reFORM:
APPLYING MODULAR CONCEPTS
TO THE APPAREL DESIGN PROCESS

Master's Thesis 2016
Fashion and Clothing Design
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The master thesis "reFORM: Applying Modular Concepts to the Apparel Design Process" investigates an alternative design approach towards sustainable fashion and clothing. The main objective is to propose a way to slow the pace of fashion by promoting sustainable consumption and use practices that extend the lifecycle of products using modular design solutions. These solutions specifically cater to the sensitivities of designers and consumers as they greatly influence supply and demand in the industry; which in turn has ecological and sociological effects.

The thesis can be classified as project-based and is made up of two converging parts of equal relevance: theoretical study and concept development. Research methods employed review academic literature and collected focus group data. The theoretical part of the thesis presents and discusses several sustainable design strategies directly related to consumption that have been known to support emotional durability and product longevity. These strategies which include participatory design, transformability, and modular design are combined with design opportunities yielded from market research to create a solid basis for the concept development. All stages of the concept development process are described at length prior to the presentation of the new design concept. Furthermore, a modular garment is designed, produced, and rendered in three different types of materials to tangibly illustrate how the new concept could work in practice.

The final concept proposes/promotes creative sustainable design practices and solutions that consider garment lifecycle in advance using systems and design thinking strategies in tandem with modular methodologies derived from engineering perspective. Based on the produced garment’s modular design structure and the numerous style variants it yields, it is expected to extend its own lifecycle by way of continuous transformation; simultaneously satisfying consumer needs for ‘new’ without producing more. According to focus group participants, the garment’s readily transformable and customisable features are considered to provide more personal design options capable of instantly gratifying the ever-changing physical and emotional needs of consumers than that of non-transformable garments.

The thesis serves as a counteractive response to the fast pace of fashion by offering possible solutions for overconsumption and the early disposal of garments. It proposes design methods that maximise product variants while minimising production; offering economical, ecological, and sociological benefits for everyone involved and/or affected by the lifecycle of products. Relevant fields for this work include new fashion practices and sustainable development.

KEYWORDS: Garment Lifecycle, Sustainable Clothing Consumption, Emotional Durability, Transformability, Modular Design
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INTRODUCTION

In recent decades, consumer culture has drastically increased on a global level. This is partly due to the rise of fast fashion retail brands that offer the latest styles and trends at staggering low cost. According to a recent Fashion Sustainability report by Deloitte (2013), companies such as H&M (SHE), Marks & Spencer (UK) Bestseller (DK) and Uniqlo (JP) have grown considerably over the last decade, dominating the fashion market along with other high-street fashion brands. Based on this observation, it is apparent that the fashion industry’s frivolous fast pace in tandem with relentless production habits makes fashion one of the most material intensive retail businesses today, as well as one of the most wasteful and polluting industries (ibid). In addition to waste generated from the industry’s production, increase of consumption as a result of low cost ‘fast fashion’, has greatly contributed to the shortening of garment lifecycles which in turn further contributes to the industry’s overall waste.

In Finland, clothing and textile consumption increased 35% between 2001 and 2006 (Pystynen, 2013). By 2016, it was estimated that 72.6% of all textiles ended up in landfills, which resulted in over 38,700 tonnes of textile waste (Tojo et al., 2012). In the United Kingdom (UK), statistics show that even if the total amount of household waste has decreased over the last decade, the amount of textile waste has still been increasing despite the country’s extensive research regarding the fashion and textile industry’s negative environmental impacts (Morley et al., 2009). Estimates made on UK households also reveal that 42% of discarded clothing and textiles is actually reusable (ibid); evidently showing that garments are often prematurely disposed.

As a result, various ethical and environmental issues related to fashion have been at the forefront of public consciousness and debate over the last few decades. Problems arising from raw material extraction and manufacturing processes seem to have garnered most attention (Karell, 2014). Although it has been acknowledged that the greatest environmental impact of a garment’s lifecycle is caused during its use phase, the focus of sustainable fashion appears to firmly stay on the production stage. This is evident by the number of designers and companies that concentrate on using ecological, recycled, or ‘cradle-to-cradle’ material in tandem with local manufacturing. Moreover, the current fashion system which includes but is not limited to e.g. manufacturers, companies, designers, stores, and magazines has stayed unimaginative and relatively passive with regards to promoting alternative ways to consume fashion (ibid).

1.1 DEFINITIONS

Some key definitions for terms that pertain to this thesis are provided in this section, as some of their meanings may vary depending on their context or be open to various interpretations.

1.1.1 CLOTHING / FASHION

The terms ‘clothing’ and ‘fashion’ are often casually used interchangeably despite their inherent differences. This may partly be due to the fact that ‘fashion’ is also an umbrella term used to describe clothing, apparel, accessories, jewellery, footwear, etc. However, it is important to make a clear distinction between the two terms as they are often used in parallel within this thesis.

In theory, fashion is an art form dedicated to the creation of clothing and other lifestyle products; a cultural entity that aligns with economics. It denotes immaterial aspects such as social, symbolic and communicative (Karell, 2014) attributes. Clothing, on the other hand, refers to the fibrous material form of a garment that serves functional and protective needs (ibid). Kawamura (2005) supports this distinction, by describing fashion as a socially produced immaterial phenomenon; a belief that only becomes tangible through the material form of clothing. Fashion is not actual clothing but rather the extra societal added values given to clothing, which exist only in people’s imagination and belief (ibid).

This thesis recognises fashion in part as a phenomenon, that aside from Kawamura’s ideology, also acknowledges von Busch’s (2008) views which describe fashion in a constant state of becoming. Once a garment is deemed fashionable, it inevitably limits the lifecycle of the product, which in effect contributes to (over)consumption and its damaging effects. Although this thesis recognises the immaterial aspects of fashion, the term is used throughout this manuscript in the broader sense that also includes the material aspect related to clothing.
1.1.2 SUSTAINABLE CLOTHING / FASHION

'Sustainable fashion' and 'Sustainable Clothing' are often synonymous, however, there are clear distinctions between both terms. Sustainable fashion (a.k.a eco fashion) is part of a design philosophy motivated by sustainability. It focuses on creating a system which can be supported (indefinitely) in terms of human impact on the environment while being ethical and socially responsible. Sustainable clothing, more specifically, is the product of that system and derives from ecological fibres and/or recycled/up-cycled materials. Both terms promote reducing, reusing, and recycling materials while encompassing three main areas associated with sustainability: environmental, sociological, and economical.

For this thesis, sustainable fashion is perceived as a mindset in order to produce tangible fashion that exemplifies the objective which is to extend the lifecycle of products by applying modular concepts to the apparel design process.

1.1.3 SUSTAINABLE CONSUMPTION

Sustainable consumption is generally viewed as the use of products and services that have minimal impact on the environment, are socially equitable, and economically viable so that human needs can be met at present and in the future. However, sustainable consumption is more than just the use of ecological materials and production methods; it is, more importantly, an approach towards sustainable development where people’s choices, behaviour, and lifestyles play vital roles (Marchand and Walker, 2008).

According to The Oslo Symposium (1994), sustainable consumption practices improve quality of life, while minimising the use of natural resources, toxic materials and emissions of water/pollutants over the lifecycle of products, so as not to jeopardise the needs of future generations. In other words, it is possible to meet our needs and desires without depleting our planet’s finite natural resources.

What should be derived from the above mindset is that the overall lifecycle of products transcends the use of ecological materials and production methods. Fundamental changes in the way societies consume, use, and dispose products are indispensable for global sustainable development (United Nations, 2016). The main way to achieve this is by focusing on what happens to products after their point of purchase which includes the use, maintenance, and disposal phase.

1.1.4 GARMENT LIFECYCLE

A product progresses through a sequence of six phases that encompass environmental, sociological, and economical systems. This sequence is known as the product lifecycle and consists of 1) product design 2) raw material extraction/processing 3) manufacturing 4) packaging/distribution 5) product use/maintenance and 6) end-of-life (Udo de Haes et al. 2005; UNEP 2005). Every phase of the product lifecycle has potential to increase sustainability and extend use time (Koo, 2012). Product design is considered to have the biggest impact on sustainability as decisions made during this phase predetermine all product-related environmental issues (European Commission, 2014). However, consumers have the greatest responsibility as it is they who are accountable for product use, upkeep, and final disposal (Mugge et al. 2005). According to Stahel (2001), doubling the use time of goods reduces the amount of resources input and waste output in addition to reducing resource consumption related to distribution, advertising, waste, transport, and disposal services by 50%.

In this thesis, product lifecycle stands for garment lifecycle and includes all of the above-mentioned phases (Figure 1). All processes between the extraction of raw materials up until product distribution is hereafter considered the production stage. What happens to the garment after the point of purchase (daring its use, maintenance, and disposal) is hereafter referred to as the consumer stage.

![Garment Lifecycle Diagram](image-url)

Figure 1. Garment Lifecycle

1.1.5 SYSTEM THINKING

Systems thinking is a method that examines the interconnectivity of factors within an overall system that is often practiced during the planning and design phases of a project. It is used to comprehend/visualise the overall scope in order to predetermine challenges and issues which can then be considered, reconfigured, redesigned, modified, and/or optimised while mapping out causes and effects among factors within the system.
1.1.6 DESIGN THINKING

Design thinking is an approach for innovative problem solving that employs design skills and processes such as rapid prototyping and user profiling. It induces innovation activities with a human-centered design ethos where innovation is generated by a thorough understanding (through direct observation of people's wants, needs, likes, and dislikes) regarding the way particular products are made, packaged, marketed, sold, and supported (Brown, 2008). In other words, design sensibility and methods are used to fulfill people's needs with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunity (ibid).

