu tasarımların daha fazla kullanıcıya ulaşabilmesi için ürün özellikleri ne olmalı?
Siz modaaya uygun giyilebilir ürünlerin tasarlanması konusunda ne rol oynamayı tercih ederdiniz?

TURKISH VERSION OF INTERVIEW QUESTIONS ASKED TO TECHNOLOGY EXPERTS

i. Teknoloji Sektörü ve İş Birlikleri Hakkında

Mesleğinizi (mühendis/yazılım) teknoloji endüstri içinde nasıl konumluyorsunuz?

Ekibinizde başka hangi uzmanlar ile çalışıyorsunuz?

Ortak çalışma sürecinizde hangi aşamalarda yer alırsınız? (Prototip, Nihai Ürün, Ideation...)

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Daha önce ortak proje geliştirme sürecine girdiğiniz ve sonucu olumlu bitmeyen iş birliği oldu mu?

İsim vermeseniz de bu deneyimi anlatabilir misiniz?

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Kendi sektörünüz dışından kişilerle çalışırken en çok karşılaştığınız zorluklar neler oluyor?

Yaşanan bu zorlukları aşmak için nasıl bir tutum izlemek gerekiyor?

Zorlukları aşma ve sorun çözme sorumluluğunu sizin almanız gerektiği durumlar oluyor mu?

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Bu tasarımların daha fazla kullanıcıya ulaşabilmesi için ürün özellikleri ne olmalı?
Siz modaaya uygun giyilebilir ürünlerin tasarlanması konusunda ne rol oynamayı tercih ederdiniz?

APPROVAL FORM GIVEN TO FASHION EXPERTS

AYDINLATILMIŞ ONAM FORMU

Koç Üniversitesi öğretim üyesi Yrd. Doç. Aykut Coşkun ve Tasarım, Teknoloji, Toplum Bölümü yüksek lisans öğrencisi Gül Kaner tarafından yürütülen moda uygun giyilebilir teknolojiler konusunda yürütülen araştırmaya katılımınız rica olunmaktadır. Bu çalışmada katılımınız tamamen gönüllülük esasına dayanır. Lütfen aşağıdaki bilgileri okuyunuz ve katılmaya karar vermeden önce anlamadığınız herhangi bir şey varsa çekinmeden sorunuz.

ÇALIŞMANIN ADI: Modaya Uygun Giyilebilir Teknolojiler

ÇALIŞMANIN AMACI

Bu çalışmanın amacı, moda uygun giyilebilir teknolojiler hakkında moda sektöründen uzmanların görüşlerini araştırmaktır.

PROSEDÜRLER

Bu çalışmaya gönüllü katılmak istemeniz halinde; öncelikle size uygun bir görüşme zamanı belirlenecek, daha sonra belirlenen bu zamanda Koç Üniversitesi-Arçelik Yaratıcı Endüstriler Araştırma Merkezi'nde veya size uygun bir yerde bire-bir görüşmeler yapılacaktır. Bu görüşmelerde sizlere, teknoloji sektörü ve giyilebilir teknolojilere yönelik sorular yöneltilmektedir.

OLASI RİSKLER VE RAHATSIZLIKLAR

Bu çalışma normal yaşam deneyimlerini bozmayı veya manipüle etmeyi önermemekte ve herhangi bir yanıtıma içermemektedir. Bu çalışmaya katılmanız sizin için gündelik hayatta karşılaşılabileceklerinizden daha fazla bir risk taşımamaktadır.

TOPLUMA VE/VEYA DENEKLERE OLASI FAYDALARI

Bu çalışmanın amacı, giyilebilir teknolojilerin katılım sürecine dahil olan uzmanlar için en uygun çalışma yönteminin tanımlanmasıdır.

GİZLİLİK

Bu çalışmayla bağlantılı olarak elde edilen ve sizinle özdeşleşmiş her bilgi gizli kalacak, 3. kişilerle paylaşılmayacak ve yalnızca sizin izniniz ile ifşa edilecektir. Gizlilik tanımlanmış bir kodlama prosedürüyle sağlanacak ve kod çözümüne erişim yalnızca çalışmanın sorumlusu araştırmacıyla sınırlı kalacaktır. Tüm veriler, sınırlı erişime sahip güvenli ve şifreli bir veri tabanında tutulacaktır.