This thesis approaches design thinking as a solution-focused mindset that seeks to build up ideas unlike critical thinking which breaks them down.

1.1.7 DESIGNER / FACILITATOR

A designer is a person who plans the look and/or function of something prior to its execution by drawing or plan. More specifically, a designer is an agent that "specifies the structural properties of a design object" (Ralph and Wand, 2009) or product. However, anyone who conjures intangible processes, services, and experiences is also regarded as a designer.

A facilitator, on the other hand, serves as a catalyst between a person and an object or subject; an enabler that supports participants as they pursue their goals and objectives by creating an environment or situation where every participant has the opportunity to collaborate, innovate, and excel (Meket, 2013).

More specifically, "The facilitator’s job is to support everyone to do their best thinking and practice. To do this, the facilitator encourages full participation, promotes mutual understanding and cultivates shared responsibility. By supporting everyone to do their best thinking, a facilitator enables group members to search for inclusive solutions and build sustainable agreements" (Kasent, 2007, p.32).

For this thesis, in addition to the traditional meaning of the word, the 'designer' is also considered a ‘facilitator’ that communicates a satirical language to users through modular design in order to encourage and promote sustainable behaviour that extends garment lifecycle.

1.1.8 MODULARITY

Modularity is the degree to which a system’s units (modules) may be decomposed and reconfigured. The meaning of the word, however, can vary depending on its context (Greene, 2006). In construction, for example, modularity relates to the process of creating three dimensional or volumetric standardised components of a structure on mass off-site prior to installation. These components are then delivered to a construction site as the main structural elements of a building (Lawson et al., 2014). Similarly to construction, modularity in manufacturing, relates to the production processes and assembly operations associated with a product (Kamran and Nasr, 2010). Automobiles are good examples of modular-based manufacturing due to the use of their exchangeable parts and features during fabrication; these exchangeable parts and features such as audio decks, seats, and wheel types can be applied to multiple car models of an automobile company’s product line to expand their product range.

Modularity in industrial design, on the other hand, relates to the engineering technique of building larger systems by combining smaller subsystems (Black et al., 2011). In this case, industry mirrors nature as it relates to the construct of joining standardised units to form larger compositions; as for example, the hexagonal cells found in honeycombs (ibid). Similarly, modularity in architecture and contemporary art can refer to the construct of a structure or an object by joining standardised units to form larger compositions. In both cases, modules can be used as standardised units of measurement and proportion. Modularity however, is a coined term that describes a branch of modular art. In this case, modularity denotes the ability to alter the work by reconfiguring, adding to and/ or removing its elements (ibid).

For this thesis, modularity refers to the use of common units to create product variants. It entails the implementation of adaptive modules, component-swapping and bus modularity methods to achieve rationalised engineering, manufacturing, and support processes that produce a large variety of products. Further definitions of adaptive modules, component-swapping, and bus modularity as defined by Huang and Kusiak (1998) are explained below.

**ADAPTIVE MODULES** are modules that exude adaptive functions. These functions adapt a part or a system to other products or systems and are intended to handle unpredictable constraints.

**COMPONENT SWAPPING** occurs when two or more alternative basic components can be paired with the same modular components to create different product variants that belong to the same product family.

1.2 BACKGROUND

Many industries have undergone huge system changes in conjunction with the development of information technology over the last couple decades to consistently improve their operation business structure in a manner that is more ecologically and sociologically responsible. Health, food and drink, pulp and paper, and beauty are all good examples of ecologically conscious and active industries that consistently try to improve their operations. So why has an industry like fashion, which prides itself in being ‘so-called’ innovative, current, and at the centre of modern culture remained relatively unimaginative and unchanged in regards to production and consumption habits since the technological development of manufacturing ready to wear garments introduced during the late 1800s? It seems that the traditional linear thinking of this old system prevails to date as a garment’s journey still starts from a designer’s sketch and tickles down the production line; going through a rigorous industrial system before reaching the final consumer (Fletcher and Grose, 2012).

Over the past couple decades however, there has been more ecological and sociological awareness and discussion within the industry regarding it’s manufacturing / production practices. This is evident by the increasing number of designers and companies that focus on using ecological and recycled materials in tandem with local manufacturing. Although it is certainly easier to develop ecologically sound products by focusing on materials and production, it still does not solve the problem of early garment disposal, which poses the following questions:

- What could satisfy the interests and needs of both designers and consumers and still be ecologically and sociologically responsible?
- How can the habitual need for creating and acquiring new products be fulfilled without producing more?

The following chapter discusses the overall objective of this thesis and how it answers the above questions.
2 OBJECTIVE

This thesis aims to provide an alternative design approach towards sustainable fashion and clothing. The main objective is to propose a way to slow the pace of fashion by promoting sustainable consumption and use practices that extend the lifecycle of products using modular design solutions. These solutions specifically cater to the sensibilities of designers and consumers as they greatly influence supply and demand in the industry; which is in turn has ecological and societal effects.

In addition, this thesis also serves as a counteractive response to the fast pace of fashion by offering possible solutions for overconsumption and the early disposal of garments. It proposes design methods that maximise product variants while minimising production: offering economical, ecological, and societal benefits for everyone involved and/or affected by the lifecycle of products. Furthermore, a modular garment is designed, produced, and rendered in three different types of materials to tangibly illustrate how the new concept could work in practice.

The following chapter discusses the methods employed to achieve the above mentioned.

3 METHODS

This thesis can be classified as project-based and is made up of two conversing parts of equal relevance: theoretical study and concept development. Resorted methods consist of literature review, product development, focus group, and focus group data analysis. The following sections in this chapter provide detailed accounts for each method employed to execute the thesis objective and project.

3.1 LITERATURE REVIEW

Literature reviewed for this thesis derives from academic studies and research. All text is collected from multiple sources such as public library, academic journals, wide internet search, e-books, and downloadable pdf articles. Most of the reviewed texts discuss several sustainable design strategies directly related to consumption that have been known to support emotional durability and product longevity. These strategies include participatory design, transformability, and modular design are reviewed at length and presented to help create a solid basis for the new modular concept for this thesis.

3.2 PRODUCT DEVELOPMENT

Standard practices in fashion and clothing design dictate that the product development process should start with wide visual research of inspirational sources to communicate theme, mood, materials, silhouettes, cuts, and details (Galliani, 2005). However, due to the modular structure and customisation requirements for the product of this thesis, the development process required a completely different approach. Inspirational aspects of the research were considered irrelevant because part of the objective of the modular concept is for the product to adjust to the user’s mood and needs. Therefore, it was deemed more essential to focus on shape, structure, and materials that would enable and contribute to the modification and versatility of the product.

Rather than sketching random initial shapes based on inspirational sources, research of classic garment shapes that could possibly lend well to the modular concept was conducted. The motive behind this research was to find a garb that would serve as a stylistic starting point for the design process. Subsequently, the Kimono and Trench Coat were chosen for further exploration as it was deemed that they embody all of the characteristic requirements dictated by the design brief and outline set by the developed concept.

After selecting the kimono and Trench Coat as inspirational starting points for the product, the next step was to create a rapid half-scale prototype. Rather than sketching on paper, markings for possible alterations were directly made onto the prototype with pencil. These markings were made to visualise possible modular structures and to aid further development.

Based on the half-scale prototype a full-scale sample was made to test how the modular structure of the product works on an actual person. Once the design was deemed satisfactory by the designer, the product was rendered in ecological and sustainable materials that abide by restrictions dictated by the design brief and outline set by the developed concept. In addition, analysed data collected from focus group participants aided in further development of the product. Section 3.2 (Design Process) and all of its sub-sections provide a detailed account of the product’s development process.

3.3 FOCUS GROUP

A focus group interview is a qualitative research method generally employed to better understand consumer interest and behaviour. It is used to gain information regarding the attitudes and reactions of consumer’s towards a particular topic, issue, or product (Solé, 2001). In addition, companies and researchers often use the method to learn about conscious, semiconscious and unconscious psychological and sociological characteristics and processes (Kawamura, 2011).

There are several types of focus groups (e.g. single focus group, two-way focus group, dual moderator focus group, etc.) depending on the need of the research. Standard focus group interviews often employed by market researchers usually consist of six to eight participants. The idea is not to have too many participants, so that the group stays focused, on topic, and manageable for the moderator. Focus group interviews are built according to certain structures and conducted by one or more moderator(s) whose role is to observe the conversation and document the most relevant information concerning the subject. Usually focus group sessions last anywhere from one to two hours depending on the need (Solé, 2001).

For this thesis a focus group was assembled by the author to introduce the new design concept and produced modular garment to consumers. The goal for this task was to gain consumer insight and views regarding the concept and garment. Criticism was encouraged and welcomed from participants to create a creative dialogue in order to generate ideas and possible solutions for issues that might not have been previously considered.
The overall goal for conducting the focus group was to collect information that could possibly help develop the garment and/or the concept further.

The process began by compiling a series of probing questions relevant to the topic. To obtain information, seven participants were recruited to participate in the discussion via private and individual social media invitation. The selection of these participants was based on age, gender, and line of work; which varied in all accounts. Most importantly however, all participants were chosen for their critical and opinionated nature in addition to their enthusiasm for fashion and clothing design.

The focus group was modelled after informal American tupperware and cosmetics parties of the 1950s and 60s in which housewives gathered to view and discuss new products. The meeting of this group took place in the author/mediator’s residence. The reason for conducting the meeting in this type of space was to create a personal and social atmosphere in the form of an informal cocktail party. Guests were greeted with a selection of wines, cocktails, and hors d’oeuvres in a small reception so that they could get better acquainted. This was done to achieve a level of comfort and intimacy among the participants so that they could feel more comfortable and confident to share their views and opinions during the discussion.

After all focus group participants were in attendance, the session began with a short presentation to introduce the modular concept. Modularity as it pertains to this thesis (as defined in previous sections 1.1.8 Modularity) was explained during this introduction in addition to providing background information for the concept’s inception and reason for being. Following this introduction was a detailed demonstration of the modular garment and its features. Participants were shown the garment’s customisation capabilities along with the style variants it yields. At this point in the session, participants were invited to try on the garment. The goal for this exercise was to get the participants to interact with the garment and each other in order to exchange stylistic ideas and views. Input of this interaction and exchange was documented by taking copious notes and a series of photographs in addition to audio and video recording.

After each group participant had the opportunity to try on the garment first-hand and style it in various ways to their liking, they were asked to individually fill out a questionnaire. The questionnaire (which can be found in the appendix section of this thesis) consisted of a series of questions which were broken down into two parts. The first part of the questionnaire consisted of general questions regarding the participant’s lives and their consumption habits. The second part of the questionnaire consisted of focus questions which solicited the responses of participants regarding their opinions on the concept and garment presented. After every participant had the opportunity to fill out the questionnaire they were collected for later assessment and evaluation.

The session concluded with a collective group discussion reflecting on the questions of the questionnaire. Notes and audio recording was taken during this discussion to document the responses of the group so that they could be compared to the individual responses previously given when filling out the questionnaire. This was done to see if there would be any consistencies or changes in the feedback of the participants when exposed to the opinions and views of others. The following section is this transformation, and the collected input and data was organised and assessed.

3.4 FOCUS GROUP DATA ANALYSIS

As mentioned in previous sections (3.3 Focus Group), input and exchange of the conducted focus group was documented by taking copious notes along with a series of photographs in addition to audio and video recording. All information obtained was organised and compiled into respective categories (questionnaires, notes, photographs, audio, and video recording) so that the feedback may be efficiently assessed.

The first task of this process was to assign every participant a code name to easily and anonymously refer to their input when assessing the data. Next, a participant chart was created using these code names for easy referencing. In addition, the assigned code names were also added to each of the participant’s questionnaires.

To assess the information of the questionnaires, the questionnaires were lined-up and simultaneously reviewed one question at a time. This was done to easily detect similar responses among the participants. Similarities found were promptly highlighted and recorded separately on a new document. Other input deemed insightful, useful, or relevant to the topic by the moderator was also highlighted and added to said document in a separate section.

Similarly to the assessment process of the questionnaire, recorded notes were carefully reviewed and assessed. Input deemed insightful, useful, or relevant to the topic by the moderator was also highlighted and added to a separate document specifically assigned for the input of notes. Once the notes were reviewed and all the relevant information was recorded on a separate document, the process was repeated for audio and video recordings.

Overall, the analysis data provided useful information that helped to develop the garment and concept further. A detailed analysis of user and disposal phases of the garments that they design by having a better understanding of the people who buy and use them. Connecting with customers and soliciting information from them regarding their experiences can provide a deeper understanding of the value and longevity of the products that they purchase and allow the designers to improve future designs.

4.1 DESIGNER’S ROLE

Ordinarily, designers create garments based on design briefs that outline specific requirements which must be met in order to satisfy the demands of consumers within their respective market. But in order to develop and produce said garments, designers need to identify and source a wide range of materials and services (Gowl, 2014). According to ecological design consultant and sustainability activist Kate Fletcher (2014, pg. 7), “materials play an emphatic role in our current understanding of the way in which fashion and textiles can contribute towards sustainability.” This can be witnessed in the amount of designers concentrating on the use of ecological and recycled materials. However, the focus of sustainable fashion appears to have stayed on the production phase of the garment lifecycle (Karell, 2014).

Fashion design academic and researcher Alison Gowl (2014) believes that while some designers may feel confident in their ability to influence the reduction on some of the impact that occurs during the design and production phases (usually known as ecological materials and ethical manufacturing), it is often more difficult to envision how to make an impact on what happens to a garment after the point of purchase; during the use and disposal phases (Gowl, 2014). As people become aware of the environmental and sociological implications concerning the fashion industry, tendency and willingness to make conscious decisions in consumption and use practices must increase in parallel. This requires more innovative ideas and solutions from designers (Karell, 2014).

According to Gowl (2014), designers can begin to address and possibly impact the use and disposal phases of the garments that they design by having a better understanding of the people who buy and use them. Connecting with customers and soliciting information from them regarding their experiences can provide a deeper understanding of the value and longevity of the products that they purchase and allow the designers to improve future designs.

4.2 DESIGN STRATEGIES

Design strategies that focus on sustainable practices can be seen as tools that designers can implement in the design process to make informed decisions on how to engage with sustainable design principles (Gowl, 2012). They aim to minimise environmental impacts within the design, production, and consumption stages of products; ultimately postponing their disposal (Karell, 2014). Although the fashion industry has started to become more aware of alternative design strategies, a report by Deloitte (2013) shows that implementing them is still a relatively new concept for many companies. According to the report 8 out of 10 companies in the fashion industry are not putting a high degree of effort into engaging with consumers with regards to sustainability” (Deloitte, 2013, 3). Most fashion brands that claim to be sustainable seem to only focus on the use of ecological textiles, surplus waste materials, and local production (Aikko and Niinimäki, 2012). Although these approaches can be reductively considered sustainable due to their eco-efficiency, they have been criticised for superficially requiring little change from producers and consumers instead of demanding radical shifts in behaviour (Fletcher, 2008). They mainly focus on excessive material use, recycling, and up-cycling instead of examinating reasons for premature clothing disposal.

The following sections in this chapter introduce four design strategies that have been proposed to lengthen the lifecycle of garments. With a focus on person-product relations, they include emotional durability, participatory design, transformability, and modularity.
4.2.1 Emotional Durability

Emotionally durable design is a sustainable design approach that focuses on the relationship between consumer and product. It acknowledges empathy, a kind of felted relationship that leads to the dumping of one by the other” (Chapman, 2005, 51).

In order to extend the lifespan of products, it is important for designers to find ways to strengthen the relationship between consumer and product. (Nimimakki and Koskini, 2011). According to a study by Schifferstein and Zwartkruis-Pelgrim (2008), enjoyment and memories are vital for long person-product attachment. They suggest creating useful and enjoyable products that evoke sensory and aesthetic pleasure. In fashion, aesthetic pleasure found in the function, intrinsic nature, and appealing aging characteristics of a product can also be perceived as a precondition for long person-product attachment (Nimimakki and Koskini, 2011). Schifferstein and Zwartkruis-Pelgrim (2008) also suggest that increasing memories associated with a product can prolong the relationship between person and product (ibid). Nimimakki and Koskini (2011, 169) support this theory in their study which found that the oldest garments that people kept had strong connections to memories of people, experiences, times, and places.

To aid designers in the quest of embedding such elements into their products, several design strategies associated with emotional durability are explored in the following sections of this chapter. Transformable and participatory design were among the strategies chosen for discussion due to their customisable qualities. Products with customisable qualities such as modular and open-ended products offer customers a more active role in the design and making process which can lead to creating more meaningful and individualised person-product connections extending the longevity of a product (Nimimakki and Hassi 2011).

4.2.2 Participatory Design

Participatory design is the concept of creating open-ended generative systems as opposed to finished products (Armstrong and Sojo-Novicic, 2011). It requires designers to design intentionally unfinished or ‘open’ products that allow users to have an essential role in the making process which gives the product creation value (Park, 2010). Hallway or customisable products are good examples of participatory design concepts in fashion; they give consumers the opportunity to customise/complete their products based on personal aesthetic and preference which allows them to form stronger attachment to them (Nimimakki and Hassi, 2011). The process of making also enables customers to embed their creative experience and personal memories into their products (ibid) which is something that traditional ready-to-wear garments cannot do.

According to Karl, “consumers are seen as active participants that form communities where methods and experiences are shared to support new forms of craftsmanship. Such a mind-set has gained great interest in the past few years especially in the form of open source fashion platforms where various practices of creativity are shared through the Internet” (Karl, 2014, 10). Free downloadable DIY-patterns, sewing instructions, and ‘how-to’ videos are all good examples of open source platforms (ibid).

Fletcher and Grose (2012) expand on the above-mentioned approach by urging designers to concentrate on the lives and daily rituals of people in order to create stronger sustainable messages. They suggest redirecting people’s attention from ‘having to doing’ by focusing on how people behave as opposed to what they purchase (ibid). Designers should generate strategies that encourage consumers to act, in order to give products meaningful value which can strengthen customer-product relation. According to Fletcher (2012), designers need to be mindful about the competency of clothes and their ‘craft of use’ if they are to advocate product longevity in fashion. Rather than continuously producing more clothes using more materials, there should be a greater emphasis on the social and experiential constructs of fashion where form and function becomes a focal point for interaction. With this mind-set, active participation can potentially extend the lifecycle of garments and help change people’s perceptions and consumption habits. Thus, combining emotional and participatory design with other strategies can very well serve as a solid foundation for new concepts and practices in fashion.