KATILIM VE AYRILMA

Bu çalışmanın içinde olmak isteyip istemediğinize tamamı ile bağımsız ve etki altında kalmadan karar verebilirsiniz. Bu çalışmaya gönüllü olarak katılmaya karar vermeniz halinde dahi, sahip olduğunuz herhangi bir hakkı kaybetmeden veya herhangi bir cezaya maruz kalmadan istediğiniz zaman çekilebilirsiniz. Çalışmadan çekilmek isterseniz bir cezası yoktur ve sahip olduğunuz faydaları kaybetmezsiniz.

ARAŐTIRMACILARIN KİMLİĐİ

Bu araŐtırma ile ilgili herhangi bir sorunuz veya endiŐeniz varsa, lütfen iletiŐime geçiniz:

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Yukarıda açıklanan prosedürleri anladım. Sorularım tatmin olacađım şekilde yanıtlandı ve dilediđim zaman ayrılma hakkım saklı kalmak koŐulu ile bu çalıŐmaya katılmayı onaylıyorum. Bu formun bir kopyası da bana verildi.

Katılımcı Adı-Soyadı

Katılımcı İmzası

Tarih

AraŐtırmacının İmzası

Tarih

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ÇALIŞMANIN ADI: Modaya Uygun Giyilebilir Teknolojiler

ÇALIŞMANIN AMACI

Bu çalışmanın amacı, moda için uygun giyilebilir teknolojiler hakkında teknoloji sektöründen uzmanların görüşlerini araştırmaktır.

PROSEDÜRLER

Bu çalışmaya gönüllü katılmak istemeniz halinde; öncelikle size uygun bir görüşme zamanı belirlenecek, daha sonra belirlenen bu zamanda Koç Üniversitesi-Arçelik Yaratıcı Endüstriler Araştırma Merkezi'nde veya size uygun bir yerde bire-bir görüşmeler yapılacaktır. Bu görüşmelerde sizlere, teknoloji sektörü ve giyilebilir teknolojilere yönelik sorular yöneltilmektedir.

OLASI RİSKLER VE RAHATSIZLIKLAR

Bu çalışma normal yaşam deneyimlerini bozmayı veya manipüle etmeyi önermemekte ve herhangi bir yanıtı içermemektedir. Bu çalışmaya katılmanız sizin için gündelik hayatta karşılaşılabileceklerinizden daha fazla bir risk taşımamaktadır.

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Bu çalışmanın amacı, giyilebilir teknolojilerin katılım sürecine dahil olan uzmanlar için en uygun çalışma yönteminin tanımlanmasıdır.

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Katılımcı Adı-Soyadı

Katılımcı İmzası

Tarih

AraŐtırmacının İmzası

Tarih

COLLABORATIVE DESIGN FOR FASHIONABLE WEARABLES: A FASHION SYSTEM PERSPECTIVE

NEGOTIATIONS, CONTROVERSIES

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ABSTRACT

Wearable technologies are used by only a small part of the consumer market, and their abandonment rates are still high. Aesthetic value and style are essential for making these devices fashionable, thus facilitating their widespread use. Designing fashionable wearables requires a collaboration between professionals working in technology and fashion fields. Although many studies in the literature indicate a need for collaboration, none explored the attitudes of professionals from these fields towards collaborating with each other. Addressing this gap, we conducted in-depth interviews with 4 fashion designers, 1 fashion editor, 3 product developers and 1 public relations manager working in fashion industry. Based on the insights derived from these fashion professionals, we presented stakeholders that should be actively involved in the collaboration, the characteristics of collaboration environment, barriers for a successful collaboration, and two product development process models driven by either fashion and technology.