4.2.3 Transformability

Transformation is the process by which one thing (e.g., material, expression, function) converts into another. In most cases, it describes physical change in appearance, shape, form, and/or structure without the loss of substance (Schmid, 2008). According to Karl (2014), transformable design in fashion refers typically to multi-functional garments that can be altered by the wearer, providing variety to their wardrobe. These garments serve multiple purposes which undoubtedly fulfill more needs than their traditional challengers (ibid). Transformable design can closely be linked to emotional durability and participatory design. It can also be categorised as a strategy for adaptability, which aims to increase product use. Lastly, designing with strategies such as transformability allows consumers to be actively involved in sustainability (DombekKeith & Loker, 2011; Farrer, 2011; Loker, 2008).

For this thesis, transformability is utilised as a design tool that enables product renewal and sustainability. Due to its variable characteristics, transformability is employed in order to help maintain the user’s interest for the product. As Koo (2012) points out, garments with alterable attributes may form deeper connections with users than that of garments with standard solutions. This assumption correlates with the ideology of emotional design strategies, for they also promote deeper connections between product and user, which lead to longer product lifecycle. According to Koo (2014), because transformable design has the ability to fulfill multiple needs, it is expected to enhance frequent usability for a longer period of time among users.

The Consumers and Transformable Garment Circulation (CGC) model based on Koo (2012, 27), underlines both design and use in the lifecycle of garments (figure 2). According to the diagram, steps of the design process are viewed as opportunities for implementing sustainability (ibid). It shows that the use of transformable garments can distinctly be prolonged in comparison to standard non-transformable garments. Although the designer controls the transformable features and the degree of sustainability in products during the design process, the active involvement of the consumer is equally crucial to the cycle of products. In other words, transformability generates the continuous reincarnation of garments in order to constantly achieve customer satisfaction.

In “Design Functions in Transformable Garments for Sustainability”, Koo (2012) classifies four types of transformable garments based on their changeable aspects: 1) reversible and folded/tying designs 2) modular designs 3) smart clothing and 4) Do-it-Yourself (DIY) and multi-lives design. Reversible design denoted double-sided garments that can be worn two ways, while modular design denote alterable components that may be detached, reconfigured, or replaced with other components. Smart clothing in contrast, incorporates wearable technologies to achieve design variations in colour, pattern, or shape. Do-it-Yourself principles are brought into context as they often involve the modification of existing garments which may result in multi-lives garments or accessories (ibid).

So far, transformable products have been exiguously available on the fashion market. This may partly be due to the fact that transformable garments require much more time and consideration during the design phase than that of non-transformable garments. Another reason may be economical. From a business perspective, transformable products tend to render other products obsolete, which reduces consumption and potential revenue for companies (Karel, 2014). These contributing factors may very well explain the lack of visibility and availability of transformable garments on the fashion market to date.

Figure 2: Consumers and Transformable Garment Circulation (CTGC) graph based on Koo 2012
4.2.4 MODULAR DESIGN

Modular design is a design technique that can be used to develop complex products by using similar components (Koskimies and Nass, 2010). The components (modular) must have attachable features that enable them to be grouped. Single modules usually perform discrete functions, but collectively can provide various functions (ibid). Although this view is based on an industrial engineering perspective, its basic principles provide sufficient knowledge and guidelines for designers of various disciplines to utilise in order to solve design problems or refine existing solutions. Modular design was selected from the previously mentioned transformable design approaches as an explorative topic for this thesis as the methodology is rarely practiced by designers in the fashion industry.

Modular design, from a fashion and clothing design perspective, makes it possible to change pieces of a system or product without redrawing the whole (Baldwin and Clark, 2000). In this case, the main emphasis is to design a product family with a common platform (as opposed to individual products), for which modularity and commonality are the foundation (Hu et al., 2011). Based on the versatility of the modules and their possible configurations, a higher number of product variants may be achieved in order to satisfy a wider range of consumers (ibid) thus extending the lifecycle of products.

According to consumers, the ability to modify textiles or garments is a good reason to postpone a product’s disposal (Niinimäki 2010 in Niinimäki and Koskinen 2011), or adaptable products with modular structures enable upgrades which satisfy their changing functional and aesthetic needs (Mugge et al., 2005). In garments, such upgrades may include (but not be limited to), for example, application of latest technology (for smart garments), new material development, material modification (e.g. dying, painting, embossing), and re-draping, re-lacing, or creating new modules for updated and personalised looks.

Modular garments notably impact their lifecycle the most during the consumption stage which determines their use and disposal. Niinimäki and Hass (2011) believe this is because users have an active role in the on-going design process of their products. By satisfying the changing wants and needs of consumers through continuous transformation, modular garments are expected to increase the rate of wear which postpones disposal; ultimately expanding the garment lifecycle (Koo, 2012). Even if consumers lack knowledge or indications about sustainability, transformable/modular garments have the potential to encourage them to engage in sustainable behaviour without their awareness (ibid).

Aside from the above-mentioned, modular design can also be beneficial for designers. Advantages of applying modular concepts to the design process may include: economies of scale, increased feasibility of product/component change, increased product variety, reduced lead time, and improved product diagnosis, and decoupled risks (Kuusla, 1999). In addition, modular design can also reduce oversupply and surplus saving time, money, and space. However, despite the clear benefits of modular design, industrial designers must be cautious of the challenges associated with modularity. Issues include difficulty in making the transition to modular design, and the challenge of integrating modular design into existing systems (ibid). This may partly be due to skepticism from designers regarding the advantages of modularity. Nevertheless, modular design concepts are used to provide a holistic view of the design process, a formal framework, and the concept to modularity is still lacking (ibid). This may partly be due to skepticism from designers regarding the advantages of modularity. Nevertheless, modular design concepts are used to provide a holistic view of the design process, a formal framework, and the concept to modularity is still lacking. Furthermore, complex and in-deep exploration of pattern and prototyping is required, as opposed to designing and manufacturing regular ready to wear garments (Koo, 2014).

By viewing these aspects only as challenges, this thesis employs modular design as a strategy to satisfy consumers and strengthen the emotional bond between them and the product. As less material is required to meet consumer needs, modularity appears to offer mutual benefits for designers, consumers, and the environment; simultaneously enforcing responsible consumer behaviour, extending the garment lifecycle, and minimizing waste. The design approach in the following chapter is partly built on this hypothesis.

4.3 MODULARITY IN APPAREL

Modularity in apparel is not a 20th century idea since there are many examples of modular solutions in garments throughout fashion history. For instance, the mid-17th century bodices of the original garment was a dress bodice that could be detached and reattached by users according to desire or need (Harrington and North 1998). However, modularity as a deliberate fashion design concept is a relatively new phenomenon in this day and age. Although the concept is still obscure to most fashion designers and consumers, modular apparel has been gaining interest in recent years for its eco-efficiency, indicating that sustainable fashion is not a gimmick (Forum for the Future, 2011).

One of the earliest modular clothing brands on the market which was established in 1979 by American designer Sandra Garratt is UNITS/MULTIPLES. Garratt, who claims that she had not seen a modular approach used in fashion before her brand (only in buildings and furniture design), has been advocating modularity in clothing since the late 1970s (Carlson, 2016). Her brand’s motto is “Heightened individuality through apparent uniformity” and caters to busy women with active lives by offering them transitional (day-to-eve) clothing with simple lines, muted colours, and no hard fastenings (ibid).

With a range of roughly fifty styles in twenty colour choices, all UNITS/MULTIPLES garments are made of high quality organic cotton and are sold as pre-packaged concepts where each piece of an ensemble constitutes one module that can be worn in a variety of ways (collectively or individually) to generate multiple looks. The aim, according to Garratt, is to offer consumers a canvas for them to express their own unique individual style (ibid). People magazine has described the brand as being “an iconic (...) uniform” that allows for just a touch of the consumer’s personality, adding that “It’s not just style, it’s concept” (Demartini and Shapiro, 1988).
Currently, Garratt is still offering versions of her 1980s modular garments with SGDBOX; a new brand concept under which she has condensed all of her UNITS/MULTIPLES and freelance endeavours. SGDBOX holds all of Garratt’s various departments, including MGDBOX which is her ‘modern modulars for modern living’ collection (Garratt, 2016). Garratt ensures early UNITS/MULTIPLES patrons that her original designs, which are still in production, remain unchanged and that the company is just going through a transitional period of rebranding. After decades of selling UNITS/MULTIPLES products retail, Garratt has consciously decided not to tap into commercial retailing for SGDBOX, opting instead to offer her products via an e-commerce platform to keep things manageable as she pursues other interests.

Following in Garratt’s footsteps is Italian women’s wear designer Flavia La Rocca. La Rocca, who has worked for several major luxury brands including Blumarine, Valentino, Vivienne Westwood, and Prada, founded her company Flavia La Rocca in 2011. La Rocca, who’s mission is “to propose a new attitude towards clothing” (La Rocca, 2016), creates garments that “lend themselves to the fashion game, in a responsible, dynamic, and contemporary way” (ibid). This entails, treating entire collections based on modular concepts.

The garments, which are composed of interchangeable modules, connect with the use of hidden zippers. The modules can be detached and reconfigured to create different combinations which generate new looks. Modules from past seasons can also be combined with pieces from current seasons to create what La Rocca considers “a never-ending wardrobe” (La Rocca, 2016). La Rocca believes that this approach is “a contemporary and modern way to dress” (ibid); it starts from style matters and has the possibility to change and customise with very simple actions, saving time and space (ibid).

La Rocca’s commitment to sustainability is also part of her brand’s ethos to being a responsible, honest, and modern company. The entire operation focuses on reducing the waste of raw materials, energy, and water; bearing in mind the importance of protecting the planet. The pieces, which are made to order out of natural, regenerated, and recycled fabrics, are all produced in Italy (the company’s home-base) to reduce CO2 emissions and minimise environmental impact while contributing to her own economy.

According to La Rocca, sustainable design practices are the future of fashion. She believes that awareness is growing and that technological advancement in the industry, as a result of that awareness, is creating new materials and processes that lessen the negative impact that the industry has on the planet. She points out that designers are capable of controlling the degree of sustainability in their products by adjusting their steps during every stage of the design and production process in order to work more ethically. According to La Rocca, who is constantly researching new materials and ways to apply them, says that “there is no limit!” (La Rocca, 2016) and includes that designers must relentlessly try to educate consumers by advocating that sustainable fashion can be chic (ibid).

Another modular fashion concept with a slightly different take on modular garments from that of Flavia La Rocca and UNITS/MULTIPLES is Fragment Textiles, a design initiative by sustainable design consultancy agency Refinery. Conceived in February of 2009 by Dutch Designers Ellen van Balgooi and Berber Snoepker, Fragment Textiles is a modular textile concept based on mathematics and geometric principles that is comprised of two modular fabric tiles. The tiles, which are multi-coloured square and star shaped units, can be combined to create larger fabric compositions or garments of repeating modular tessellation; reconfigurable in both colour combination and form (Huir and Thomas, 2011). Each module contains a ‘two tabs and two slots’ click/fold system that enables it to interlock with other surrounding modules, eliminating the need for thread or fastening haberdashery. Because Fragmented Textiles don’t require any sewing, its easy assembly enables users to manipulate the look of the textile or garments on demand; allowing them to become involved in the design and making process. Made from cradle-to-cradle certified felted wool, each tile can also be washed or replaced separately, as needed (Dean, 2009).

van Balgooi and Snoepker created Fragmented Textiles as a clothing production system, use, and disposal experiment motivated by cradle-to-cradle principles. Their objective was “to create a system of fashion that was not only efficient but essentially waste free” (Huir and Thomas, 2011). The result, “mosaic-like clothing that can be worn in a variety of dynamic ways” (Dean, 2009) so users can possess less garments and still satisfy their need for new products without consuming more (van Balgooi, 2016).

van Balgooi and Snoepker believe that a Fragmented Textiles garment will sustain user interest due to its achievable variations and sustainable philosophy (ibid). The geometric shape of the tiles utilise every last scrap of material, promoting zero-waste. When the garment or its components wear out, they can easily be dismantled for scraps or recycled. This is why the click/fold and cradle-to-cradle materials were crucial to the design (ibid). Both with this concept and design, van Balgooi reiterates the words of Flavia La Rocca, saying “By making conscious choices about every design step of a product, from functionality and material to technique, shape, colour and use, it is possible to create a well-designed, eco-effective product” (van Balgooi, 2016).

4.4 RESEARCH REFLECTION

This section, which is broken down into two parts, reflects on the research provided in previous sections of this chapter.

Part one answers the following questions:

- Are modular concepts applicable to fashion and apparel design?
- Has anyone previously applied modular concepts to the apparel design process, if so, who has explored the methodology and what was his/her outcome?

Part two answers the following questions:

- Are modular garments relevant in today’s world?
- Who benefits from modular garments?
- What are the benefits of modular garments?

Figure 9: Modular garment including storage zip pouch clutch by Flavia La Rocca 2014, www.flaviarocca.com

Figure 10: ‘Fragmented Textiles’ modular garments by Refinity 2009, www.refinity.eu
4.4.1 RESEARCH REFLECTION: PART 1

Based on the research collected and presented in this thesis, it is clear that modular concepts can in fact be applied to fashion and clothing. As the works of Sandra Gavaret, (2003) and Eliseen van Balkom (2008) show, formal outcomes of modular structures are usually limited; even with the possibility of changing modular structures, there is typically a distinctive look or texture that can be recognized. Moreover, most consumers are instantly blinded by first appearances and aesthetic aura so considering quality, functionality or anything beyond the look is easily forgotten (Akkok, 2013; Niinimaki, 2013).

In Gaarnt's work for example, modular clothing is interpreted as set looks, where each article of clothing within a set (e.g. top or bottom) constitutes a single module. Modules of a set, which are "one size fits most" and have no fixed front or back sides can be manipulated and joined using tying, folding, and wrapping techniques to achieve multiple looks. This approach when combined with slinky jersey fabric (Garratt's material of choice) creates oversized silhouettes with flowing and draping effects suitable for most body types.

La Recca, on the other hand, approaches modularity in clothing using decomposition methods. In her work, pieces that make up a garment such as sleeves, collars, bodices, and yokes are all viewed as individual modules. These modules are joined by a network of zippers in order to achieve modularity. Modules within this system can be mixed and matched to build different garment types. Although this technique offers a variety of possible looks and silhouettes, modular features of the garments are obtrusive due to La Recca's choice of materials and construction methods.

Unlike the works of Garratt and La Recca, Van Balgooy's incorporation of modular clothing has less design restrictions and combination limitations because her concept focuses on the construct of the actual material as opposed to the garment itself. As previously mentioned, Van Balgooy employs mathematics and geometric principles in order to create a modular network made up of fabric tiles with "two tabs and two slots" click/fold system. This method allows users to mold the fabric into virtually any type of garment and silhouettes. However, much like La Recca's garments, Van Balgooy's "two tabs and two slots" click/fold fabric tile system display obvious signs of modularity and inevitably adds non-optimal texture to surfaces.

Based on this observation, it is reasonable to assess that one of the reasons modular design concepts have previously been widely unsuccessful in fashion and clothing is in part due to clearly visible modular features. These obvious signs of modular elements in garments may not meet consumer needs and wants in terms of aesthetics. As Armstrong and Stojanovic (2011) point out, formal outcomes of modular structures are usually limited; even with the possibility of changing modular structures, there is typically a distinctive look or texture that can be recognized. Moreover, most consumers are instantly blinded by first appearances and aesthetic aura so considering quality, functionality or anything beyond the look is easily forgotten (Akkok, 2013; Niinimaki, 2013).

4.4.2 RESEARCH REFLECTION: PART 2

As the research presented in sections 4.1 (Designer's Role), 4.2.4 (Modular Design), and 4.3 (Modularity in Apparel) all show, modular design principles can closely be linked to sustainable practices which, in effect, have positive ecological, sociological, and economical impacts. Based on this logic, it is correct to think that modular garments are relevant in today's world. However, as previously mentioned, sustainable development is dependent on people's choices, behaviour, and lifestyles (Marchand and Walker, 2008), which means that designers and consumers must be willing to implement and use modular concepts in order to help change the current fashion system into a more sustainable one. Karel (2014) supports this by pointing out, that as people become more aware of the social and environmental concerns within the apparel and textile industry, tendency and willingness to make better decisions in shopping and use practices must increase in parallel and that to do so, more innovative ideas from all parties are required. She suggests that a simple way to begin could be to redesign the offerings related to fashion purchasing (ibid). However, if we want to see changes in the consumption patterns of fashion or the attitudes among consumers we will have to design systems that include them and take their role in the lifecycle of clothing seriously (von Rusc, 2008). To achieve this, it is important to recognize that most people are inherently driven by what is beneficial and convenient for them; a good way to motivate designers and consumers alike towards engaging with modular practices and systems is to underline the benefits as they apply to them.

It is understandable that designers might be reluctant towards creating modular products as transformable garments require much more time and consideration during the design phase than that of non-transformable garments. Additionally, from a business perspective, transformable products tend to render other products obsolescent, which reduces consumption and potential revenue for companies (Karel, 2014). However, if designers/companies take time to reformat their operational business structure to include and sustain modular concepts, they can potentially reap many benefits. For example, creating modular garments under a 'made-to-order' operating business structure can reduce stock and dead-stock as the only stock required is a limited predetermined amount. This is a notable economic benefit because extra material is not required even for relatively small numbers. Moreover, it is possible to change pieces of a product without redesigning the whole (Baldwin and Clark, 2000) which, from a designer's viewpoint and as the research shows, has many considerable benefits. It increases product component change, increased product variety, reduced lead time, easier product diagnosis, and decoupled risks (Kusiak, 1999).

Although modular structures and all their variations are predetermined and defined by the designer, modular garments always remain in a constant design state. This is because the designer consciously extends the design role to the consumer by creating an "open-product" turning him/her into a facilitator rather than a dictator in the process. As previously mentioned, the ability to customize one's clothing may help strengthen person-product relationships thus postponing early product disposal/replacement (Mugge et al. 2005). Niinimaki and Hasli (2011) believe this is because users have an active role in the on-going design process of their product. Adaptable garment structure enables consumers to enhance the product to meet their changing functional and aesthetic needs. By facilitating upgrades with more functional or modern units, consumers are able to incorporate the benefits of a new technology in their current product and/or to renew it aesthetically (Mugge et al., 2005). This design approach to garment making is particularly beneficial for consumers that like to update their look seasonally as they relentlessly strive for continuous change in their quest for new.'
DESIGN PROJECT

The objective of the thesis design project is to offer possible solutions for overconsumption and the early disposal of garments. To achieve this, a modular concept that could be applied to the apparel design process is developed to create a garment capable of satisfying changing fashions for new while maintaining person-product relationships. The aim is to illustrate and underline the economical, ecological, and sociological benefits of the practice by focusing on the sensibilities of designers and consumers who arguably strongly influence supply and demand. The following sections in this chapter provide a detailed account of the entire process.