INTRODUCTION

Studies showed that although wearable technologies are quite popular, they do not meet user expectations. Their abandonment rates are high (Ledger & McCaffrey 2014), their technological capabilities are not comprehended well enough, as well as they are not easy to use and attractive to wear (Motti & Caine 2014). Recently, these problems have led to the emergence of

fashionable wearables, which refers to designed garments, accessories, or jewellery that combine aesthetics and style with functional technology (Seymour 2008). Although there are a few examples from academia (Elblaus et al 2015; Juhlin & Zhang 2015; Lee, Koo & Zhou 2016) and industry (Apple Smart Watch, Project Jacquard), the work on fashionable wearables is still in its infancy, indicating an area for its advancement.

Designing fashionable wearables requires a collaboration between technology professionals (e.g. engineers) and fashion professionals (e.g. fashion designers). A systematic method for realizing this collaboration would increase the number of examples, and serve as a facilitator for the widespread use of wearable technologies. However, developing a systematic collaboration method is difficult, because technology professionals and fashion professionals have different approaches towards wearable technologies.

We believe that a first step for such a method is to understand how professionals from these fields think about collaborating with each other, and what they expect from such a collaboration. This understanding can be acquired by exploring questions like, for both parties, who should participate in the collaboration (i.e. stakeholders), who should lead the process (i.e. drivers), how should it proceed (i.e. process), what kind of environment is needed (i.e. environment), and what kind of challenges would emerge (i.e. barriers).

In this paper, we explored these questions from the perspectives of three major stakeholders of the fashion system: fashion designers, product developers in fashion brands, and fashion media and communication specialists. We wanted to focus on fashion as a system because it is not all about fashion designers. It is a bigger system constituted of various institutions (Kawamura 2004) whose involvement is essential for designing fashionable wearables. To the best of our

knowledge, no study has provided a similar exploration before.

DESIGNING FASHIONABLE WEARABLES

Lee, Koo and Zhou (2016) emphasize the rising consumer demand for wearable technology that looks less like a gadget and more like an aesthetically pleasing accessory, and add that wearable technology and fashion companies have started designing smart clothing to meet this new demand. For example, *Apple Watch Hermes* (Business Insider 2016), *Project Jacquard* (Google ATAP 2016), represent a new line of wearables combining aesthetics and style with functional technology, which require a collaborative design process bringing technology and fashion together (McCann, Hurford & Martin 2005; Mihaleva & Koh 2016). Aside from industry, there are also initiatives and professionals working together to materialize fashionable and technological products in an interdisciplinary and collaborative environment, e.g. *Berlin Graffiti* and *The Marlene Project* (ElektroCouture 2017).

As for the research studies emphasizing the significance of fashionable wearables, one part explores the process of designing these wearables. Researchers argue that, when designing fashionable wearables, fashion designers should be involved in various product development stages including ideation, design, production, diffusion and consumption (Choi & Kim 2016; Mihaleva & Koh 2016; McCann, Hurford & Martin 2005). In this view, the purpose is to help product designers and engineers using the input from fashion designers during the design process.

However, Juhlin and Zhang (2015) argue that making product designers more knowledgeable about fashion is not enough. Fashion designers should also be *digitized* by learning the nature of digital technologies. Fashion designers know how to make garments fitted for human bodies. People aspire to their clothes and enjoy wearing them. To design wearable technologies, they should also be more knowledgeable about using technologies like computer software, sensors, and conductive yarn and so on. While doing so, they should work together with product designers rather than merely informing them in different stages of the design process.

Another part of the research studies uses prototypes to illustrate how technology and fashion could be integrated. The first example is *Nebula*, an interactive garment which aims to examine properties of textiles, fashion accessories, and digital technologies. The design process brings interaction designers and fashion designers together to balance the fashion aspect with the technological competence of the garment (Elblaus et al. 2015). Another prototype is a shape changing digital device designed by taking the statements of fashion editors and bloggers' and dynamics of fashion system into consideration during the design process. The concept focuses on making a wearable device part of an outfit and adapt to style changes (Juhlin & Zhang 2015).