5.1 CONCEPT DEVELOPMENT

This section explicates the development process of the new modular garment concept for this thesis. It entails the collection of information regarding the requirements to be embedded in the design process based on the research findings in chapter three. As a result, functions that make up the product are established within this section. This includes conceptual elements of the product that correspond to mechanisms or systems which are clearly defined to provide a design brief and outline for the design process.

5.1.1 CONSUMER PERSPECTIVE

Research findings in chapter three establish that in order to change the consumption patterns of fashion or the attitudes among consumers, new systems that include them and take their role in the lifecycle of clothing seriously must be developed (von Busch, 2009). One of the only ways to achieve this is to accept and work with the constant change in the desire of consumers (Chapman, 2009). This notion is supported by Fletcher and Gough (2012) who believe that products must be adaptable in order to reflect the current environmental state of the owner. According to Hirsch (2013), the desire for certain products is found in the meaning that consumers assign to them. This meaning, which is usually symbolic and communicative, is an inelastic societal fabrication where the added values given exist only in people’s imagination and belief (Kawamura, 2005). Despite this fact, consumers continue to relentlessly strive to obtain this meaning through the act of purchase (Chapman, 2009). In their quest for ‘new’, they no longer value the gratification of this captured moment as temporary, which is specifically why Hirsch (2013) adamantly believes that clothes should be updatable by the user.

In accordance with Hirsch’s notion, one way to offer product upgradability to users is to make the garments readily transformable. This idea is supported by collected data from a customer focus group conducted by Karel, in which a participant was quoted by saying “it would be great if the garments were originally designed so that they could be modified later on and the seams and all the other things would not be locked” (Karel, 2014, 39). Doing so would offer new ways to consume while creating opportunities for new business structures and service models (Fletcher & Gough, 2012). Moreover, by designing products that can adapt to the wearer’s sensibilities, emotional and aesthetic needs can lead to improved product performance for the wearer, simultaneously lengthening the lifecycle of the garment, while having positive environmental and sociological effects (Gaeli, 2014). Lastly, as previously mentioned, making clothes upgradable by the user would also give them an active role in the on-going design process of their product while evoking a sense of achievement which could very well help strengthen person-product relationships thus postponing early product disposal or replacement (Mugge et al., 2010).

5.1.2 DESIGNER PERSPECTIVE

Research findings in chapter three recognise that as people become increasingly aware of the environmental and sociological implications concerning the fashion industry, tendency and willingness to consciously make better decisions in consumption and use practices must increase in parallel, and that to do so, requires more innovative ideas and solutions from designers (Karel, 2014). As previously suggested, one idea to improve consumption and use practices is to create updatable products that focus on the desires and needs of consumers. In this case, upgradability can be offered by making garments readily transformable using modular solutions.

Although upgradability through transformability by way of modularity seems like a promising solution for improving consumption and use practices among consumers, it is also recognised that designers might be reluctant towards creating modular products as transformable garments require much more time and consideration during the design and pattern-making phases than that of non-transformable garments (ibid). Additionally, as previously mentioned, the fact that transformable products tend to render other products obsolete (effectively reducing consumption and potential revenue) might exacerbate the reluctance of designers. Unfortunately, there is no remedy or shortcut for the time and consideration required for the development of modular products/garments. It is a process that must be accepted and endured by the designer. However, research findings also show that doing so, can potentially save time in the long-run in addition to money and space.

It is possible to create modular garments that satisfy the interests of designers while responding to the desires and needs of consumers; but to do so, requires operative business structure reform and product analysis to include and sustain modular concepts. This is supported by Batstone and Clark (2000), who assert that it is possible to change pieces of a product without reshaping the whole if modularity is enforced. One way to achieve this notion is by employing modular clothing/ garment design methods as proposed by Huizing and Kusak (1998) in their publication: Modularity in Design of Products and Systems, in which the consensus is to create a platform base to which all other modules can be attached. From this point (2011) support this notion by stating that the main emphasis is to design a product family with a common platform (as opposed to individual products), to which modularity and commonality are the foundations.

Designers can initiate a product foundation based on modularity and commonality by establishing modular attachment points during the initial stages of design. These points should be kept uniform across the product range to ensure possible product variants and to accommodate new modules. By creating new modules, designers can offer add-ons and upgrades to consumers which ensures continuous revenue while generating new styles. As previously mentioned, automobiles are good examples of modular-based manufacturing due to the use of their exchangeable parts and features (e.g. audio decks, seats, and wheels) among others during fabrication which can be applied in the automobile industry to extend a car model’s product line to expand their product range. This tried and tested design tactic which is very successful and lucrative in the automobile industry is certainly adaptable to the clothing design. Benefits of applying the methodology include economies of scale, increased feasibility of product/ component change, increased product variety, reduced lead time, easier product diagnosis, and decoupled risks (Kusak, 1999).

5.1.3 DESIGN OPPORTUNITY

Research reflections in chapter three assess that part of the reason modular design concepts have previously been widely unsuccessful in apparel is due to eminent signs of modularity which may not meet the needs and wants of consumers in terms of aesthetics. As previously mentioned, the aesthetic aura and appearance of products are paramount for consumers, so considering quality, functionality or anything beyond looks is easily dismissible (Akkou, 2013, in Njinimb, 2013). With this said, this assessment can be viewed as a design opportunity to refine modularity in apparel by presenting new solutions for this visual dilemma.

In addition, research findings also assess that even with the possibility of changing the structures of modular garments, formal outcomes are usually limited (Armstrong and Stoianovici, 2011). Flavialloraeco garments which are profiled in chapter three exemplify this statement: Figure 11, for example, shows how the brand utilises nine random modules to generate twenty-three looks among them, however, based on observation, it is possible to generate (at least) double that amount of looks using fewer modules by employing system and design thinking strategies during the early stages of the design process.
According to Chiayan Carine Tati (2013), size labels are confusing and inconsistent in measurements. This is especially true when attempting to convert sizes internationally among different brands. Creating one-size garments would ensure fit for consumers while making the selection process more systematic. From a design perspective, eliminating garment sizing would impose fewer restrictions during the design process as there is less pressure to accommodate different body types; especially among men and women who are inherently different in body shape and size. Lastly, adopting a ‘one-size fits most’ system would save additional time, money, and space as pattern grading and storage for extra patterns would not be necessary.

In sum, this section brings forth four design opportunities that include obscene modularity, transformability maximisation, gender-neutrality, and size abolition. For this thesis, aesthetically undesirable aspects of modularity in clothing are viewed as design challenges, where the goal is, in part, to design/create a one-size gender-neutral modular garment that conceals any visible signs of modularity and its features while maximising style variations. The following section in this chapter provides a design concept based on all of the above-mentioned, which is used as a design brief and outline for the project of this thesis.

5.1.4 DESIGN CONCEPT

This section presents the new modular garment concept (for the thesis project) based on design opportunities highlighted in previous section (5.1.3 Design Opportunity). All conceptual elements of the garment which correspond to mechanisms or subsystems are clearly defined below. In addition, all of the characteristic requirements to be embodied in the design are listed along with functions that make up the product to provide a design brief and outline for the design process in the following section of this chapter.

OBJECTIVE:

The objective is to present/propose a way to slow the pace of fashion by promoting sustainable consumption and use practices that extend the lifecycle of products using modular design solutions which cater to the sensibilities of designers and consumers as they greatly influence supply and demand in the industry; which in turn has ecological and sociological effects.

5.2 DESIGN PROCESS

A modular garment was designed and produced for this thesis based on the design brief in previous section (5.1.4 Design Concept) to illustrate the benefits of modular concepts when applied to the process of apparel design. Choices regarding process, style, structure, customisation, and material selection for the execution of the modular garment is explicated below to show how the concept could work in practice.

Standard practices in fashion and clothing design dictate that the beginning of the design process should start with wide visual research of inspirational sources to communicate the theme, mood, materials, silhouettes, cuts, and details for each collection. However, due to the modular structure and customisation requirements for the garment of this thesis, the development process required a completely different approach. Inspirational aspects of the research were considered irrelevant because part of the objective of the modular concept is for the garment to adjust to the changing mood and needs of the user. Therefore, it was deemed more essential to focus on the shape, structure, and materials that would enable and contribute to the modification and versatility of the garment in order to meet the desires and needs of the user. Overall, the design process proved to be both calculative and somewhat restrictive as it required a great deal of system and design thinking to create modules that could be combined in various ways to achieve style variants. The following sections in this chapter, provide a detailed account of the design process and how modularity was achieved.

5.2.1 STYLE AND STRUCTURE

Based on the design brief and outline in previous section (5.1.4 Design Concept), minimal and classic attributes were selected as core characteristics to govern the design style. In addition, genderless and ageless attributes were also deemed essential as to appeal to a broader range of consumers. Rather than sketching random initial shapes based on inspirational sources to start the design process, research of classic garments that are generally worn by men and women was conducted. The motive behind this research was to find a garb that would serve as a stylistic starting point for the design process. Subsequently, the kimono was selected for further exploration as it was deemed that it embodies all of the attributes above-mentioned and surpasses them by meeting most of the characteristic requirements dictated in previous section (5.1.4 Design Concept). Further justification for this choice is explicated below.

The kimono itself is inherently classic and minimal in design. Its basic shape has remained unchanged since the Edo period (1603–1867 AD) and is still just as relevant in fashion now as it was then. Excluding adornments and embroidery, the kimono is relatively minimalist in design as it consists of only seven pattern pieces (two sleeves, two bodice pieces, two overlap pieces, and one collar) or eight pieces if you count the optional collar guard. Moreover, the rectangular shapes of the pattern pieces yield zero-waste when cutting the material which promotes ecology and sustainability.
Despite minimal differences in design such as sleeve and hem lengths (which culturally define gender, age, marital status, and rank), the style and structure of the kimono is essentially the same between the sexes and wrap the body in the same direction. Due to its wraparound design and loose structure, the kimono also accommodates many body shapes and sizes which makes it possible to work around a ‘one-size-fits-most’ requirement. Additionally, in terms of age, the kimono is the same for adults and children; the only difference is in pattern grading to accommodate height. Moreover, the kimono is worn all year round for numerous occasions which makes it transitional, versatile, and seasonless.

After selecting the kimono as an inspirational starting point for the design process, the next step was to study its structure at length. Although its aesthetics were unnecessary to study the structure of such an overly simplistic garment, there are symbolic reasons for certain aspects of the kimono. For example, the centre back seam of the kimono is a symbol of protection, thus it was deemed necessary to understand the logic behind the garment by exploring it further if it was to be altered or reinvented. In addition, because the kimono is a national and cultural symbol of Japan, it was important to approach it with a degree of diplomacy and respect by investigating Japanese society’s opinions and views towards the garment.

A valuable source of information for this process was Stephanie Assmann’s Kimono de Ginza: Case Study in her article Between Tradition and Innovation: The Reinvention of the Kimono in Japanese Consumer Culture (2008). In it, Assmann argues that wearing a kimono in contemporary Japan is as much about displaying an individualistic sense of aesthetic sensibility as it is about consumption. Assmann supports her argument by pointing out that in addition to purchasing the garment itself which is an act of consumption, training of how to wear a kimono also relates to consumption as it involves education and experience. This very notion of education and experience which is tied to the kimono strengthens the decision to use it as a style reference for this thesis as it presents an opportunity to strengthen the relationship between consumer and product to extend the lifespan of the product through design as suggested by Nilmińska and Kossik (2011) in previous section (4.2.1 Emotional Durability).

Further justification for using the kimono as a style reference for this thesis was based on the views of Kimono de Ginza participants as presented in Assmann’s case study. According to the case study, activities performed by Kimono de Ginza suggest a new form of collective individualism. This community of kimono enthusiasts revive and reinvent a tradition while rejecting the restrictive conventions that are associated with this very same tradition. Assmann points out that some participants of Kimono de Ginza also experiment with gender and age boundaries to break from some of the defined rules of kimono wearing. This desire to experiment with gender and age boundaries perfectly correlates with the genderless and ageless characteristics imposed in the design concept for this thesis. Furthermore, many of the participants that Assmann interviewed defy a formal kimono education altogether because they reject the values of discipline, hierarchy, and propriety that are implied in such an education. Many Kimono de Ginza participants prefer to practice wearing the kimono on their own terms as it allows them to create their own combinations of kimono wear. This interest to create own combinations of wear suggest a desire and need for stylistic options within the kimono to which modularity can be a solution.

In addition to Assmann’s Kimono de Ginza: Case Study, another valuable source of information and inspiration was John Marshall’s book Make Your Own Japanese Clothes (2013). According to Marshall (2013), kimonos have fallen increasingly into disuse over the last hundred years in Japan despite still being relevant in fashion. He believes this is due to utility of fashion which yields less time to spend on dressing and caring for clothes. Assmann (2008) supports this statement by stating that the kimono is utterly too cumbersome for modern life. In addition, chairs, cars, and other elements introduced by Western culture are simply not conducive to kimono wear. As a result, kimonos are now rarely worn outside of formal occasions such as weddings, funerals, and tea ceremonies (Marshall, 2013). In light of these facts, Marshall believes that for the kimono to survive, it must continue to evolve and thrive in a new identity to become a practical, attractive, and comfortable garment for both Easter and Western use (ibid).

Marshall’s belief regarding the survival of the kimono in modern times, inspired further investigation. If Western elements such as chairs and cars have contributed to the increasing disuse of the kimono in Japan, what can be done to make it more practical? This question evoked the following idea. If Western elements contribute to the increasing disuse of the kimono, Western stylistic elements should be infused into the kimono through design while keeping its cultural integrity to aid in its survival.

The following task based on the above notion was to find a western garment that could be used for stylistic elements to incorporate into the kimono. Remembering the repertoire of classic garments researched at the beginning of this process, the trench coat was chosen as it too embodies most of the characteristic requirements dictated in previous section (5.1.4 Design Concept) and is a classic staple in Western dress. The following section in this chapter describes the creative process of fusing elements of both garments (the Kimono and Trench Coat) together to create a new type of garment suitable for Easter and Western use by men and women respectively.

5.2.2 CUSTOMISATION AND CONSTRUCTION

After selecting the kimono and Trench Coat as inspirational starting points for the design process, the next step was to study their construction. After becoming familiar with the kimono, its history, and reason for being, a half-scale prototype was made out of toile using traditional Japanese construction methods. Rather than sketching on paper, markings for possible alterations were directly made onto the prototype with pencil. These markings were based on the silhouette and cut of the classic trench coat to aid further development.

After sketching directly onto the half-scale prototype, the succeeding task was to then conduct customisation brainstorming by deconstructing the prototype and rearranging its pieces for possible style variants. Additional rudimentary shaped fabric pieces were added during this stage to enhance customisation and transformability. This stage of trial and error quickly gave insight into the elements (pieces) of the garment and how they collectively worked together to yield different styles, shapes, and silhouettes. Subsequently an abundance of style variants was conceived during this stage. Through a process of elimination, styles which were deemed most useful and desirable for both genders were selected for further development based on designer’s discretion. Once the desired styles were selected, the next step was to create a modular system to which all of the pieces (modules) may be attached. To execute this task, modular concepts from an engineering perspective were employed to create harmony in the design and aid ease of transition between the style variants.

As previously mentioned, the consensus of modular concepts based on industrial engineering perspective is to design a product family with a common platform (as opposed to individual products), to which modularity and commonality are the foundation so that single modules can perform discrete functions but collectively can provide various functions (Kamrani and Naz, 2010).
5.2.3 MATERIAL SELECTION

As discussed in previous section (5.2.2 Customisation and Construction), to make the modular garment user friendly, it’s attachable features had to be carefully considered during selection. The criteria for this selection was based on strength, functionality, and utility to provide ease of use and quick transition between the possible style variants of the garments while concealing any visible signs of modularity.

After testing possible attachment options, two-hole buttons, snap button tracks, and open-ended concealable zippers proved to be the most suitable for the design.

Using the garment’s bodice as the foundation/base for modularity and commonality, the placement of these attachable features was determined by modular attachment points which best concealed their position. As a result, two-hole buttons were placed along the inner shoulder seams of detachable modules which connect to on-seam button holes along the shoulder seams of the bodice. Snap button tracks were sewn along the inner neckline of the bodice and along the edges of modules which attach to it. Lastly, open-ended concealable zippers were used to attach the sleeves to the bodice and other modules. These open-ended concealable zippers were based on essential attachable features of the garment due to their prominent placement. Normal zippers, hooks, buttons, velcro, or ties were not an option as they would clearly be visible along the garment’s armhole seams.

An equally important aspect of the material selection process was to find fabric which was conductive to the attachable features while meeting high quality, cradle-to-cradle standards. Based on these preconditions, wool was selected for the fabrication of the final modular garment as it is a natural and renewable resource that is 100% biodegradable. Further justification for this choice was based on the properties of the material, which use less energy and emit lower quantities of carbon dioxide than that of comparable manmade fibres (LWTO). In addition, Hetherington and Grant (2012) point out that laundering is likely to be a major source of pollution which exhausts many resources over the course of a garment’s life; thus, wool was deemed the best suited material to reduce these environmental impacts as it only requires airing and seldom dry-cleaning. Lastly, in terms of utility, wool is a multifaceted and complex fibre that provides many practical features such as absorption, breathability, and the ability to adapt to temperature changes; making it suitable for many seasons. Other notable features include wrinkle, flame, and moisture resistance. However, the most important feature of wool is its durability. Given proper care, the material can last for centuries without losing its resilience or structure (LWTO), which further supports the ethos of the design concept for this thesis.

Another equally important aspect of the fabric was its look. It was deemed that basic colours would better suit the design as it would force focus to the structure and features of the garment. In addition, it was feared that using ‘trendy’ colours and/or prints might shorten the lifespan of the product as they would inevitably fall out of fashion, thus it was thought that using basic colours would enhance the garment’s use and wearability as basic colours such as black and white are always in fashion.

5.2.4 FEEDBACK ASSESSMENT, FINDINGS, AND REVISION

Upon completing the modular garment, a focus group was assembled (as described in previous section: 3.3 Focus Group) to introduce the concept and garment to consumers. The goal for this task was to gain consumer insight and views regarding the concept and garment. Criticism was encouraged and welcomed from participants to create a creative dialogue in order to generate ideas and possible solutions for issues that might not have been previously considered in the early stages of the design process. The overall goal for conducting the focus group was to collect information that could possibly help develop the garment and/or the concept further.