One potential direction for advancing this current state of fashionable wearables is collecting insights from professionals working in technology and fashion fields regarding their attitudes towards collaborating with each other.

METHOD

We conducted 9 in-depth interviews with fashion designers, a fashion editor and a public relations (PR) manager, as well as textile and fashion brand professionals.

Table 1: Participant Profiles.

Occupation	Task	WT	ST	CO	CO WT
Fashion Designer I	Designer and creative director of her/his own brand	✓	✓	✓	✓
Fashion Designer II	Designer, creative director and marketing & communication manager of her/his own brand	✓	✓	✓	✓
Fashion Designer III	Designer of a fast fashion brand	✗	✓	✓	✗
Fashion Designer IV	Designer of a fast fashion brand	✗	✓	✓	✗
Media & Communication I	Fashion editor & brand consultant	✗	✓	✓	✗
Media & Communication II	Public relations manager	✓	✓	✓	✓
Product Developer I	Product developer of a fast fashion brand	✗	✗	✓	✗
Product Developer II	Product and business developer of a fast fashion brand	✗	✓	✓	✗
Product Developer III	Product developer of a fast fashion brand	✗	✓	✓	✗

WT: Experience in Design of Wearable Technologies

ST: Experience in Design with Smart Textiles

CO: Experience in Collaboration in Fashion Industry

CWT: Experience in Collaboration of Wearable Technologies

We chose to conduct an interview with these stakeholders due to their significant role in the fashion system. Fashion designers are the creative brain of the

industry; the design process starts and continues with them. Product developers are essential in process management, product feasibility and production. They are responsible for receiving the brief from the designer and conveying it to the other departments. Media and PR professionals have a major role in the visibility, diffusion and fashionability of textile products. They form the decision mechanism of style creation process as they can reach masses. They are also responsible for making an issue understandable by the public.

We gave special care to recruit participants who have either worked in projects focusing on wearable technologies and smart textiles, or participated in collaborative projects within fashion industry. Participant profiles are given in Table 1.

We structured the interview questions around four themes. We explored 1) the participants' role in the fashion system in terms of material and cultural production of fashion, 2) their previous collaboration experience, 3) their assessment of the current state of wearables, and 4) their expectations of collaborating with technology professionals and companies when designing fashionable wearables.

We voice-recorded each interview, and transcribed the recordings into text for data analysis. Then, we coded the transcripts deductively (Miles & Huberman, 1994) by using four pre-determined categories: stakeholders, process, environment and barriers.

RESULTS

Experts agreed that collaborative work between fashion and technology is essential to design fashionable, desirable and functional wearable technologies. They stated that they were willing to participate in such a collaboration. They shared their insights about stakeholders that should be actively involved in the collaboration, description of the collaborative product development process, the characteristics of collaboration environment and barriers for a successful collaboration. In the remainder of this section, we present these insights.

1. Stakeholders

Fashion designers appear to be the main and creative stakeholder of the process who need to be involved in the entire process. In some cases, they also perform as a creative director, project manager, and art director. Engineers, developers, research and development departments, hardware and software technology companies are other main stakeholders that should participate in the several stages of the process including research, design and production. There are also other stakeholders who need to participate in particular phases. For example, end users should be involved in design evaluation phase so that unsatisfying situations can be solved before the production start and the product meets the consumer. Pattern makers, tailors,

mechanists, material providers (as textile, yarn) should participate in the production phase. Marketing, communication, public relations specialists, journalists and editors should participate in the diffusion phase. Their role is to make the product reach a broader user group. Finally, academicians, universities, state authorities and NGO's should also be involved to enlighten and educate people and mould public opinion. But, the participants did not specify in which stage of the process these stakeholders should participate.

Interviews showed that it is highly important to choose the right stakeholder for a successful collaboration. Decisions concerning whom to collaborate mainly depend on the company and brand identity, project goals, harmony of partners, and end-users. Along with these, the existence of highly motivated stakeholders having a common vision was also mentioned as a criterion for selecting the right partner, thus bringing success to the project.

2. Process

The results indicated that there can be two collaboration models where fashion designers have different roles. The first model is fashion-driven in which fashion designer initiates the process with ideation and leads the development of new technologies. Their role in this model is to inspire the invention of new technologies, (e.g. inventing a new textile that can transmit electricity). After generating the design idea, the designer brings together the stakeholders required to invent the essential technology and design the product. Personal acquaintances are perceived highly beneficial and rewarding for this phase. For example, two of the study participants reports that self-brand owned fashion designers, come up with an idea and searches for hardware and software technology companies to realize this idea.

In the fashion driven model, the textile company, which has a vision in investing new textile technologies and smart garments, hosts the invited stakeholders and provides all the required material and environment for the realization of the design idea. After a period of research and development, and after all the stakeholders agree on the final prototype, production stage starts. All the stakeholders must attend personally to the stages before this stage, because ideation, development, design and prototyping phases require the collaboration of partners. Fashion designer and product developer can be involved in this last stage as well. Lastly, as this model may require invention of new technologies, the generated concepts are more likely to become haute couture pieces that may never reach to mass production.

The second model is technology driven in which the design process starts after the invention of new technology. In this model, designers are mostly inspired by the technology. An example scenario shared by the participants is that a technology company was in search of a fashion designer to make their wearable

technologies more fashionable and the PR agency introduced two convenient brands for the collaboration. In this model, the main drivers of the process could be the technology companies, brands or other partners as state authorities or NGO's that bring all the stakeholders together for the design process. Aside from fashion designers' initial ideation and research on technology development, this model follows the same steps as in the first one. However, as the participants revealed, the technology-driven model moves faster than the fashion-driven model, because the required technology is already available.

3. Environment

As for the collaboration environment, coming together physically is necessary, particularly at the early stages of the design process. In further phases, after the stakeholders agreed upon the concepts and the project brief, they can participate in the process through digital communication methods like e-mail, Skype or through teleconference. Participants stated that they do not use software specialized for collaboration, e.g. designing in a virtual studio.

Another important expectation was that all the stakeholders should participate personally, indicating a need for a collective effort. However, it is neither easy nor common to ensure the active participation of all the stakeholders when the project follows a fast fashion design process – rapid production of garments in response to the latest trends. When this is the case, our participants indicated that they are used to meet up with other stakeholders only in cases of emergencies and crises. They added that the role of the product developer becomes very important in such cases, as he or she manages the process and reconciles the stakeholders.

Fashion designers who work in fashion-driven model prefer to host all the stakeholders in their place. Other participants advised that the collaborative work environment can be within technology companies. They stated that fashion designers should experience the technology environment, learn about the material possibilities and limitations as well as inspire from them.

Designer's imagination and expectation from the technology can be formalised in short-term and long-term goals. Workshop type of collaboration environment is more suitable to projects with short term goals. This setting can be fruitful to inspire fashion designers and stakeholders, i.e. what can be done with existing technologies and the materials. However, during this process, fashion designer can also trigger new technologies for future design projects and products, leading to a project with long term goals. When this happens, research and development teams, engineers and developers can work on finding the relevant existing technologies or inventing new ones.

Participants believed that big sponsors and brands should finance the process to afford the cost of

collective creation process. Opportunities of a big partner can provide better possibilities to the collaboration environment. However, the work environment should be independent from these sponsors and brands to be free from limitations.

4. Barriers

The first barrier to the collaboration between fashion and technology is the uniqueness of projects. In fashion industry, every project defines its own route and re-defines it in case of troubles. As there is no tested pathway or method to follow, stakeholders often improvise. The second one is the difficulty in communicating abstract ideas to other stakeholders. Sometimes designers might need to teach non-designer stakeholders how to think like a designer. Yet, the communication problem is not only related with the abstractness of the idea. Each stakeholder tends to see the problem at hand from her/his expertise, and tend to communicate by using their own terminology.