All information obtained from the conducted focus group was organised and compiled into respective categories (questionnaires, notes, photographs, audio, and video recording) so that the feedback may be assessed for any possible revisions necessary for the design and/or concept. Overall, the feedback of the focus group was quite positive and constructive. All of the participants were very receptive and showed great interest and enthusiasm towards the modular concept. All agreed that applying modular concepts to the apparel design process is an interesting topic to explore. Participant P-1002 eloquently expressed this collective opinion by saying that “modularity is a very interesting and relevant concept that is worth exploring in today’s ‘buy and toss’ consumer culture”. Participant P-1005 added to this comment by saying “It is a good concept that questions the industry and it’s traditional garment making methods”. Based on this feedback it was clear that the concept for this thesis was solid enough to not need revision as it did not receive any contradictory notes.

In addition to the concept, the assessment of collected data found a consistent pattern of similarly positive responses among the participants regarding the overall execution of the modular garment. Despite the varied individualistic styles and personal tastes of the participants, which naturally influenced their judgement, all were in agreement with the overall aesthetic, material selection, structure, versatility, and usability of the modular garment. Assessment of the feedback found that aesthetic, material, and structure were often grouped together in singular responses given by the participants, which according to them, strongly contributed to the attractiveness of the garment. These responses also validated some of the design choices made during the design process. For example, participant P-1007 keenly pointed out that “solid colours are a good design choice because it focuses on the structure of the garment”. Participant P-1002 supported this statement by adding that “using solid colours makes the garment timeless which maximises its wearability”. Based on these and other similar comments it was concluded that the overall look of the garment was worth preserving.

In addition to the look of the garment, participants also showed great interest and enthusiasm towards the garment’s versatility. All agreed that the garment’s modular features were practical, beneficial, and user friendly. Participant P-1001 expressed amazement by saying “it is surprising how many ways there are to wear it”. Participant P-1005 added that “the benefit of the garment is that it contains a whole wardrobe suitable for everyday use”. These statements inspired the choice to promote the product as a self contained capsule wardrobe within a single garment.
However, participant P-1002 pointed out that although "the garment is user friendly in the sense that it gives the user the opportunity to change its look to fit different moods, it requires a strong sense of style". Regardless of this probable fact, the garment is arguably suitable for conservative and fashionforward individuals alike. Whether or not the garment is used to its full capacity is left to the user's discretion as possible modification will always be an optional factor of the garment.

Although all participants were in agreement regarding the look and versatility of the garment, there were conflicting opinions regarding the fit. The assessed data revealed that this was particularly due to issues related to height. Taller participants of the group expressed satisfaction with the fit of the garment while the shorter members expressed concern. Although all tall and short members alike agreed that the design was flattering for most body types, the shorter participants were particularly afflicted by the sleeve and hem lengths of the garment. Participant P-1003 said that she found the length of the sleeves restrictive when she tried on the garment and that she felt they would be challenging for shorter people. Similarly, participant P-1007 included that "if the garment is to be one-size then the hem and sleeve lengths need to be considered for smaller people". In light of this information, the 'one-size' fits most sizing was revised to a letter sizing system (S, Small; M, Medium; and L, Large) for the concept. Due to the general oversize drape of the garment, it was deemed that converting to a letter sizing system would not create conflict among the fixed modularity points on the garment as it is possible to keep the same measurements along the points across the range of sizes. With this sizing reform it is now possible to further customise the garment to suit unique body types. For example, it would be possible for a person with a longer torso to combine a medium or large bodice with small size sleeves and vice versa.

Aside from issues regarding sleeve and hem lengths, the assessed data also revealed that some participants felt there could be more uses for the belt. Participant P-1006 pointed out that "the belt has more potential" and that "maybe this can be the variable". Similarly, participant P-1004 suggested that "the belt could transform into something else for other uses". Although comments of this nature did not yield sufficient conclusive data that suggested an urgent need for modification, it seemed that the issue was worth exploring if it could help generate new looks. As a result, stylistic brainstorming was conducted by mounting the garment and all its pieces (modules) on a dress form and applying the belt to it in every imaginable way possible which had not been previously considered. This proved to be a fruitful process as it generated new styles that had not been previously conceived. By combining the belt with individual modules such as the removable hood and sleeves, a top, dress, and skirt were created. Subsequently, these new styles were added to the repertoire of looks which expanded the garment's use and wearability. More importantly however, this process proved that the garment is only limited by the user's imagination.

In sum, conducting a focus group proved to be an invaluable source of information that gave great insight into the desire and needs of consumers. By creating a creative dialogue with consumers, the garment was able to evolve and be developed further (as described above) to better suit their needs; which in turn added use and value to the design. This creative dialogue and exchange of ideas proved that the garment is only limited by the user's imagination as it generated new alternative ways of how to wear and use the garment which had not been previously considered. Although the main focus of the group was to obtain consumer feedback regarding the modular garment and concept, the experience also generated insightful suggestions of how to better translate and communicate the modular concept and its value to consumers. As above mentioned, these suggestions inspired to promote and market the garment as a self-contained capsule wardrobe within a single garment. Overall, the participant's reception to the concept and garment showed that there is an interest and need for modular concepts in fashion to which this thesis can possibly help promote.
6 CONCLUSION

This thesis has presented a design case that serves as a counteractive response to the fast pace of fashion by offering possible solutions for overconsumption and the early disposal of garments. In addition, a modular concept that could be applied to the apparel design process was developed to create a garment capable of satisfying cravings for ‘new’ while maintaining person-product relationships. The aim was to illustrate and underline the economical, ecological, and sociological benefits of the practice by focusing on the sensibilities of designers and consumers, who arguably strongly influence supply and demand.

The development of the concept was partly based on the literary review of several sustainable design strategies known to support emotional durability and product longevity. These strategies which include participatory design, transformability, and modular design were combined with design opportunities yielded from market research to create a solid basis for the concept. The result of this process is a modular design concept that presents an alternative design approach for sustainable fashion.

The concept development process for this thesis began with an examination of the current fashion system. Designers and consumers were considered the main actors of this system as they arguably strongly influence the industry’s supply and demand. Therefore, it was crucial to recognize and focus on their interests and needs for the concept to succeed. Subsequently, consumers were seen as passive recipients who rarely (if ever) determine the final look of their products. Conversely, designers were seen as fashion dictators who rarely (if ever) involve the user in the design process. Based on this revelation of designer and consumer roles in the current fashion system, it was deemed that finding a creative bridge between both roles and combining it with the above mentioned sustainable design strategies could have great possibilities for a new conscious design concept.

7 DISCUSSION

This thesis has proposed an alternative design practice that enables designers (and businesses) to satisfy their interests while responsibly fulfilling the needs of consumers. In this thesis, this design has also presented ways to approach sustainable fashion beyond conventional sustainable strategies, such as ethical/ecological production and usage of recycled/surplus material.

Even though this thesis has provided concrete ways to incorporate modular concepts and structures to the process of apparel design, there is certainly room for expansion. Fashion designers are invited and encouraged to explore the methodology to further develop the concept. Although this work has focused on the role of fashion designers and the implementation of modular structures in clothing, the concept may also be explored by textile designers to conjure new methods within their respective sector. Textile designers are also invited and encouraged to create modular surfaces for textiles which may be used in the fabrication of garments with modular structures, thus further expanding the possibilities of the practice.

Although the fashion industry proclaims to be ‘innovative’ and ‘new’, the reality is that design processes and consumption have remained relatively unchanged since the introduction of ready-to-wear clothing in the late 1800s, thus relevant fields for this work include new fashion practices and sustainable development. As stated earlier, the greatest obstacle of applying alternative design and operative business models in conjunction with more system-centered thinking to fashion is the lack of imagination within the industry. Additionally, the frivolously fast pace of fashion leaves little to no time for designers and businesses to research and explore new processes, which makes the task of slowing down the current pace of fashion all the more crucial.
APPENDIX

QUESTIONNAIRE

General Questions:
These general questions are asked in order to better understand the participant’s point of view regarding the focus questions.

Age:

Profession/Occupation:

Where do you get most of your clothes?

How often do you shop/ buy something new?

Do you have any specific criteria(s) other than aesthetics when making a purchase?

How much would you say you spend on clothes annually?

What is your favourite garment at the moment that you own; why is it your favourite?

Focus Questions:
These focus questions are asked before group discussion in order to document/collect participants initial reaction and unfiltered personal opinion regarding the subject.

What do you think of this concept?

On a scale of 1 to 6 how well does this garment represent the concept?
Not well: 1 2 3 4 5 very well:

What do you think about the execution of this garment (design, construction, choice of materials, etc.)?

Is this garment user friendly; why or why not?

When/Where could this garment be suitable?

Do you think this garment has any benefits; if so what?

How much would you be willing to pay for this garment (retail value)?
   (a) Less than €100
   (b) €100 - €200
   (c) €200 - €300
   (d) More than €300
   (e) specific amount: __________

What do you like about this garment?

What do you not like about this garment?

How would you improve this garment?
m/KIMONO is part of REFORM: A MODULAR DESIGN CONCEPT BY MARIO CADENAS (2018) that focuses on sustainable development and practices in the fashion industry. m/KIMONO is a self-contained ready-to-wear genderless capsule wardrobe within a single modular garment. It is made up of six modules that can be readily reconfigured in numerous ways to create universal style variants to fit the changing physical, emotional, and/or aesthetic needs of the wearer. The versatility of the garment allows the wearer to mix and match the pieces (modules) for vast combination choices. Depending on the combination, the outcome of a look can be androgynous, masculine, feminine, virtually anything that the wearer wants it to be. Examples shown in this book represent a fraction of the possible looks as the garment is only limited by the wearer’s imagination.