The third barrier is time. Designing wearable technologies is a race against time. Technology is moving fast. Similar projects are being performed around the world simultaneously. Value of time planning and being strict to it has utmost importance for a company. But, fashion industry and institutions of fashion system is distinctive than technology companies. They mostly deny corporate rules, want freedom and uniqueness. This might negatively affect collaboration process for projects where time is one of the major concerns.

Finally, power relations in a collaborative environment are hard to manage. As participants also emphasized, fashion system considers itself as privileged among other industries. Therefore, time-management, team management and negotiation are crucial. For example, stakeholder adding the most value to the collaboration, desires to be in the spotlight, giving her/his name to the project. Plus, each stakeholder wants to see himself or herself as the person in charge of the project. Thus, assignment of the project manager or the coordinator of the collaboration is also highly critical.

DISCUSSION AND CONCLUSIONS

In this paper, we presented the insights of the three major stakeholders of the fashion system regarding collaborating with technology professionals. The results indicated that the experts we reached for this research were already motivated for such projects, and all had a positive attitude towards collaboration with technology professionals. They indicated that strong collaborations are performed with individuals who have a personal and professional interest in working with technology. Thus, stakeholders' willingness to participate is essential for a successful collaboration.

The results indicated several barriers for successful collaboration. A collaboration between fashion and technology professional would not be easy. Most of the

experts we interviewed considers her/himself as the coordinator of the collaboration. This might create power conflicts in collaborative design environments to handle. So, human resource management of the stakeholders appears as one of the most critical aspect of collaborations for fashionable wearables. Furthermore, the involvement of various stakeholders in the collaboration makes coming together physically very challenging. A creative director or a coordinator, who is experienced and capable of managing fashion and technology teams, might perform as mediator, interpreter and director to overcome this barrier.

We identified two collaboration models derived from analysing the results. These models are technology-driven and fashion-driven. We argue that a third model, which is driven by the equal participation of each stakeholder, would be much more useful in designing fashionable wearables. The results showed that collaboration between fashion and technology is bigger than bringing fashion designers and technology developers together. For example, in an ideal scenario, academicians, sponsors, NGOs, and state authorities should also be involved in the process (Figure 1). These parties should actively participate in all stages to educate producers and consumers, to pioneer collaborative projects, to mould public opinion, to motivate individual participation, as well as support reformation in the industrial dynamics if necessary. Furthermore, users should be involved in early stages of the process and participate not only as evaluators of concepts but also as active contributors to the design and ideation.

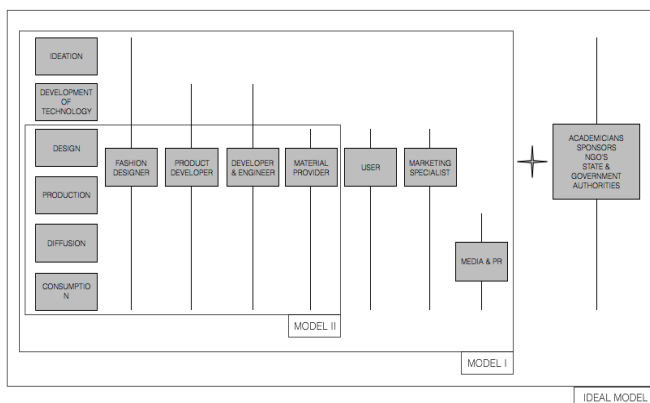


Figure 1: Fashionable Wearables Design Collaboration Model

Technology-driven and fashion-driven models can provide an opportunity to design more desirable and usable products. However, active and equal participation of each stakeholder in a collaborative design process would not only empower different parties but also offer benefits beyond facilitating their widespread use. Such a model could contribute to a more responsive and sustainable fashion system by extending the product life-cycle, e.g. garments and accessories that can adopt themselves to the changes in trends, contexts and user requirements.

This study is the first part of a bigger research project, which aims to collect insights from professionals in both fashion and technology for collaborating with each other. In the long turn, we plan to conduct interviews with technology professionals and compare diversities in approaches to collaborate with fashion professionals. We also plan a collaborative method based on the result of these stakeholders and existing co-design methods (Sanders 2000) in the literature.

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